APPENDIX - II
SELF-LEARNINGMODULES
SELF LEARNING MODULE

ON

GEOGRAPHY

AN OVERVIEW

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THIS MODULE PRESENTS AN OVERVIEW OF THE FIVE MODULES ON GEOGRAPHY FROM YOUR SYLLABUS.

READ IT CAREFULLY AS IT WILL HELP YOU TO UNDERSTAND THE SUBJECT MATTER EASILY.
CONCEPT OF MODULE

A Self Learning Module is one type of instructional material with which a learner can acquire knowledge, skill and attitude in the absence of a teacher.

It differs from other types of instructional material in that it is self contained and independent of live instruction.

OBJECTIVES OF MODULE

1. To inform the learner what they are supposed to learn.
2. High motivation facilitates fast learning.
3. Active participation promotes fast learning & longer retention.
4. Learning in small steps with feedback (immediate knowledge of result) accelerate the process of learning.
5. Individual differences result into different learning style.

HOW TO USE MODULES

If you are going to gain maximum benefit from these modules you will have to follow all the instructions carefully:

(a) There are five modules. Each module is presented as a separate booklet.

(b) Pages are numbered according to the module/unit.
(c) Each unit has a sequence of activities.

OBJECTIVES

These are the general and specific objectives for that unit.

INPUT

This contains new information for you to learn.

PRACTICE TASK

Here you are presented with a series of tasks (based on the input which you must complete).

FEEDBACK TO PRACTICE TASK

This contains the correct answers to the practice task.

SUGGESTED ACTIVITIES

Here you are supposed to do various activities within your local environment.

(d) You must work through each unit in the sequence in which it is presented. After going through the Input do the Practice Task. Look at the Feedback to Practice Task page only after you have completed the practice task.

(e) Work as a member of a group wherever possible. When you can’t work in a group, work on your own.
(f) Begin working on the next unit in the module only after you have completed the previous unit, and you are confident that you have achieved the objectives of the unit.

(g) When you have successfully completed every unit of a module, do the post test. After you have completed the post test, compare your answers with the feedback provided. The post-test will indicate an acceptable level of performance. If you reach the acceptable level, proceed to the next module. If you do not reach the level, work through this module again.

(h) Don't mark/spoil module in any way. You will be given separate practice task sheets by the investigator. Use the separate sheets for writing on.
THE BENEFITS YOU GET FROM THIS MODULE WILL DEPEND ON YOU AND HOW YOU USE IT.

GOOD LUCK!

NOW GO TO MODULE I
SELF LEARNING MODULE
ON
GEOGRAPHY

SOILS

PH.D. THESIS

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OBJECTIVES

After the study of this module you will be able to:

Understand the concept of Soil.

Specific Objectives:

1.0 Describe the significance of soil.
1.1 Differentiate between rock and soil.
1.2 Describe important properties of soil.
1.3 Explain various factors responsible in soil formation.
1.4 Draw diagram of soil profile.
1.5 Classify soils into different types.
1.6 Mark places/countries heading different types of soil in the world map.
1.7 Explain soil erosion and methods of soil conservation.
1.0 Significance of Soils  Let us start with one of the most important natural resources which is a medium for plant growth and that is the soil. The soil layer is indispensable for man because it is the basis for all plant kingdom. Agriculture provides food crops and raw materials for agro based industries like textiles and sugar. Agriculture is the main occupation of people in the developing nations of the world like India. Soil layer supports forests and pastures as well. The fertile soils of river valleys provided conditions favourable for the growth of early civilizations.

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Without soil we can't think of Agriculture & Natural Vegetation
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1.1 Rock and Soil

What is soil? How it is distinguished from rock? These questions often come to our mind.

Soil is a dynamic, thin, loose, unconsolidated surface layer of the earth comprising of mineral particles, organic matter, water and air.

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O.M. → ORGANIC MATTER
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Believe! these are the Components of Soil.
On the other hand rock refers to consolidated, compact materials of which the earth's crust is mainly made up of minerals. A rock, however, doesn't normally have a definite chemical composition, as a mineral does. Three major types of rocks are found in the earth's crust, namely: Igneous, Sedimentary and Metamorphic.

Soil = Loose, unconsolidated surface layer made of Minerals, Air, Water, Organic matter
Rock = Consolidated, Compact material made of minerals.

1.2 Properties of Soil

You must be aware that each soil has two types of properties - physical and chemical. The physical properties of a soil refers to colour, texture and structure. You might have seen different shades of soil i.e. yellow, brown, red, grey or black. Red soils indicate high iron content while black colour indicates high organic content. Yellow or grey soils represents high extent of leaching. Colour by itself is not adequate to understand the nature of soil.

Now let us observe soil texture and structure. Texture of soil refers to the size of particles present in the soil. This may range from gravel, sand and silt to fine clay. On the basis of their texture, soils are classified into four groups namely- sand, sandy loam, loam and clay.
The soils with large proportions of sand are called sandy soils.

The soils which have high proportions of clay, silt and a little of sand are called clayey soils.

The soils with equal proportions of clay, silt and sand are called loams. Loams are further termed as sandy loam, clayey loam and silty loam depending upon the varying proportions of sand, silt and clay.

Look at the diagram!

Soils texture also affects its porosity because it indicates the spaces between its particles. The porosity of soil refers to the capacity of soil to percolate water downwards. For example, a sandy soil with bigger pores is more porous than the clayey soil with the small pores. Thus a soil made of fine particles retards water seepage is water retentive.

Loamy soils are better for agricultural purposes as compared to sandy soils. The clayey soils, on the other hand, develops cracks on drying and became sticky on getting wet.
Another property of soil which has greater relevance for cultivation is the structure of the soil. Structure refers to the manner in which soil particles are arranged or grouped.

Four soil structures have been recognised which include platy, prismatic, blocky and granular.

Examples

<table>
<thead>
<tr>
<th>Soils Texture</th>
<th>Sand, Sandy loam, Clay, Loam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Structure</td>
<td>Platy, Prismatic, Blocky, Granular</td>
</tr>
</tbody>
</table>

On the basis of chemical properties, soil may be acidic, alkaline or neutral. The chemical properties are related to the quantity of soil moisture and the extent to which leaching has removed soluble materials.

Excessive leaching of calcium salts leads to the soil becoming acidic. Lime is added to such soils in suitable form to neutralise the acidity. High concentration of alkalis in the soil makes it alkaline. Such salt encrustation on the surface may be removed or washed down by water to dissolve the salts. Most cultivated plants prefer neutral soils.

The type of chemical fertilizers used depends on the acidity or alkalinity of soils, so that they are rendered almost neutral.

Excessive leaching of calcium salt results in acidic soil
High concentration of Basic Salt results in alkaline soil.
PRACTICE TASK

(A) Give a single term for each of the following:

1. Loose, unconsolidated surface layer mainly made of minerals, organic matter, air and water is called.

2. Consolidated, compact material of which the earth's crust is made is named as.

3. The soil with equal proportion of sand, silt and clay.

4. The manner in which soil particles are arranged or grouped.

5. Soils having high concentration of alkaline salt or basic salt.

(B) Answer the following questions in one or two sentences:

1. Give significance of soil to human beings.

2. The components of soil are ....... ?

3. Name of different soil types on the basis of texture.

4. Give examples of soil structure.

5. What causes the formation of acidic soil?
FEEDBACK TO PRACTICE TASK


(B) 1. Soil is the base of all Agricultural production. Man can’t live alive in the absence of soil.

2. Components of Soil
   (i) Mineral  (ii) Water  (iii) Air  (iv) Organic Matter

3. Sand, Sandy loam, Loam, Clay

4. Platy, Prismatic, Blocky, Granular

5. Excessive leaching of calcium salt results in acidic soil.
1.3 Soil Formation

You must be wondering what are factors responsible for the soil formation. Soil formation is mainly related to the parent rock material, relief, time, climate, and plant & animal organisms. The former three are called the passive factors while the later two are the active factors.

(a) Parent Material:
You must have some characteristics of your parents. Similar is the case with soil. The material for soil formation is mainly derived from the rocks and is termed as the parent material. The surface rocks are exposed to the process of weathering and suffer decay and decomposition. In this process, the rocks are converted into fine grains, termed as soil. The parent rock influences the rate of soil formation, their chemical composition, colour, texture, structure, mineral content and fertility.

(b) Relief:
Relief influences the process of soil formation in many ways, the most important being the slope of the land.
Steep slope encourages swift flow of water so very thin layer of soil is formed due to erosion. The areas of gentle slope generally experience deposition and have deep layer of soil.
Soil formation is a slow process. A well developed soil results as an end product of physical, chemical and biological weathering operating collectively for a very long period of time.

Climate is the most important factor of soil formation. The process of weathering, its effectiveness and the type of plant and animal organisms in a region are directly linked with the seasonal change of temperature and distribution and nature of precipitation. Chemical changes take place more rapidly in warmer regions than in cooler areas.
Natural vegetation reflects the combined effects of relief and climate. The formation and development of soil is very much influenced by the growth of vegetation. The decayed leaf material adds much needed humus to soil thereby increasing its fertility.

Earthworms help in mixing mineral and organic matter and reducing them to small grains. Burrowing animals like termites, ants, rats etc. make the soil layers libe for seepage of moisture and improve aeration.

The climate, plant and animal organisms are the active factors of soil formation.

The parent material, relief and time are the passive factors of soil formation.
PRACTICE TASK

(A) State Whether True or False
1. Climate is the most important factor of soil formation.
2. The areas of gentle slope generally have deep layer of soil.
3. Soil formation is a speedy process.
4. Chemical changes take place more rapidly in warmer regions than in cooler areas.
5. Humus is added to soil from decayed leaf materials.

(B) Fill in the Blanks
1. Two active factors of soil formation are __________

2. The material for soil formation is derived from rocks and is termed as __________.

3. On steep slopes __________ layer of soil is developed.

4. __________ helps in mixing mineral and organic matter.

5. Burrowing animals like __________, __________, __________ make the soil layer liable for seepage of moisture and improve aeration.
FEEDBACK TO PRACTICE TASK

(A) 1. True 2. True 3. False
4. True 5. True

(B) 1. Climate, Plants and Animal Organisms
2. Parent Material 3. Thin
4. Earthworm 5. Termites, Ants, Rats.
1.4 Soil Profile:

It is interesting to see and study soil profile. The nature of a soil can be fully understood only by studying a vertical cross-section of the soil from the surface to bedrock. Such a vertical cross-section is called the soil profile. The soil profile usually shows distinct layers having differences in colour and texture. Each layer is called a horizon. In a well-developed soil, four layers or horizons are usually found.

Now let us study each horizon carefully:

A Horizon The topmost layer is called A-horizon. It is rich in humus. The decayed organic matter is called humus. This horizon also has abundant moisture and air between soil particles. Water and air are needed to support bacteria, earthworms and other organisms which live in this horizon. A-horizon is the zone through which rain water seeps down and in this process soluble minerals and organic matter and fine clay particles are removed from this layer. This process is called leaching of soil layer. The material which is leached from A-horizon gets deposited in the next layer, namely the B horizon.

B-Horizon B-horizon lies below the top soil and it is known as subsoil. B horizon has particle of larger size than A horizon. This layer has a different colour from the A-horizon as it is not exposed to changes in weather conditions.
Actually C horizon is a part of weathered parent rock. Particles are of large size and organic matter is absent.

D-Horizon D horizon is the zone of unweathered parent rock and it is the deepest horizon of soil profile.

Please keep in mind that such a soil profile develops only where the weathered material keeps lying at the same place for quite some time. A soil profile of this type is not found in regions where soils have been developed of transported materials brought and deposited by agents of gradation.

The vertical cross-section of the soil from the surface to bed rock is known as soil profile. Each section/layer is physically, chemically and biologically differ from others.
PRACTICE TASK

(A) Define the following:
1. Soil Profile  
2. Humus  
3. Leaching  
4. Sub-soil  
5. Deepest horizon of soil profile.

(B) Complete the diagram of Soil Profile

A - Horizon (Soil)

D - Horizon (Bed Rock)
(A) 1. The vertical cross-section of the soil from surface to bed rock is known as soil profile. Each layer of this profile is physically, chemically and biologically differ from others.

2. The decayed organic matter is called humus.

3. The process through which soluble minerals & organic matter and fine clay particles are removed from upper layer of the soil, and deposited in the lower layer of soil.

4. B-horizon lies below the top soil and known as sub soil.

5. D-horizon is the zone of unweathered parent rock & it is the deepest horizon of soil profile.

(B)
1.5 Soil Classification

This classification will help you to correlate soil belts with climate types and natural vegetation. Following type of soils are generally recognised in the world:

1. **Tundra Soils**:

These are poorly drained soils developed in treeless regions of the arctic fringe. Excessive content of humus, absence of distinctive soil profile, acidic and thin layer of clay & humus are major characteristics of these soils. These are infertile and support a natural vegetation useful only for pasture.

2. **Pedalfer Soils**:

The soils which are developed and found in humid climate regions are called pedalfer soils. These soils are further divided into three sub groups, namely: (i) Podzols (ii) Grey-Brown Soils (iii) Red & Yellow Soils.

(i) Podzols: Podzol soils are extensively found in the coniferous forest regions of Europe, Russia and North America. These soils have been subjected to extensive leaching. The surface layer is greyish or ash coloured. The sub soil contains a hard layer in which organic matter and other leached materials are deposited. Such soils are less fertile.
y - Brown Soils: In parts of Britain, Western North Africa, and N.E. United States, grey brown soils are found. These soils are comparatively fertile as to podzols. They are being used for dairying and farming with the help of manures and fertilizers.

ed & Yellow Soils: These soils are developed and the south of grey - brown podzolic soils in low regions. These regions experience high temperatures and low of precipitation. These soils are poor in humus.

ocal Soils:

oils developed in arid, semi-arid and subhumid zones of the world and are called pedocal soils. These soils or Black Earths are the richest soils of group of soils. These soils are rich in humus and These are very fertile soils requiring little. These soils are typically well developed in region of the U.S.S.R. around Black Sea. These soils cur in central U.S.A., Southern Africa, South and Australia. Chernozem soils are widely used for itivation and commercial grazing.

rt Soils:

clear from map this soil is found in all the major of the world. Due to high temperature, low ination and high rate of evaporation, these soils are
unleached and alkaline in nature. Desert soils are infertile and cultivated only where the texture of soil is fine, salt is comparatively less and irrigation facilities are available.

5. Mountain Soils:

These soils are found in mountainous regions of the world. There is great variety of mountain soils. In the river valleys and on the river terraces we find alluvial soil, on the slopes we generally come across soils of different textures varying from silty loam to just rock fragments.

Out of five groups of soils, Pedalfers and Pedocals are two main groups.
Now concentrate on Map:

It gives us a clear picture of various types of soils found in different regions of the world.

See your home region also.

Fig. World Soils map
PRACTICE TASK

(A) Mention area of each type of soil

<table>
<thead>
<tr>
<th>Soil</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tundra</td>
<td>4</td>
</tr>
<tr>
<td>Podzol</td>
<td>1</td>
</tr>
<tr>
<td>Grey Brown Podzol</td>
<td>1</td>
</tr>
<tr>
<td>Pedocal</td>
<td>5</td>
</tr>
<tr>
<td>Desert</td>
<td>5</td>
</tr>
</tbody>
</table>

(B) Fill in the blanks:

1. Podzol soils are mainly found in the ___________ forests.
2. Soils which are used for dairying and mixed farming are ___________.
3. Soils found to the south of grey-brown podzolic soils are ___________.
4. ___________ soils are the richest soils of pedocal group.
5. ___________ soils is found in river valleys.
**FEEDBACK TO PRACTICE TASK**

(A) | Soil                      | Area                      |
---|---------------------------|---------------------------|
1. | Tundra                    | Arctic                    |
2. | Podzol                    | Europe, Russia, N.America |
4. | Pedocal                   | USSR, central USA, S. Africa, S. America |
5. | Desert                    | Arid lands                |

(B) 1. Coniferous  
2. Grey Brown Soils  
3. Red & Yellow Soils  
4. Chernozem  
5. Alluvial
1.7 **Soil Erosion and Soil Conservation**

You might be aware that soil erosion is an ecological problem of the world. Soil erosion is the removal of soil by the forces of nature, particularly wind and water. Soil erosion mainly takes place due to man's ill-judged activities such as deforestation, over-grazing and faulty methods of cultivation.

The removal of soil layer naturally or by man's ill-judged activities is called soil erosion.

**How to Conserve Soil?**

You know soil is an important resource because it is a medium for plant growth. The formation of soil is a very slow process & soil cannot be created by human effort. Soil conservation is treatment of land with those adaptable practical measures that keep it permanently productive while in use. The following steps are recommended for conservation of soils:

(i) **Protection of Forests:**

Since roots of the trees hold the soil material together, it is desirable to protect these trees from such felling. If the forests are preserved and protected in reality, the soil erosion will not be a problem in those areas.
(ii) Afforestation:

The best way to check soil erosion is afforestation. New trees are to be planted in areas of soil erosion and old ones are to be protected.

(iii) Erecting Dams and Barriers:
Many rivers cause heavy erosion to soil in rainy season due to swift flow of the water current. This can be checked by erecting dams and barriers.

(iv) Avoid Over - Grazing:
Another effective method to check soil erosion is to avoid overgrazing.

(v) Changes in Agricultural Practices:

We can conserve soil to a great extent by bringing about some basic changes in our agricultural practices. This includes crop rotation, crop combination, terraced cultivation etc. Contour ploughing is a very effective method of checking soil erosion in areas of steep slopes.

Modern soil conservation is based on sound principle of land use and treatment of land with those adaptable practical measures that keep it permanently productive. This includes protection of forests, afforestation, controlling floods & over grazing and crop rotation, crop combination, terraced cultivation, contour ploughing.
PRACTICE TASK

(A) State Whether True or False.
1. Soil formation is a natural process.
2. Roots of the tree binds the soil.
3. Over grazing is necessary for soil conservation.
4. Swift flow of water can be checked by erecting dams.
5. Contour ploughing is a very effective method of checking soil erosion in hilly areas.

(B) Define the following
1. Soil Erosion
2. Soil Conservation.
A. 1. True 2. True 3. False
4. True 5. True

B. 1. Soil Erosion: The removal of soil layer naturally or by man's ill-judged activities is called soil erosion.
2. Soil Conservation: Modern soil conservation is based on sound principle of land use and treatment of land with those adaptable practical measures that keep it permanently productive.
TERMINAL QUESTIONS

(I) Answer the following questions in one or two sentences:
1. Define Soil.
2. Name the horizons in a soil profile.
3. What is soil conservation?
4. What conditions favour the formation of Red & Yellow soils?

(II) Distinguish between the following:
1. Soil Texture and Structure
2. Pedalferr and Pedocal Soils
3. Loamy and Clayey Soils
4. Acidic and Alkaline Soils

(III) Answer the following questions.
1. What are the functions of soil for which it needs to be conserved?
2. What is soil erosion?

(IV) Essay Type Questions
1. Discuss the factors affecting formation of soil.
2. Discuss practical methods of conservation of soil.

(V) Cartographic Work:
1. Draw a neat and diagram of Soil Profile.
2. On an outline map of the world, indicate the distribution of major soil types.
FEEDBACK TO TERMINAL QUESTIONS

Ans (I)

1. Loose, unconsolidated surface layer made of minerals, air, water and organic matter is known as soil.

2. A Horizon    B Horizon
   C Horizon    D Horizon

3. Soil conservation is based on sound principle of land use and treatment of land with those adaptable practical measures that keep it permanently productive.

4. High temperature and high rainfall.

Ans (II)

1. Soil Texture: Texture of soil refers to the size of particles present in the soil.

Soil Structure: Structure refers to the manner in which soil particles are arranged or grouped.

2. Pedalf er Soils: The soils which are developed and found in humid climate regions are called pedalfer soils.

Pedocal Soils: The soils developed in arid, semi arid and sub humid climate zones of the world are called pedocal soils.

3. Loamy Soils: The soils with equal proportions of sand, silt and clay are called loamy soils.
Clayey Soils: The soils which have high proportions of clay and silt and a little of sand are called clayey soils.

4. Acidic Soils: Excessive leaching of calcium salt from soil results in the formation of acidic soils.

Alkaline Soils: High concentration of salt results in the formation of alkaline soils.

Ans (III)

1. Soil is the medium for plant growth. Soil is indispensable for man because it is the basis for all agriculture. Soil layer supports forests and pastures as well. The fertile soil of river valleys provided conditions favourable for the growth of early civilization. The formation of soil is a very slow process and soil cannot be created by human effort. So soil must be conserved.

2. The removal of soil layer naturally or by man’s ill-judged activities is called soil erosion.

Ans (IV)

1. Soil formation is mainly related to the parent rock material, relief, time, climate, plant and animal organisms. The former three are called the passive factors while the later two are the active factors.
(a) Parent Material:

You must have some characteristics of your parents. Similar is the case with soil. The material for soil formation is mainly derived from the rocks and is termed as the parent material. The surface rocks are exposed to the process of weathering and suffer decay and decomposition. In this process, the rocks are converted into fine grains, termed as soil. The parent rock influences the rate of soil formation, their chemical composition, colour, texture, structure of mineral content and fertility.

(b) Relief:

Relief influences the process of soil formation in many ways, the most important being the slope of the land. Steep slope encourages swift flow of water so very thin layer of soil is formed due to erosion. The areas of gentle slope generally experience deposition and have deep layer of soil.

(c) Time:

Soil formation is a slow process. A well developed soil results as an end product of physical, chemical and biological weathering operating collectively for a very long period of time.
(d) Climate:

Climate is the most important factor of soil formation. The process of weathering, its effectiveness and the type of plant and animal organisms in a region are directly linked with the seasonal change of temperature and distribution and nature of precipitation. Chemical changes take place more rapidly in warmer regions than in cooler areas.

(e) Plant and Animal Organisms:

Natural vegetation reflects the combined effects of relief and climate. The formation and development of soil is very much influenced by the growth of vegetation. The decayed leaf material adds much needed humus to soil thereby increasing its fertility.

Earthworms help in mixing mineral and organic matter and reducing them to small grains. Burrowing animals like termites, ants, rats etc. make the soil layers liable for seepage of moisture and improve aeration.

2. The formation of soil is a very slow process and soil cannot be created by human effort. Soil conservation is treatment of land with those adaptable practical measures that keep it permanently productive while in use. The following steps are recommended for conservation of soils:

(a) Protection of Forests:

Since roots of the trees hold the soil material together, it is desirable to protect these trees from such felling. If
the forests are preserved and protected in reality, the soil erosion will not be a problem in those areas.

(b) Afforestation:

The best way to check soil erosion is afforestation. New trees are to be planted in areas of soil erosion and old ones are to be protected.

(c) Erecting Dams and Barriers:

Many rivers cause heavy erosion to soil in rainy season due to swift flow of the water current. This can be checked by erecting dams and barriers.

(d) Avoid Over-Grazing:

Another effective method to check soil erosion is to avoid overgrazing.

(e) Changes in Agricultural Practices:

We can conserve soil to a great extent by bringing about some basic changes in our agricultural practices. This includes crop rotation, crop combination, terraced cultivation etc. Contour ploughing is a very effective method of checking soil erosion in areas of steep slopes.
SUGGESTED ACTIVITIES

1. Collect sample of soil of your kitchen garden. Write few lines on the characteristics of this soil.

2. Compare this soil with the soil of any other place you visited during holidays.

3. If you visit a village, educate the farmers about soil erosion and conservation.

Further Reading


2. A.N. Strahler: Physical Geography, Wiley.

SELF LEARNING MODULE

ON

GEOGRAPHY

VOLCANOES

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OBJECTIVES

Learners will be able to achieve the following objectives after reading this self Learning Module.

General Objectives:

Understand the Concept of ‘Volcanoes’.

Specific Objectives:

1. Describe the term sudden forces
2. Write the definition of Volcano through recall correctly.
3. Make a list of the products of volcanic activity.
4. Describe the various causes of volcanic eruption
5. Give a suitable classification of volcanoes
6. Identify major volcanic landforms.
7. Describe effects of volcanoes on man.
8. Give world wide distribution of volcanoes.
1. SUDDEN FORCES

Our earth is called unstable because the crust of the earth is not stable although it is in solid state. Earthquakes and volcanic eruption often reminded us of the unstable conditions that exist beneath the earth’s surface causing sudden movements in the earth’s crust along the lines of weakness.

Now let us turn to the forces which show their effect all of a sudden, known as sudden forces. These forces originate inside the earth but show surprising sudden effects on the surface of the earth. 'Volcanoes' and 'Earthquakes' are two important examples of sudden forces.

2. VOLCANOES

You might have seen 'Volcano in action' in T.V. news. The volcanic phenomenon is a majestic natural phenomenon which can neither prevent nor regulate.

A volcano is a vent or opening on the earth's surface through which material is erupted from the interior of the earth. Accumulation of such material around the vent results in the formation of conical or dome shaped hill.

The form which a volcano takes depends on the nature of products erupted. A volcano is similar to an earthquake is that it becomes active suddenly and it cannot be predicted.
Though volcanic activity is generally of short duration, they erupt large quantities of products.

Hot molten rock material inside the earth is called Magma and when it comes out on the earth's surface it is known as Lava. This magma is always trying to find a way to the surface. Where the crust is weak, the tremendous force created by the magma and its gases breaks a hole in the crust and the lava spreads on the surface.

The lava accumulates around the opening in the form of a cone, the top of the cone has a funnel shaped depression called crater.

Now look at the sketch of a volcano.

A volcano is an opening in the earth's crust through which heated material are thrown out from the earth's interior.
3. Products of Volcanic Activity:

Can you imagine the materials derived from a volcanic eruption? Are they liquid, solid and gaseous in nature?

Liquid: The liquid matter is the lava. The temperature of freshly ejected lava may range between 600° to 1200°C. The speed of lava flow depends upon its composition, mobility and the slope of the ground. Usually, the movement is very slow and even a speed of 15 km per hour is rarely achieved. But sometimes the speed may be as high as 80 km per hour, making it difficult even for a good horse to run along it.

Gases: The gaseous substances are mainly composed of steam, products being hydrochloric acid, ammonium chloride, sulphur dioxide, hydrogen sulphide, hydrogen and carbon dioxide.

Water vapour is the most important of all the gases as it accounts for 60 to 90 percent of all the gases thrown out by a volcano.

Solids: Very often, the lava in the vertical passage gets solidified. The next volcanic eruption through the pipe is accompanied by explosion of highly compressed gases throwing out blocks of solidified lava from inside the choked pipe.

The solid material consists of fine ash and dust particles and angular fragments mostly of lava rock blown up from within the vent.
Solids, liquids, and gases are ejected at the time of a volcanic eruption.

4. Causes of Volcanic Eruption:

It is not possible for us to peep through a window into the interior of earth and see the exact causes of volcanic eruption. However, following causes are responsible for volcanic eruption (on the basis of indirect observations).

1. High temp. in the interior of the earth.
2. Weak points in the earth’s crust.
3. The presence of gases in the interior of earth.
4. The earthquakes are also responsible for curstal dislocations giving rise to the formation of faults.

High temperature, weak earth, gases and earthquakes are responsible for volcanic eruption.

5. Types of Volcanoes

Volcanoes are usually classified into three types on the basis of frequency of their eruption.

(1) Active Volcanoes: These volcanoes keep on ejecting volcanic material at frequent intervals.

The Etna volcano of Italy has been active for the last 2500 years.
Dormant Volcanoes: The dormant volcanoes are those in which eruption has not occurred regularly for a long time. But they cause great damage to life and property when they suddenly become active after remaining dormant for a sufficiently long time.

Volcanoes of Italy have erupted only 10 times in about 1500 years.

Extinct Volcanoes: The volcanoes which have not recorded any eruption in historic times are called extinct volcanoes. The vent of an extinct volcano is blocked and its crater is filled with rain water to form a crater lake. Vegetation starts growing on it. The possibility of future explosion becomes remote.

Popa of Myanmar is its outstanding example.

On the basis of frequency of eruption, volcanoes are of three types, namely active, dormant, and extinct.
PRACTICE TASK

(A) Fill in the blanks:

1. The two important examples of sudden forces are _____ and __________.

2. The temperature of freshly ejected lava may range between ______ to __________.

3. The solid material that comes out at the time of volcanic eruption includes ______ , ______ and __________.

4. The three reasons for volcanic eruption are ______ , ______ and __________.

(B) Give a single technical term of the following:

1. The volcanoes keep on ejecting volcanic material at frequent intervals.

2. Volcanoes which have not recorded any eruption in recent historic times.

3. The volcanoes in which eruption has not occurred regularly for a long time, but eruption may occur at any time.

(C) Define the following:

1. Volcano

2. Magma and Lava

3. Crater.
Match the type of volcano in Column A with the place where they are found, in column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dormant Volcano</td>
<td>Etna (Italy)</td>
</tr>
<tr>
<td>Extinct Volcano</td>
<td>Visuvius (Italy)</td>
</tr>
<tr>
<td>Active Volcano</td>
<td>Popa (Myanmar)</td>
</tr>
</tbody>
</table>
FEEDBACK TO PRACTICE TASK

(A) 1. Volcanoes, Earthquakes.
   2. 600°C, 1200°C.
   3. Ash, Dust particles, Angular fragments.
   4. High temperature, weak earth, gases and earthquakes.

(B) 1. Active Volcano
   2. Extinct Volcano
   3. Dormant Volcano

(C) 1. Volcano: A volcano is an opening in the earth’s crust through which heated material are thrown out from the earth’s interior.

   2. Magma and Lava: Hot molten rock material inside the earth is called magma.

   When it comes out on the earth's surface it is known as lava.

   3. Crater: The lava accumulates around the opening in the form of a cone, the top of the cone has a funnel shaped depression called crater.

(D) Column A          Column B

Dormant Volcano       Visuvius (Italy)
Extinct Volcano       Popa (Myanmar)
Active Volcano        Etna (Italy)
6. Volcanic Land Forms:

Materials ejecting out from a volcano create a variety of landforms. A few important landforms are listed below:

(1) Ash or Cinder Cone: The volcanic material thrown out by volcano cools down quickly in small solid pieces known as cinders. The solid particles are rained down and form a circular cone around the crater. This cone is called cinder cone. The cinder cone is formed after a number of explosions. The average height of a cinder cone is about 300 metres and its sides have concave slope.

The cones of Mount Pele, the Visuvius, Mt. Fuji and the Krakatao are good examples of cinder cones.

(2) Acid Lava Cone or Dome: This cone is formed by acid lava which is viscous and has the dominance of silica. This lava deposits itself near the neck immediately after explosion and forms a dome after solidification.
Puy de Dome in France are the outstanding examples of domes.

(3) Basic Lava Cone or Lava Shield: Sometimes, the basaltic lava having low silica content flows out quietly and gives rise to the formation of a shield. The lava flows out quietly around a central opening. In course of time, it builds up a shield-shaped volcano with a wide base and low slope. It cools as thin, like horizontal sheets. Probably the best examples are the Mauna loa shield volcanoes of the Hawaiian islands.

(4) Cone in Cone: Sometimes a small cone is formed inside a big cone as a result of subsequent explosion. This is also known as nested cone.
Composite Cone: These are probably the largest and the highest volcanic cones. They are formed by lava, ash etc. which are deposited one after the other in almost parallel layers. Sometimes the main cone is covered by a number of smaller cones which are called parasite cones.

Example of such cones is Fujiyama (Japan)

Caldera: Caldera is a large roughly circular volcanic depression often several hundred kilometres in area. Caldera
usually have a large crater lake. The distinction between craters and calderas is essentially one of size, one to two kilometres being the lower limit for the diameter of a caldera.

Calderas are formed in a variety of ways, but most accepted mechanism is the collapse or subsidence which may relate to explosive eruptions.

There are numerous examples of caldera in Alaska and Aleutian Islands. The largest caldera of the world is Aso in Japan which is 27 km by 16 km.

(7) **Volcanic Plug**: Volcanic plug is formed by the solidification of lava in the vent of the volcano after eruption is over. The plug becomes clearly visible after the erosion of the upper rock material.

The Devil Tower in Wyoming (USA) is the best example of a volcanic plug.
(8) **Crater Lake**: The funnel shaped crater of the head of a volcanic cone is filled with rain water and a lake, known as crater lake is formed.

The Toba lake in North Sumatra is the largest crater lake in the world.

(9) **Volcanic Mountains**: When viscous lava comes out in large quantity and deposits itself around the neck of the volcano, a volcanic mountain is formed.

Fujiyama of Japan is the largest volcanic mountain in the world.

(10) **Lava Plateau**: When more fluid lava with low silica content comes out of a volcano, it spreads to great distance and covers a vast area with thick sheet of lava. Thus, lava plateaus are formed.

The deccan plateau of India was formed in this way.

| Ash cone, Acid lava cone, Basic lava cone, Cone in cone, Composite cone, Caldera, Volcanic plug, Crater lake, Volcanic mountains and lava plateau are the major volcanic landforms. |
7. **Volcanoes and Man**

It is interesting to note the positive and negative effects of volcanoes on human life.

**Advantages:**

1. **Safety Valves:** Volcanoes help in releasing the intense pressure which build up in the interior of the earth. They act as natural safety valves for us as we have a safety valve in a pressure cooker.

2. **Knowledge about Interior of Earth:** We get to know something about the interior of the earth from the study of volcanoes.

3. **Fertile Soil:** Lava erupting from the volcanoes forms very fertile black soil which is useful for the cultivation of important crops like cotton, wheat, sugarcane, tobacco etc.

4. **Minerals:** Many valuable minerals are obtained from the volcanic eruptions.

5. **Scenic Beauty:** Volcanoes leave a great deal of scenic beauty in the form of geysers, mineral springs of hot water and crater lakes.

6. **Igneous Rocks:** Igneous rocks are formed by volcanic eruptions. Igneous rocks are the parent rocks from which other rocks are also formed. All such rocks are very useful to man.
Disadvantages:

1. Destructive to Life: Volcanoes are highly destructive to life and property. It was estimated that a volcano in Mexico in 1943 went on erupting 4,00,000 tons of lava and cinder a day in its first year. It depopulated an area of over 750 sq. km causing huge losses.

2. Earthquakes: Volcanoes cause earthquakes which are themselves very destructive.

3. Damage to Agricultural Crops: Lava flow destroys vast agricultural crops.

4. Harmful to Aquatic Life: Volcanic eruptions taking place under the sea harms aquatic life.

5. Environmental Pollution: Many poisonous gases come out at the time of volcanic eruptions and cause environmental pollution.

A volcano which has unfolded the mysteries of the interior of the earth is itself a great mystery for man. Volcanoes have both advantages and disadvantages.

8. Distribution of Volcanoes:

Out of 486 active volcanoes since the year A.D. 1500, 403 are located in and around the pacific ocean and 83 are in the mid world belt along mediterranean sea, alpine - himalaya mountains and in the atlantic and indian oceans. If the more ancient known eruptions are taken into account, we get a total of 522 volcanoes.
Volcanoes are unevenly distributed over the earth and vast areas have no active volcanoes at all. There are no volcanoes in Australia, in Asia they are largely concentrated in circum-Pacific region and Africa has a few of them.

Thus, the Pacific belt is truly known as the 'ring of fire' because of the largest number of active volcanoes along the coasts of Americas and Asia around this ocean.

The mid-world volcanic belt occupies a second place running from west to east along the Alpine and Himalayan fold mountains and their extensions. Iceland and Japan have both active and dormant volcanoes and are counted among the biggest volcanic islands of the world.

Africa occupies the third place having one volcano on the west coast, an extinct one in Mt. Kilimanjaro of Tanzania and several such in the Rift-Valley lake belt passing through Red Sea and extending up to Palestine in the north.

Most of the volcanoes in the world occur along linear belts or lines of weakness marked by intense folding and faulting.

Borders of the Pacific Ocean, Mid-world belt, the African Rift Valley are the major volcanic belts of the world.

We find a close relation between earthquakes and volcanic phenomenon. The earthquake is caused due to volcanic eruption. The crust of the earth which has fissures for the emission of lava and hot gases is subjected to great pressure. The emission of hot gases, lava etc. creates an earthquake wave in the
surrounding areas. Hence, volcanic activity is also a cause of
earthquakes. Because of this reason, the world distribution of
volcanic belts and earthquake belts are alike and similar.

An earthquake always takes place before a volcano starts
erupting. It is a warning to the local people.
PRACTICE TASK

(A) Match the volcanic landforms in column A with name of volcano of column B.

<table>
<thead>
<tr>
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<td>Decan plateau</td>
</tr>
<tr>
<td>Lava plateau</td>
<td>Mt. Fuji.</td>
</tr>
</tbody>
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(B) Draw sketch of following land features formed by volcanic eruption:

(1) Ash or cinder cone
(2) Basic lava cone
(3) Cone in cone
(4) Crater lake

(C) How volcanoes are helpful to man?

(D) Name the major volcanic belts of the world.
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Ash or Ciner Cone
Basic Lava Cone

Cone in Cone

Crater Lake
(C) We get lots of benefits from volcanoes:

1. Safety valves: Volcanoes help in releasing the intense pressure which build up in the interior of the earth. They act as natural safety valves for us as we have a safety valve in a pressure cooker.

2. Knowledge about interior of earth: We get to know something about the interior of the earth from the study of volcanoes.

3. Fertile soil: Lava erupting from the volcanoes forms very fertile black soil which is useful for the cultivation of important crops like cotton, wheat, sugarcane, tobacco etc.

4. Minerals: Many valuable minerals are obtained from the volcanic eruptions.

5. Scenic beauty: Volcanoes leave a great deal of scenic beauty in the form of geysers, mineral springs of hot water and crater lakes.

(D) (i) Borders of the pacific ocean
(ii) Mid-world belt
(iii) African rift valley
TERMINAL QUESTIONS

Answer the following questions:

1. Why is our earth called an unstable earth?
2. What is a volcano? What are its probable causes?
3. What relationship do you find between earthquake and a volcanic phenomenon?
ANS 1: Our earth is called unstable because the crust of the earth is not stable although it is in solid state. Earthquakes and volcanic eruption often reminded us of the unstable conditions that exist beneath the earth's surface causing sudden movements in the earth's crust along the lines of weakness.

ANS 2: A volcano is an opening in the earth’s crust through which heated material are thrown out from the earth’s interior.

On the basis of indirect observation following causes of volcanic eruption are recognised:

1. High temp. in the interior of earth.
2. Weak points in the earth’s crust.
4. Earthquakes are also responsible for crustal dislocation giving rise to formation of faults.

ANS 3: We find a close relation between earthquakes and volcanic phenomenon. The earthquake is caused due to volcanic eruption. The crust of the earth which has fissures for the emission of lava and hot gases is subjected to great pressure. The emission of volcanic material reduces this pressure but, the emission of hot gases, lava etc. creates an earthquake wave in the surrounding areas. Hence, volcanic activity is also a
cause of earthquakes. Because of this reason, the world
distribution of volcanic belts and earthquake belts are
alike and similar.

An earthquake always takes place before a volcano
starts erupting. It is a warning to the local people.

SUGGESTED ACTIVITIES

Collect pictures of volcanoes from periodicals and develop
an album.

FURTHER READINGS

2. F.J. Monkhouse: Physical Geography - University of London
SELF LEARNING MODULE
ON GEOGRAPHY
THE UNDERGROUND WATER

Supervisors
Dr. G S SODHI
Dr. SUNIL DUTT

Developed By
VIKAS KOHLI

Department of Education
Panjab University
Chandigarh
OBJECTIVES

Learners will be able to achieve the following objectives after reading this self learning module:

General Objectives:
Understand the concept and role of 'Underground Water'.

Specific Objectives:
1.0 Define underground water through recall correctly.
1.1 Distinguish between porosity and permeability.
1.2 Describe water table with the help of diagram.
1.3 Describe the term well, artesian well, spring correctly.
1.4 Identify the role of underground water as an agent of gradation.
1.0 Underground Water

You know that water is obtained from rivers, wells and tanks. Have you ever thought, "From where does the water in rivers, wells and tanks come"?

It is estimated that one-third of rain water evaporates back into the atmosphere, another one-third goes back to sea through rivers and the remaining one-third sinks into the ground through cracks and joints of crustal rocks. This is known as underground water, which again comes upto on the earth's surface in the form of springs, lakes, geysers etc. A part of it goes directly to the sea.

The water which accumulates in the rocks after seeping through the surface is called underground water.

1.1 Porosity and Permeability

It is interesting to note that all types of rocks do not hold the same quantity of underground water. The water holding capacity of a rock depends upon the pore spaces which is known as its porosity.

The permeability is another property of a rock which means its capacity to allow water to pass through it. The pore spaces or openings if connected with each other make a rock permeable. If these openings are not interconnected, the rock is impermeable.
and water cannot move through it.

Thus, a permeable rock is always porous or previous but a porous rock is not always permeable.

The rocks which have large connected pores through which water can flow are known as aquifers. Thus, an aquifer is a water bearing rock and refers to an underground reservoir of water.

**Porosity** : Porosity refers to number of pore spaces in the rock.

**Permeability** : Permeability refers to capacity of rock to allow water to pass through it.

**Aquifers** : The rocks which have large connected pores through which water can flow are known as aquifers.
PRACTICE TASK

(A) Fill in the blanks:

1. We get water from rivers, __________ and tanks.
2. Underground water comes on the surface in the form of lakes, __________ and __________
3. The water holding capacity of a rock depends upon the __________.
4. A permeable rock is always __________.

(B) Define the following:

1. Underground water
2. Porosity
3. Permeability
4. Aquifers
FEEDBACK TO PRACTICE TASK

(A) 1. Wells
2. Springs, Geysers
3. Pore Spaces
4. Porous

(B) 1. The water which accumulates in the rocks after seeping through the surface is called underground water.
2. Porosity refers to number of pore spaces in the rock.
3. Permeability refers to capacity of rock to allow water to pass through it.
4. The rocks which have large connected pores through which water can flow known as aquifers.
The Water Table

Many new facts have come to light about underground water in the search for petroleum and in drilling wells. The rainwater seeps into the surface and collects in the various layers of the earth's crust.

The pore spaces of the rock are all filled with percolating water at a certain level below the ground. The zone of previous or porous rocks fully bearing this water is called the zone of saturation. The level below which the rocks are completely saturated with water is called the water table. The water table thus, separates the saturated zone from the unsaturated zone lying above it.

**Zone of Saturation:** The zone of previous or porous rocks fully bearing with water.

**Water Table:** The level below which rocks are completely saturated with water.
In general, three successive zones may conveniently be recognised:

(a) Non-Saturation Zone:
Which is never completely filled, but through which the water percolates on its way to the underlying zones. A certain amount of water is retained by the soil, which yields it up to plant roots.

(b) Intermittent-Saturation Zone:
Which extends from the highest level reached by ground water after a period of prolonged wet weather, down to the lowest level to which the water table recedes after drought.

(c) Permanent Saturation Zone:
Which extends downwater to the limit beneath which the ground water is not encountered. Wherever the zone of permanent saturation rises above ground level, seepages, swamps, lakes or rivers occur. When the zone of intermittent saturation temporarily reaches the surface, floods develop and intermittent springs appear.

Three successive zones of underground water is recognised namely Non-Saturation Zone, Intermittent Saturation Zone and Permanent Saturation Zone.
1.3 Wells
You must have seen wells and tubewells. They are man made holes, dug into the earth’s surface through which underground water is drawn for drinking purposes and for irrigation.

If a well is dug just upto intermittent saturation level, it may dry up in dry season when water table falls down. This is known as intermittent well.

But if the well is dug quite deep to reach the permanent saturation level, it gives water through out the year and is known as permanent well. Both these wells are shown in Figure.

A man-made hole in the earth’s surface through which underground water is obtained is called a well.

Artesian Well
An artesian well is a special type of well in which water rises to the ground under hydraulic pressure through a natural or a man-made hole. Can you imagine? The name artesian is derived from the province of Artois in France, where the first well of this type was sunk. Artesian wells occur in regions which fulfil the following conditions:

(1) Position of Rock:
There should be a layer of permeable rock lying between two impermeable rock layers.
(2) Intake Area of Rock:
Permeable rock should be exposed at the ground surface so that rain water percolates into it.

(3) Availability of Water:
There should be sufficient amount of rainfall in the area where permeable rock is saturated with water.

(4) Shape of Rock Strata:
The level of the exposed permeable rock should be higher than the level of the hole so that sufficient hydraulic pressure can build up in the permeable rock.

The necessary conditions required for occurrence of artesian wells are - position of rocks, intake area of rocks, availability of water, space of rock strata.

Springs:
Springs are surface outflows of ground water through natural rock opening under hydraulic pressure. The most common site for a spring is at the junction of permeable and imperable rocks.

Now let us study various types of springs
(a) Cold Water Spring:
When cold water is coming out of a spring, it is known as cold water spring. They are generally less deep and contain rain water.
The cold water springs are found in Himalays, the Western Ghats along Konkan Coast and the Chhota Nagpur
Uplands.

(b) **Hot springs and Geyers**

They generally occur in regions of active or recent volcanism. The ground water comes in contact with the heated steam inside the earth and emerges at the surface either as a hot spring or as a geyser.

A Geyser is a hot spring in which water is forced up at intervals in the shape of a fountain. The steam pressure forces the water to shoot out through the openings. Some of the important hot springs are the Manikaran (Kulu), Tatapani (Shimla), Jawalamukhi (Kangra).
(c) **Mineral Springs**:

The water of mineral springs contain several minerals and salts. These springs have some medicinal value especially for skin diseases. In India, mineral springs are found as Sahashtradhara (Dehradun), Sohna (Haryana) etc.

The surface outflows of groundwater through natural rock opening under hydraulic pressure is called a spring.

They are classified as: Hot water, Cold Water and mineral springs.

A Geyser is a hot spring in which water is forced up at intervals in the shape of fountain.
PRACTICE TASK:

(A) Give a single term for each of the following:

1. The zone of previous or porous rocks fully bearing with water is called

2. The level below which rocks are completely saturated with water is named as

3. A man-made hole in the earth’s surface through which underground water is obtained is termed as

4. A special type of well in which water rises to the ground under hydraulic pressure is known as

5. Surface outflow of ground water through natural rock opening under hydraulic pressure is called

(B) Answer the following questions in one or two sentences:

1. Name the three successive zones of underground water.

2. What is Permanent Well?

3. From where the name Artesian is derived?

4. Name various types of spring.

5. What is Geyser?
(A) 1. Zone of Saturation 2. Water Table 3. Well 4. Artesian Well 5. Spring

(B)
1. (i) Non Saturation Zone (ii) Intermittent Saturation Zone (iii) Permanent Saturation Zone

2. If a well is dug quite deep to reach the permanent saturation level, it gives water throughout the year and is known as permanent well.

3. The name artesian is derived from the province of Artois in France, where the first well of this type was sunk.

4. (i) Cold Water Springs (ii) Hot Springs (iii) Mineral springs

5. A Geyser is a hot spring in which water is forced up at intervals in the shape of a fountain.
1.4 Underground Water as an agent of Gradation:

Underground water does the work of erosion, transportation and deposition which results in formation of a variety of topographical features. Topographical features made by underground water cannot be seen particularly in highlands composed of limestone.

This distinctive topography formed due to the action of underground water on limestone region is known as 'Karst Topography'.

'Karst' word comes from the Karst region of Adriatic Sea Coast in Yugoslavia where such formation are noticeable. This region is made up of limestone rocks, where underground water is the most active agent of gradation.

You know limestone rock is soluble in water? The rain water carrying carbon dioxide absorbed from the atmosphere forms a mild acid. This acid acts on limestone and dissolve it.

Topographical features made by underground water in limestone region is called 'Karst Topography'.

Erosional Work of Underground Water

Limestone rocks have numerous joints and fissures through which surface water percolates and become underground.
Underground water flows slowly and its physical erosional power is very small. Most of the erosional work is in the form of chemical erosion.

Let us study various land features formed by the erosional action of underground water.

1. Lapies

In places where the limestone region has a steep slope, rain water runs down the slope dissolving the rock along with their path. Long irregular grooves are formed. Between these grooves, undisolved rock stands out. The surface of the rock presents a rugged form. Such landforms are called lapies in French, They are called karren in German and Clint in English.
2. Sink Holes

A sink hole is a funnel shaped depression which has an average depth of three to nine metres. In area it may vary from one square meter to more. Sink holes are developed by enlargement of cracks in limestone rocks due to solution action of water.

Areas having so many sink holes are dangerous for construction work especially for railways tracks and roads.

Sink holes get enlarged by solution and adjoining sink holes may merge to form an elongated depression. Though such depressions resemble a valley, they do not have any stream or surface drainage. Such valleys caused by solution are called Blind Valleys.

In India sink holes are mainly found in limestone region of Meghalaya.
3. Swallow Holes

Swallow Holes are cylindrical in shape lying underneath the sink hole at some depth. The surface streams that often sink suddenly disappear underground through them. It is so, because these holes are linked with underground caves in rocks through vertical shafts. They justify their names by virtually swallowing the sub surface streams which may reappear from rock openings further down the slopes. Sink holes and swallow holes are shown in given figure:

A - Sinks on the surface of limestone rock.
B - Swallow holes at the bottom of a funnel shaped sink.

SINK HOLES AND SWALLOW HOLES.

14. Caves and Caverns

In certain areas there are hard insoluble rocks at the surface and soluble limestones below it. The underground water dissolve the limestones from below while the upper rock remains intact like a roof. Thus, a cave is formed. A large limestone cave formed by solution due to underground water is known as a cavern.

CAVE AND NATURAL BRIDGE.
5. **Natural Bridge**

A part of the roof of a cavern collapses, but part of its remains contact and looks like a bridge. Since this bridge is made by nature, it is called natural bridge.

Landforms formed by erosional work of underground water are Lappies, Sink Holes, Swallow Holes, Caves, Caverns and Natural Bridges.

**Depositional Work of Underground Water:**

The underground water dissolves a large quantity of minerals but the same is deposited elsewhere later on. Following features are formed due to depositional work of underground water:

1. **Stalactite:**
   
   The water, containing limestone in solution, seeps through the roof of the caverns in the form of a continuous chain of drops. A portion of the drop hangs on the roof and on the evaporation of water, a small deposit of limestone is left behind contributing to the formation of a stalactite. A stalactite grows downwards from the roof. The thickness is maximum near the roof and it thins out downwards.

2. **Stalagmite:**
   
   The remaining portion of the drops falls to the floor of the cavern. This also evaporated, leaving behind a small...
deposit of lime stone resulting in the formation of stalagmite, rising upwards from the floor. The thickness is maximum at the floor of the cavern and it thins out upwards.

3. **Cavern Pillars or Columns**:

Sometimes a stalactite from above and stalagmite from below develop towards each other and combines together to form a pillar. This is known as cavern pillars or column.

![Diagram of Stalactites and Stalagmites](image)

SC—Stalactite SG—Stalagmite C—Column

*Stalactites and stalagmites*

Major landforms formed by depositional work of underground water are Stalactite, Stalagmite and Pillars.
PRACTICE TASK

(A) Fill in the blanks:

1. The work of underground water is more active in ________ rocks.

2. The another name of Lappies in German is ________.

3. In India Sinkholes are mainly found in ________.

4. A large limestone cave formed by solution due to underground water is known as ________

5. A stalagmite grows ________ from floor.

(B) Answer the following:

1. In which country is 'Karst' region located?

2. How rainwater act on limestone rocks?

3. What is a Swallow Hole?

4. When Stalactite and Stalagmite joins what is formed?

5. Draw a rough sketch of 'Natural Bridge'.
FEEDBACK TO PRACTICE TASK

(A) 1. Limestone 2. Karren
5. Upward

(B) 1. Pomolavia
2. The rainwater carrying carbon dioxide absorbed from atmosphere forms a mild acid. This acid acts on limestone and dissolve it.
3. Swallow Holes are cylindrical in shape lying underneath the sinkhole at some depth.
4. Cavern Pillar is formed
5. [Image of natural bridge and cave]
TERMINAL QUESTIONS

(A) State whether True or False.

1. All types of rocks hold some quantity of underground water.
2. Water can move in impermeable rocks.
3. Limestone rock is soluble in water.
4. Areas having so many sinkholes are dangerous for construction work.

(B) Multiple Choice questions.

1. Wells in which underground water rises up to the surface of its own accord are called:
   (a) pucca wells  (b) kutcha wells  (c) artesian wells (d) tubewells.
2. Blind vallyes are produced by:
   (a) river action  (b) wave motion  (c) glacial action (d) solution of rock
3. Solution is the main process of gradation in:
   (a) limestone region  (b) grafite region  (c) glacier region (d) earthquake region

(C) Distinguish between the following carefully:

1. Porosity and Permeability
2. Cave and Cavern
3. Stalagmite and Stalactite
(D) What is meant by 'Karst Topography' ? Name any five topographical features and explain any two of these with the help of diagrams.

(F) CARTOGRAPHIC WORK

Draw sketches of landforms formed by deposition action in limestone regions.
FEEDBACK TO TERMINAL QUESTIONS

(A) 1. False 2. False 3. True 4. True

(B) 1. (c) Artesian Wells 2. (d) Solution of Rock 3. (a) Limestone regions

(C) 1. Porosity:
   Porosity refers to number of pore spaces in the rock.

   Permeability:
   Permeability of refers to capacity of rock to allow water to pass through it.

2. Cave:
   In certain areas there are hard insoluble rocks at the surface and soluble limestone below it. The underground water dissolve the limestone from below while the upper rock remains 'intact like a roof. Thus a cave is formed.

   Cavern:
   A large limestone cave formed by solution due to underground water is known as Cavern.

3. Stalagmite
   Limestone deposits which fall on the floor of the cave and rise upward from the floor is called Stalagmite.
Stalactite:
Limestone deposits which grow downward from the ceiling of the cave are called Stalactite.

(D) Topographical features made by underground water in limestone region is called 'Karst Topography'.
The major topographical features are:

a) Lapis
b) Sink Holes
c) Swallow Holes
d) Caves and Caverns
e) Natural Bridge
f) Stalactite
g) Stalagmite

h) Cavern Pillars

In places where the limestone region has a steep slope, rain water runs down the slope, dissolving the rock along their path. Long irregular grooves are formed. Between these grooves undissolved rock stands out. The surface of the rock presents a rugged form. Such landforms is called lappies in French. They are called Karren in German and Cill in English.
b) Sink Holes:

A sink hole is a funnel shaped depression which has an average depth of three to nine metres. In area it may vary from one square metre to more. Sink holes are developed by enlargement of cracks in limestone rocks due to solution action of water. Areas having so many sink holes are dangerous for construction work especially for railway tracks and roads.

Sink holes get enlarged by solution and adjoining sink holes may merge to form an elongated depression. Though such depressions resemble a valley, they do not have any stream or surface drainage. Such valleys caused by solution are called Bline Valleys.

In India sink holes are mainly found in limestone region of Meghalaya.
SUGGESTED ACTIVITIES

Visit some areas of sandstone during rainy season. Find out why water percolates into the ground so quickly. Try to explain this by relating it to permeable and impermeable...

FURTHER READING

* E.J. Monkhouse: Principles of Physical Geography, University of London Press (1977)
* A.N. Stahle: Physical Geography, Wiley (1975)
SELF LEARNING MODULE

ON

GEOGRAPHY

EARTHQUAKES

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OBJECTIVES

Learness will be able to achieve the following objectives after reading this self Learning Module.

General Objectives:
Understand the concept of 'Earthquake'.

Specific Objectives:

1. Writes the definition of Earthquake through recall correctly
2. Explain causes of Earthquake
3. Describe effect of Earthquakes on man
4. Identify major Earthquake prone zones in the world
5. Suggests major protective measures from Earthquakes.
1. Earthquakes:

If a stone is thrown into the pond of still water, a series of concentric waves are produced on its surface which spread out in all directions from the point at which the stone strikes the surface. Similarly, any sudden disturbance below the earth's surface may produce vibrations or shakings in the crust.

When rocks break, the particles next to the break are set in motion. It is the movement of one rock mass against another that causes vibrations. Some of these vibrations reach the surface and are known as earthquakes.

Earthquakes are tremors or vibrations caused by sudden earth movements, which may take place at a point or along a line of weakness in the crust. These are caused by internal forces which produce earth movements of various kinds.

When the crustal layers are unable to withstand the force, they break and move relative to one another. This produces tremors or shocks which spread through out the earth.

The point of origin of an earthquake is called seismic focus and the point on the earth's surface vertically above the focus is called the epicentre.

The intensity of the tremors is maximum near the epicentre and decreases gradually with distance from the epicentre.
The tremors produced by earthquakes are recorded in instruments called seismographs in the form of waves.

The seismographs in different parts of the earth record thousands of earthquakes per year. Generally, most of the earthquakes originate at a depth of less than 10 KM. A few earthquakes have their origin at greater depths.

Earthquakes may have their foci on the ocean floor as well as continents. Shallow focus earthquakes cause great damage to life and property.

The intensity of earthquake is indicated by Richter scale of numbers ranging from 0 to 9.

Gigantic tidal waves caused by earthquake are called tsunamis.

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Earthquakes are tremors or vibrations caused by sudden earth movements, which may take place at a point or along a line of weakness in the crust.

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Focus and Epicentre of an Earthquake
2. Causes of Earthquakes:
It is interesting to note various causes of earthquakes.

1. Volcanic eruption are often violent and cause earthquakes.
2. Earth has been constantly contracting since its birth, contraction creates disorder in the rocks and cause earthquakes.

3. Folding and faulting are related to compression and tension in the rocks and cause earthquakes.

4. It is believed that upper sial of the earth's crust is higher and is floating on the lower denser sima and tries to maintain Isostatic Equilibrium. An earthquake is caused whenever this equilibrium is destroyed.

Volcanic eruption, contraction of earth, folding and faulting, isostatic equilibrium are some major causes of earthquakes.

3. Earthquake and Man:
Earthquakes are often harmful and rarely useful to man.

Disadvantages

1. Loss of Life and Property:
Earthquakes cause heavy loss to life and property. The maximum damage is caused near the epicentre of the earthquakes.

Some 25,000 people lost their lives when the earthquake struck Quetta in 1935. In addition it caused heavy damage to buildings and other installations.
2. Tsunamis:

   Earthquakes occurring in sea result in high waves in the sea water and cause heavy damage to ships. As you know earlier such seismic sea waves are called Tsunamis in Japanese.

3. Land Slides:

   Earthquakes are responsible for landslides in highlands which cause heavy damage.

4. Disturb Flow of Water:

   Sometimes earthquakes disturb the existing rock strata and block the flow of water in a river. The river water submerges the surrounding low lying areas causing severe floods. The floods in the Brahmaputra Valley in 1950 was caused by an earthquake.

Advantages of Earthquakes:

   Some of the indirect advantages are as under:

1. Knowledge about interior of earth:
   We come to know about the interior of the earth from the study of earthquake waves.

2. Soil formation:
   Earthquakes cause landslides which encourages weathering of the rocks. This process helps in the formation of soils and creates suitable conditions for agriculture.
3. New landforms:
Earthquakes are responsible for folding and faulting which creates new landforms such as mountains, plateaus, valleys etc.

4. Natural harbours:
Earthquakes in the coastal regions cause subsidence in large area resulting in deep bays. This gives rise to good natural harbours which are extremely useful for international trade. On the other hand, many sub-marine areas come out of sea and new land is formed.

5. Minerals:
Sometimes the fissures caused by the earthquakes yield valuable minerals.

4. Distribution of Earthquakes:
The distribution of earthquakes is more or less similar to that of volcanoes. The earthquakes mostly occur in weak crustal areas of the earth.

1. Circum-Pacific Belt:
About 68% of world's earthquakes are observed along the coasts of the vast Pacific ocean. This is known as the 'ring of fire'. This is the area of intense volcanic activity also.

This area is closely linked with the region of crustal dislocations and volcanic phenomenon. Chile, California, Alaska, Japan, Philippines, New Zealand and the Mid-Ocean areas have
had many minor and major earthquakes in this belt. Mountains here run along the border of continents and nearly parallel to the depressions in oceans. It causes sharpest break in relief which becomes a cause for the earthquakes.

2. Mid-World Mountain Belt:

Nearly 21% of the world's earthquakes occur in the mid world mountain belt. It extends parallel to the equator from Mexico across Atlantic Ocean, the Mediterranean sea from Alpine - Caucasus ranges to the Caspian, Himalayan mountains and the adjoining lands. This zone has folded mountains, large depression and active volcanoes.

3. Minor Belts:

The remaining 11% of the shocks are recorded outside these two belts. Only a few occur along the fracture in African lakes, red and the dead sea zone.

Earthquakes in India:

Earthquakes in India are mainly confined to the Himalayan region and its foothills. They are also felt in the Ganga Valley.

There have been a number of violent earthquakes in India in historic times. The Kutch earthquake (1819), the Assam earthquake (1897), the Kangra earthquake (1905), the Bihar earthquake
(1950), the Latur earthquake (1995) are some of the well known examples.

The peninsular plateau has remained practically free from earthquakes. But the earthquake of Koyna dam region in Maharashtra in 1968 is an important exception. This was most probably caused due to large quantity of water in the reservoir which resulted in fissures and cracks.
5. Protection from Earthquake

Can We Protect us from Earthquakes?

Man is unable to prevent earthquakes, all he can do is to take steps for safety.

More seismic stations can be established for issuing warning to the people of coming earthquakes.

The suitable building structures need to be encouraged in earthquake areas.

Sometimes our own observations, like sudden changes in atmospheric conditions and abnormal behavior of animals, can help us to forecast the arrival of an earthquake.
PRACTICE TASK

(A) Fill in the blanks:
1. The point of origin of an earthquake is called ________________________.
2. The point on the earth’s surface vertically above the focus is called the ________________.
3. The tremors produced by earthquakes are recorded in instrument called ____________________.
4. The intensity of earthquake is indicated by ________ scale of numbers ranging from 0 to 9.
5. Gigantic tidal waves caused by earthquake are called ____________________.
6. Circum - pacific belt is also known as __________.
7. About _________ of the world’s earthquake are observed along the coasts of the vast Pacific Ocean.
8. Earthquake in India are mainly confined in _______ region.

(B) Answer the following:
1. Define Earthquake.
2. Name of major causes of earthquake:

(C) Give any two disadvantages of earthquake.

(D) Name the two major earthquake prone zones in the world.

(E) Give your suggestions on "Protection from earthquake".

FEEDBACK TO PRACTICE TASK

(A) 1. Seismic Focus
2. Epicentre
3. Seismograph
4. Richter
5. Tsunamis
6. Ring of Fire
7. 68%
8. Himalayan

(B) (1) Earthquakes are tremors or vibrations caused by sudden earth movements, which may take place at a point or along a line of weakness in the crust.

(2) Volcanic eruption, contraction of earth, folding and faulting, isostatic equilibrium are some major causes of earthquakes.

(C) (1) Loss of Life and Property:

Earthquakes cause heavy loss to life and property. The maximum damage is caused near the epicentre of the earthquake.

Some 25,000 people lost their lives when the earthquake struck Quetta in 1935. In addition it caused heavy damage to buildings and other installations.
(2) Tsunamis:

Earthquakes occurring in sea result in high waves in the sea water and cause heavy damage to ships. Such seismic sea waves are called tsunamis in Japanese.

(D) Circum-Pacific belt and Mid-World mountain belt are the major earthquake prone zones in the world.

(E) Man is unable to prevent earthquakes; all he can do is to take steps for safety.

(1) More seismic stations can be established for issuing warning to the people of coming earthquakes.

(2) The suitable building structures need to be encouraged in earthquake areas.

(3) Sometimes our own observations, like sudden changes in atmospheric conditions and abnormal behaviour of animals, can help us to forecast the arrival of an earthquake.
SUGGESTED ACTIVITIES

1. Collect newspaper cuttings of recent earthquakes and locate them on a world map.

2. Visit a seismological station near your school.

FURTHER READINGS

SELF LEARNING MODULE
ON
GEOGRAPHY
ATMOSPHERE

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OBJECTIVES

After the study of this module you will be able to:

General Objectives:
Understand the concept and importance of Atmosphere.

Specific Objectives:
1.0 Writes the definition of Atmosphere through recall correctly
1.1 Explain composition of Atmosphere
1.2 Describe Structure of Atmosphere
1.3 Explain the importance of Atmosphere
1.0 Concept of Atmosphere:

The surface of the earth is surrounded by a blanket of air and this gaseous sphere surrounding or hanging over the surface of the earth is called 'The Atmosphere.'

According to F.J. Monkhouse, 'The atmosphere is a thin layer of gas held to the earth by gravitational attraction.'

According to H.J. Critchfield, 'The atmosphere is a deep blanket of gases which entirely envelops the earth.'

Do you know the air of the atmosphere is colourless, odourless and tasteless? We cannot feel the presence of the air unless it blows as winds.

Our Atmosphere contains life-giving gases like oxygen for man and animal, and carbon dioxide for plants. The atmosphere extends to thousands of kilometers. But it has no clear-cut upper limit and it gradually merges with the outer space.

The Atmosphere is a deep blanket of gases which entirely envelops the earth.
1.1 COMPOSITION OF THE ATMOSPHERE:

Our atmosphere is composed of three elements -
(a) gases which remain gaseous under all circumstances,
(b) Water vapours, which under special condition changes into liquid and solid forms,
(c) the dust particles.

(a) GASES

The air that we feel around us is a mixture of various gases. The important gases are nitrogen, oxygen, carbon dioxide, hydrogen, ozone. The nitrogen and oxygen together make-up over 99% of the atmospheric air by volume. Percentage of different gases in dry air is given in the following table:

<table>
<thead>
<tr>
<th>Name of Gas</th>
<th>Percentage by volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>78.03 %</td>
</tr>
<tr>
<td>Oxygen</td>
<td>20.99 %</td>
</tr>
<tr>
<td>Argon</td>
<td>0.94 %</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>0.03 %</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>0.01 %</td>
</tr>
<tr>
<td>Neon</td>
<td>0.0015 %</td>
</tr>
<tr>
<td>Helium</td>
<td>0.0005 %</td>
</tr>
<tr>
<td>Krypton</td>
<td>0.0001 %</td>
</tr>
<tr>
<td>Zeonon</td>
<td>0.000009 %</td>
</tr>
<tr>
<td>Ozone</td>
<td>0.000001 %</td>
</tr>
</tbody>
</table>
The composition of the atmosphere is not constant. It varies from time to time and from place to place. This variability is readily observed when we drive from the rural countryside into the city and see increase in dust and smoke. But the proportion of the main gases remains almost uniform up to a height of about 80 kilometres from the mean sea level.

Some important gases are briefly described below:

(i) **Nitrogen** :

Nitrogen is the most plentiful of all the gases in the atmosphere. This gas has no colour, odour or taste. Nitrogen avoids quick burning. It would be difficult to control fire in the absence of nitrogen. Nitrogen generates proteins in the plants which is the main source of food. Nitrogen from the air is used for manufacture of nitrogenous fertilizers.

(ii) **Oxygen** :

Oxygen is called life giver because living beings use oxygen for breathing. It help in burning the fuel.

(iii) **Carbon Dioxide**  Carbon dioxide makes a very little part of the air but it is a very vital gas. Green plants use it during the process of photosynthesis. Animals consume plants as their food and release Carbon dioxide as waste product. However, the burning of fuel such as coal and oil produce carbon dioxide in the air. As a result, the
amount of carbon dioxide is increasing slightly each year. This increasing amount of carbon dioxide may affect the earth's weather by increasing its temperature.

The important gases of the atmosphere are Nitrogen, Oxygen and Carbon Dioxide.

(b) WATER VAPOURS:

The average amount of water vapours is nearly 2% of the atmosphere by volume. It may vary from 4% in the warm and wet tropics to less than 1% in dry and cold areas of deserts and the polar regions. Even the driest air has some proportion of water vapours. Water vapour is added to the atmosphere by evaporation of water from oceans, lakes, rivers and other water bodies.

Water vapour absorbs radiation from the earth's surface and helps to keep the air warm. Water vapour contains latent heat and this is released during condensation of water vapour into water particles. Such release of latent energy makes atmospheric circulation more vigorous. Precipitation of water from the atmosphere provides water for all life forms on the earth.

(c) DUST PARTICLES:

When air blows as wind with sufficient speed, it carries large quantities of dust particles and keeps them
suspended in it. They are derived from different sources and include: sea salts, fine soil, smoke, ash, pollen, dust and disintegrated particles of meteors.

As a result of gravitational pull of the earth, they are mostly found in the lower layers of the atmosphere, water vapour condenses around these particles to form clouds. The dust particle of this type, around which water vapours condense to form clouds are called hygroscopic nuclei.

Dust in the air produces marvellous optical phenomenon of red and orange hues in the sky at the sunrise and the sunset which are known as 'dawn' and 'dust' respectively. Besides, dense haze and smog (smoke and fog) are also caused due to the presence of dust particles. Sky looks blue due to the presence of dust particles in the atmosphere. "Believe!"

* Water vapour allows earth to neither become too not nor too cold.
* Dust particles in the air act as hygroscopic nuclei around which water vapour condenses to form clouds.
The Composition of the atmosphere is marked by the following characteristics:

(i) Heavier gases predominate in the lower layers while the lighter gases make up the upper portion of the atmosphere. This variation in density is due to the gravitational pull exercised by the earth.

(ii) Upto a height of 80 kms. the composition of the atmosphere is fairly uniform because of the winds and the rapidity with which the gases mix with one another.

(iii) The amount of water-vapour varies with the temperature. Therefore, its percentage in the atmosphere decreases as one moves from the equator towards the poles.

(iv) This variation in the Composition of the atmosphere is both vertical and horizontal.
PRACTICE TASK

(A) State whether True or False.
1. The atmosphere has a clear cut upper limit.
2. The proportion of the main gases remains almost uniform up to a height of about 80 kilometres from the mean sea level.
3. The Nitrogen and hydrogen together make up over 99% of the atmospheric air by volume.
4. Oxygen is used by living beings for breathing purpose.
5. The amount of Carbon dioxide is increasing slightly in our atmosphere.

(B) Fill in the Blanks.
1. The atmosphere is composed of
   \[ \text{______________}, \text{______________} \text{and} \text{______________} \]
2. The gas which generate protein in the plants is called\[ \text{______________}. \]
3. The process of photosynthesis is possible in green plants because of the availability of\[ \text{______________} \text{gas in the atmosphere}. \]
4. Water vapour absorbs radiation from the earth’s surface and helps to keep the air\[ \text{___________}. \]
5. Sky looks blue due to the presence of\[ \text{______________} \text{in the atmosphere}. \]
FEEDBACK TO PRACTICE TASK

(A) 1. False
   2. True
   3. False
   4. True
   5. True

(B) 1. Gases, Water Vapours, Dust Particles
   2. Nitrogen
   3. Carbon dioxide
   4. Warm
   5. Dust Particles
1.2 STRUCTURE OF THE ATMOSPHERE:

The atmosphere consists of almost concentric layers of air with varying density and temperature. Density is highest on the earth’s surface and goes on rapidly decreasing upwards. It can broadly be divided into five layers - the troposphere, the stratosphere, the mesosphere, the ionosphere and the exosphere.

TROPOSPHERE:
The lowest layer of the atmosphere is called the troposphere. Most of the weather phenomena take place in the troposphere. The troposphere is of great concern to us as it contains more than 90% of the water vapour and all the dust particles present in the atmosphere. Temperature decreases with height in the troposphere at an average rate of 1° C for 165 meters of height above sea level. This rate of decrease of temperature with altitude is called normal lapse rate or environmental lapse rate. The height upto which this laps rate prevails marks the limit of the troposphere. The troposphere extends to a maximum height of 18 kilometers at the equator and declines gradually to a height of 8 kilometers at the polar regions. The troposphere has maximum extent at the equator because of greater turbulence in the atmosphere caused by convectional currents.
THE STRATOSPHERE:

Beyond the troposphere lies the stratosphere. There is a transitional zone between troposphere and stratosphere called tropopause.

Stratosphere extends up to a height of about 50 kilometers from the mean sea level near the poles. Its thickness varies from 40 kilometers near the poles to 32 kilometers at the equator. Temperature is almost constant up to a height of 20 kilometers in the lower portion of this layer. Then it gradually increases with increase in height up to 50 kilometers because of the presence of Ozone in the upper portion of the stratosphere. Which absorbs sun’s harmful ultraviolet rays and increases the temperature. Ozone also prevents these harmful rays to reach the earth’s surface.

(i) Storms and other weather conditions are absent in this layer at the atmosphere.

(ii) The air movement is almost horizontal.

(iii) This layer presents ideal conditions for air flights in the absence of weather phenomena.

THE MESOSPHERE:

The third layer above the stratosphere is known as the mesosphere. It extends up to an average height of 80 kilometers from the mean sea level. Temperature decreases again and reaches up to -100 °C at the height of 80 kilometers.
THE IONOSPHERE:
The layer located above the mesosphere between 80 kilometres and 600 kilometres height is called ionosphere. It contains electrically charged ions, that reflect the radio waves back to the earth thus making wireless communication possible.

Your radio and television works only because of the presence of ions in this layer. Interesting? Temperature again begins to increase in this layer with increase in height due to radiation from the sun.

THE EXOSPHERE:
Exosphere is the uppermost layer at the atmosphere. It extends 1000 kilometres or beyond. The exact height of the top of the exosphere is uncertain. It is a transition zone between the earth's atmosphere and space. The density of the air is very low here.

The five layers of the atmosphere are troposphere, stratosphere, mesosphere, ionosphere and exosphere. Each layer is having its own function and significance.
1.3 IMPORTANCE OF THE ATMOSPHERE

The atmosphere is very useful for us. It is clear from the following description:

(i) BASE OF LIFE

Atmosphere is the very base of life on the earth. We cannot even imagine life without atmosphere. In fact, earth is the only planet of the solar system which sustains life because earth has atmosphere congenial to life. Atmosphere contains Oxygen which is very essential for breathing. It also contains carbon dioxide which is useful for vegetation life.

(ii) WEATHER AND CLIMATE

Weather and climate have a great hearing on our life. All the incidents concerning weather and climate happen in atmosphere. Evaporation, precipitation, winds etc all take place due to atmosphere.

(iii) HEAT BALANCE

Atmosphere acts as a blanket for us. It is transparent to short wave radiation coming from the sun and permits them to reach earth's surface at the same time. It is opaque to long-wave radiation reflected from the surface of the earth. Thus, it has 'Green House' effect and keeps earth's temperature at an average of 35°C warmer than it would otherwise be. Had there been no atmosphere on the earth, the
Temperature would have risen to 100°C during day and fallen to -100°C at night. Life is impossible under these extreme of temperature variations.

(iv) RADIO BROADCASTING
Ionosphere layer of the atmosphere reflects the radio waves transmitted from the earth and sends them back to earth. This help in radio broadcasting.

(v) SAFEGUARD AGAINST ULTRAVIOLET RADIATIONS
Atmosphere has a layer of ozone gas at height of 10 to 50 km. which partly absorbs the ultraviolet radiations coming from the sun. The ozone layer thus serves as a shield protecting the earth from ultraviolet radiations. If these ultraviolet rays were to reach the earth's surface in full intensity, all exposed bacteria would be destroyed and animal tissues severely damaged.

(vi) SAFEGUARD AGAINST METEORITES
Meteorites are constantly attracted from outer space towards the earth due to its gravitational force. Most of them are burnt during their passage through the earth's atmosphere due to friction of the air. In this way our atmosphere saves us from the attack of meteorites.
In this modern age of science and technology, atmosphere has become a very powerful medium for aviation which is the fastest mode of transport. Most of the planes fly up to troposphere only. However, aviators of Jet aeroplanes often avoid this layer due to the presence of bumpy air pockets and fly above it.

The atmosphere is the base of human life, builder of weather and climate, maintains heat balance, helpful in Radio Broadcasting, safeguard against ultraviolet Radiations and meteorites and act as powerful medium for aviation.
PRACTICE TASK

(A) Multiple choice questions

1. The rate of decrease of temperature with altitude is called
   a. Negative rate
   b. Altitude rate
   c. Normal lapse rate
   d. Formal lapse rate

2. The layer that is ideal for air flights is known as
   a. ionosphere
   b. troposphere
   c. stratosphere
   d. exosphere

3. The topmost layer of the atmosphere is
   a. troposphere
   b. stratosphere
   c. ionosphere
   d. exosphere

4. Our atmosphere keeps the earth's temperature warmer. This is known as
   a. blue house effect
   b. green house effect
   c. warm effect
   d. best effect
5. The layer of atmosphere where all weather phenomenon takes place is
a. troposphere
b. stratosphere
c. ionosphere
d. exosphere

(B) Fill in the blanks:
1. The density of atmosphere is highest on the earth's surface and goes on rapidly__________upwards.
2. The transitional zone between troposphere and stratosphere is called__________
3. Harmful ultra violet radiation from the sun is absorbed by _________________
4. The layer which makes the wireless communication possible is________________
5. Due to gravitational force__________are constantly attracted from outer space towards the earth
FEEDBACK TO PRACTICE TASK

(A)
1. c
2. c
3. d
4. b
5. a

(B)
1. Decreasing
2. Tropopause
3. Ozone
4. Ionosphere
5. Meteorites
TERMINAL QUESTIONS

(A) Answer the following questions in one or two sentences
(i) Define Atmosphere.
(ii) Name the variable components of the atmosphere.
(iii) What is the importance of Carbon dioxide in the atmosphere?
(iv) What is the role played by the ozone layer?
(v) Name the five layers of the atmosphere.
(vi) Which layer provides ideal flying conditions?
(vii) Which layer reflects radio waves back to the earth?

(B) Explain the following
(i) Troposphere and stratosphere
(ii) Mesosphere and Ionosphere.

(C) Essay Type Questions
(i) Explain the importance of atmosphere
(ii) Give the important characteristics of the composition of atmosphere

(D) Catrographic Work
(i) Prepare a chart showing the structure of the atmosphere and indicate the properties of each layer.

(E) Finding out
(i) Visit an observatory near your school and learn about the Instruments used for observing the atmosphere.
FEEDBACK TO TERMINAL QUESTIONS

Ans.(A)

(i) The atmosphere is a deep blanket of gases which entirely envelopes the earth.

(ii) The atmosphere is composed of three elements namely gases, water vapours and dust particles.

(iii) Carbon dioxide is used by green plants during the process of photosynthesis.

(iv) Ozone gas protects us from harmful ultraviolet rays.

(v) a. Troposphere
    b. Stratosphere
    c. Mesosphere
    d. Ionosphere
    e. Exosphere

(vi) Stratosphere

(vii) Ionosphere

Ans (B)

(i) Troposphere -

The lowest layer of the atmosphere is called the troposphere. Most of the weather phenomena take place in the troposphere. The troposphere is of great concern to us as it contains more than 90% of the water vapour and all the dust particles present in the atmosphere. Temperature decreases with height in the troposphere at an average rate of 1°C for 165 metres of height above sea level. This rate of decrease of temperature with altitude is
called normal lapse rate or environmental lapse rate. The height upto which this laps rate prevails marks the limit of the atmosphere. The troposphere extends to a maximum height of 18 kilometres at the equator and declines gradually to a height of 8 kilometres at the polar regions. The troposphere has maximum extent at the equator because of greater turbulence in the atmosphere caused by convectional currents.

STRATOSPHERE -
Stratosphere extends upto a height of about 50 kilometres from the mean sea level near the poles. Its thickness varies from 40 kilometres near the poles to 32 kilometres at equator. Temperature is almost constant upto a height of 20 kilometres in the lower portion of this layer. Then it gradually increases with increase in height upto 50 kilometres because of the presence of ozone in the upper portion of the stratosphere which absorbs Sun's harmful ultraviolet rays and increases the temperature. Ozone also prevents these harmful rays to reach the earth's surface.

Storms and other weather conditions are absent in this layer of the atmosphere. The air movement is almost horizontal. This layer presents ideal conditions for air flights in the absence of weather phenomena.
The third layer above the stratosphere is known as the mesosphere. It extends up to an average height of 80 kilometres from the mean sea level. Temperature decreases in this layer and reaches up to -100°C at the height of 80 kilometres.

IONOSPHERE -

The layer located above the mesosphere between 80 and 600 kilometres height is called ionosphere. It contains electrically charged ions, that effect the radio waves back to the earth thus making wireless communications possible. Our radio and television works only because of the presence of ions in this layer. Temperature again begins to increase in this layer with increase in height due to radiation from the sun.

C.

(i) Importance of Atmosphere -

The atmosphere is very useful for man. It is clear from the following description:

(i) BASE OF LIFE -

Atmosphere is the very base of life on the earth. We cannot even imagine life without atmosphere. In fact, earth is the only planet of the solar system which sustains life because earth has atmosphere congenial to life. Atmosphere contains oxygen which is very essential for breathing. It also contains carbon dioxide which is useful for vegetation life.
(ii) WEATHER AND CLIMATE -
Weather and climate have a great hearing on our life. All the incidents concerning weather and climate happen in atmosphere. Evaporation, precipitation, winds etc. all take place due to atmosphere.

(iii) HEAT BALANCE -
Atmosphere acts as a blanket for us. It is transparent to short - wave radiation coming from the sun and permits them to reach earth's surface at the same time. It is opaque to long wave radiation reflected from the surface of the earth. Thus, it has 'green house' effect and keeps earth's temperature at an average of 35 °C warmer than it would otherwise be. Had there been no atmosphere on the earth, the temperature would have risen to 100 °C during day and fallen to -100 °C at night. Life is impossible under these extremes to temperature variations.

(iv) RADIO BROADCASTING -
Ionosphere layer of the atmosphere reflects the radio waves transmitted from the earth and sends them back to earth. This help in radio broadcasting.
(v) SAFEGUARD AGAINST ULTRAVIOLET RADIATIONS -
Atmosphere has a layer of ozone gas at height of 10 to 50 kms. Which partly absorbs the ultraviolet radiations coming from the sun. The ozone layer thus serves as a shield protecting the earth from ultraviolet radiations.

(vi) SAFEGUARD AGAINST METEORITES -
 Meteorites are constantly attracted from outer space towards the earth due to its gravitational force. Most of them are burnt during their passage through the earth’s atmosphere due to friction of the air. In this way our atmosphere saves us from the attack of meteorites.

(vii) AIRWAYS -
In this modern age of science and technology, atmosphere has become a very powerful medium for aviation which is the fastest mode of transport. Most of the planes fly upto troposphere only. However, aviators of jet aeroplanes often avoid this layer due to the presence of bumpy air pockets and fly above it.

C.

(ii) Important Characteristics of Atmosphere:
The composition of the atmosphere is marked by the following characteristics:

(i) Denser gases predominate in the lower layers while the lighter gases make up the upper portion of the
atmosphere. This variation in density is due to the gravitational pull exercised by the earth.

(ii) Upt to a height of 80 kms, the composition of the atmosphere is fairly uniform because of the winds and the rapidity with which the gases mix with one another.

(iii) The amount of water vapour contact varies with the temperature. Therefore, its percentage in the atmosphere decreases as one moves from the equator towards the poles.

(iv) This variation in the composition of the atmosphere is both vertical and horizontal.