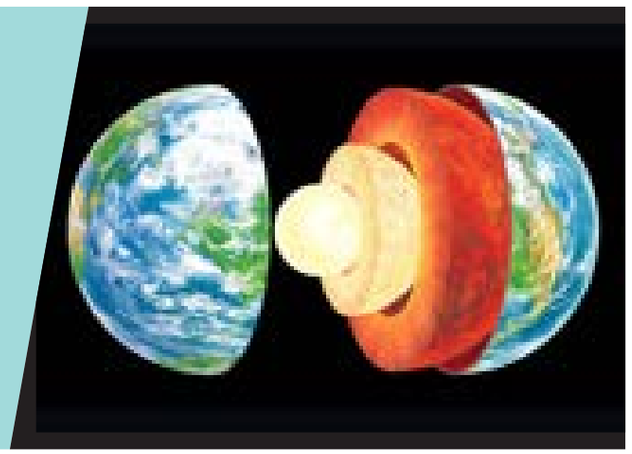
Unit -1

Interior of the Earth



Learning Objectives

- To know about the interior of the earth
- To understand the movements of earth plates
- To learn about earthquakes and volcanoes

Introduction

The earth, our homeland, is a dynamic planet. The earth's surface has lofty mountains, high plateaus, large plains and deep valleys etc. The earth's surface is constantly undergoing changes inside and outside. Have you ever wondered what lies in the interior of the earth? What is the earth made up of? Let us learn about this in detail.

Interior of the Earth

The structure of the earth may be compared to that of an apple.On the basis of the study of earthquake waves the spherical earth is found to be three concentric layers. They are:

1. The crust,
2. The mantle and
3. The core.

1. The Crust

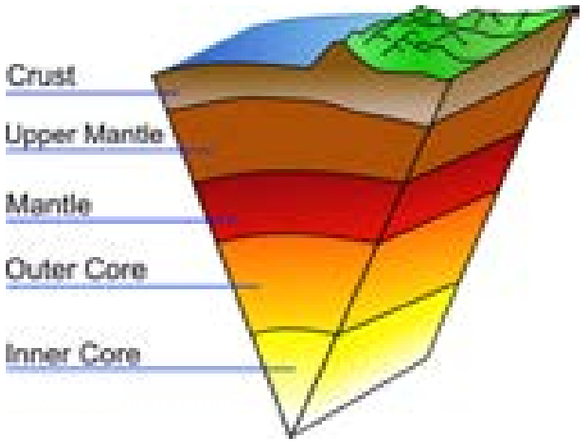
The crust is the outermost layer of the earth. Its thickness varies from 5 to 30 km. It is about 35 km on the continental masses and only 5 km on the ocean floors. Despite greater thickness, the continental crust is less dense than the oceanic crust because it is made of both light and dense rock types. The oceanic crust is composed mostly of dense rocks such as basalt.

DO YOU KNOW?

Earth is called as blue Planet. 71% of the earth is covered by water.

The crust comprises two of distinct parts. The upper part consists of granite rocks and forms the continents. It has the main mineral constituents of silica and alumina. So it is referred to as Sial. It has an average density of 2.7g/cm^3.

The lower part is a continuous zone of denser basaltic rocks forming the ocean floors, comprising mainly of silica and magnesium. It is therefore called Sima. It has an average density of 3.0g/cm^3. The sial and the sima together form the earth's crust. Since the sial is lighter than the sima, the continents can be said to be 'floating' on a sea of denser sima.



Structure of the Earth

2. The Mantle

The next layer beneath the crust is called the mantle. It is separated from the crust by a boundary called Mohorovicic discontinuity. The mantle is about 2,900 km thick. It is divided into two parts. (i) The upper mantle with a density of 3.4 – 4.4g/cm^3, extends down to 700 km. (ii) The lower mantle having a density of 4.4 – 5.5g/cm^3 extends from 700 to 2,900 km.

Why the interior of the earth is so hot?

3. The Core

The innermost layer of the earth is called the core. It is also known as *barysphere*. It is separated from the mantle by a boundary called *Weichart-Gutenberg discontinuity*. The core is also divided into two parts.

(i) **The outer core,** which is rich in iron, is in liquid state. It extends between 2,900 – 5,150 km.

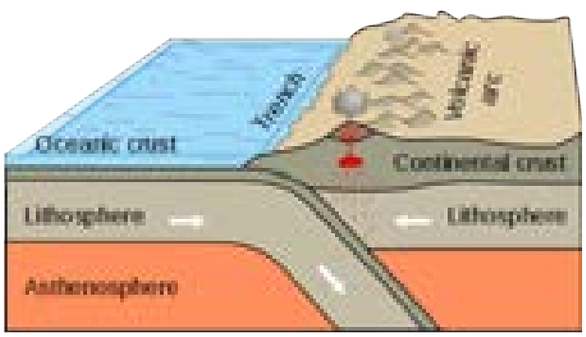
(ii) **The inner core**, composed of Nickel and Ferrous *(Nife)*, is solid in state. The central core has very high temperature and pressure. It extends from 5,150 km to 6,370 km. The average density of core is 13.0 g/cm^3

DO YOU KNOW?

The crust forms only 1% of the volume of the earth, 84% consists of the mantle and 15% makes the core. The radius of the earth is 6,371km.

The Earth Movements

The lithosphere is broken into a number of plates known as the *Lithospheric plates*. Each plate, oceanic or continental moves independently over the asthenosphere. The movement of the Earth's lithospheric plates is termed as tectonic movements. The energy required to move these plates is produced by the internal heat of the earth. These plates move in different directions at different speed.



Lithospheric Plates

At places, these plates move away from each other creating wide rifts on the earth's surface. At some places, these plates come closer and collide. When an oceanic plate collides with a continental plate, the denser oceanic plate is forced below the continental plate. As a result of the pressure from above the rocks heats up and melts. The molten rocks rise again forming volcanic mountains along

the continental edge. Alternatively, a trench may be formed between two plates

In some cases when two continental plates converge, neither plate can be forced under the other. Instead, folds may be created. Great mountain ranges like the Himalayas have been formed in this way.

The movement of these plates causes changes on the surface of the earth. The earth movements are divided on the basis of the forces which cause them. The forces which act in the interior of the earth are called as Endogenic forces and the forces that work on the surface of the earth are called as Exogenic forces.

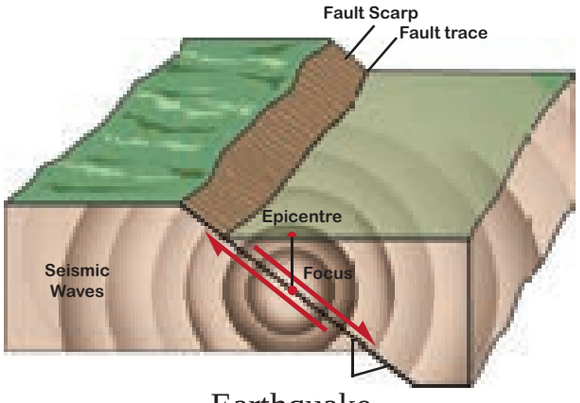
Endogenic forces produce sudden movements and Exogenic forces produce slow movements. Endogenic movements produce earthquakes and volcanoes that cause mass destruction over the surface of the earth.

DO YOU KNOW?

The asthenosphere is the part of the mantle that flows and moves the plates of the earth.

Earthquake

A sudden movement of a portion of the earth's crust which produces a shaking or trembling is known as an earthquake. The point where these vibrations originate is called the focus of the earthquake. The point of the earth's surface directly above the focus is called the epicentre of the earthquake. From the focus, the earthquake vibrations travel in different directions in the form of seismic waves.



Earthquake

The earthquake waves are recorded by an instrument known as seismograph. The magnitude of an earthquake is measured by the Richter scale. The numbers on this scale range from 0 to 9.

Causes of Earthquake

The chief cause of earthquake is the sudden slipping of the portion of the earth's crust along fractures or faults. The movement of the molten rocks underneath the surface produce strains which break the rocks apart. The sudden shifting of landmass causes upheavals in the crust of the earth sending vibrations or waves into the surrounding portions of the earth. Sometimes the surface of the earth itself cracks.

Effects of Earthquakes

Earthquakes may cause changes in the earth's surface. Vibrations often set landslides in mountainous regions. A greater danger in an earthquake is the falling of buildings. Most of the houses which collapsed were made of mud and bricks and proved to be death traps. Underground water system is naturally disturbed by such movements. Fire is another great danger.

There are three types of earthquake waves:
P waves or longitudinal waves
S waves or transverse waves
L waves or surface waves

An earthquake which originates below or near the sea causes great disturbance in the water. The floods and waves cause great loss of life, sometimes more than the earthquake

itself. Tsunami, a Japanese term, is the name given to the huge waves caused in the sea by an earthquake. Tsunamis are quite common along the coasts of Japan and other regions in the Pacific Ocean.

DO YOU KNOW?

On 26th December 2004, Tsunami in the Indian Ocean swept coastal area of Indonesia, India, Srilanka, Thailand etc., They caused immense damage to life and property in the coastal area

Distribution of Earthquakes

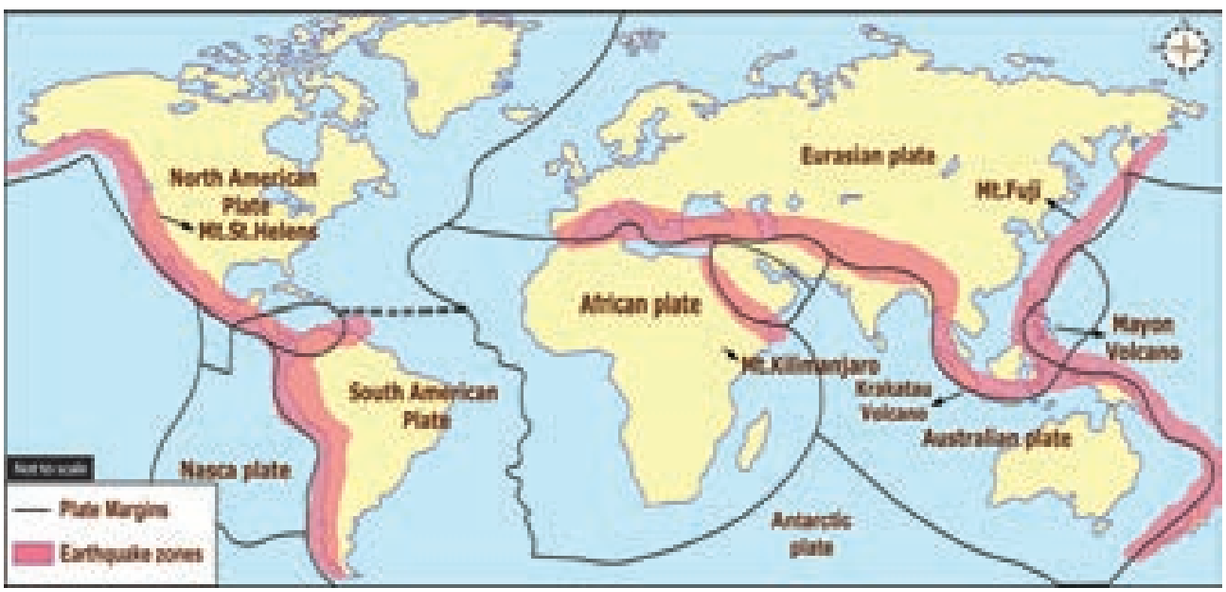
The world's distribution of earthquakes coincide very closely with that of volcanoes. Regions of greatest seismicity are circum-Pacific areas, with the epicenters and the most frequent occurrences along the Pacific Ring of Fire. It is said that about 68 % of earthquakes occur in this belt. Remaining 31 % of earthquakes take place in the Mediterranean-Himalayan belt including Asia Minor, the Himalayas and parts of north-west China. The remaining percent of earthquakes occur in Northen Africa and Rift valley areas of the Red sea and Dead sea.

In India, the Himalayan region and the Ganga-Brahamaputra valley are prone to earthquakes. A number of earthquakes have been experienced in this region. Some of them were very severe and caused extensive damage, e.g., the earthquake of Uttar Kashi in 1991 and Chamoli in 1999. The Deccan Plateau, which was supposed to be comparatively free from the dangers of the earthquakes, has experienced two severe earthquakes in the past, the Koyna (Maharashtra) earthquake in 1967 and the Latur earthquake in 1993.

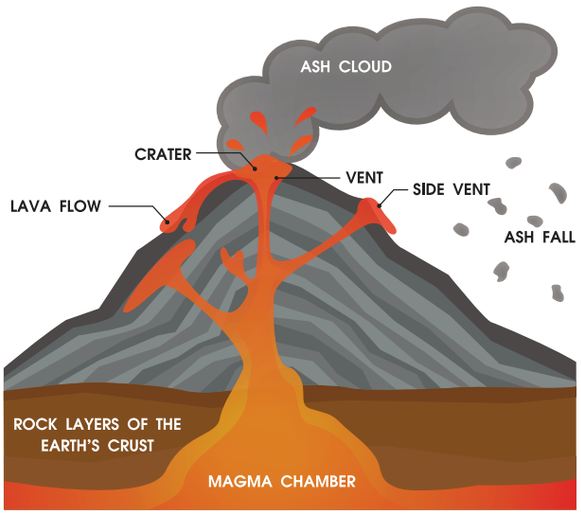
Volcanoes

A volcano is a vent or an opening in the earth's crust through which hot magma erupts from deep below the surface. The opening is usually circular in form. Volcanic eruptions may also take place through a long crack or fissure through which steam and other materials flow out.

The molten rock material within the earth, together with gases, is called magma. After it rises to the surface, it is called as lava.



Distribution of Earthquakes



Volcano

In course of time, lava and other materials flow out of a volcano accumulate around the opening and form a conical hill or a mountain vent is an openning or mouth of a volcano. The top of this cone is usually marked by a funnel-shaped depression, which is called a *crater*. If the crater of a volcano is of great size and is shaped like a basin, it is called a *caldera*. Calderas are caused by violent explosions which blow away entire tops of great cones.

Causes of Volcanic Activity

The temperature increases as the depth increases at the rate of 1°C for every 32 metres. There is also great pressure. At a depth of about 15 km the pressure is about 5 tonnes per cm^2 of rock. Under these circumstances, the interior of the earth is in a semi-molten state called magma. The magma, under great pressure has the capacity to dissolve great volume of gas; some gases are also combustible. This makes volcanic material burst forth through the weak spots in the earth's crust.

The scientific study of valcanoes are called **volcanology**.

People who study valcanoes are called **volcanologists**.

Nature of volcanic eruptions

Sometimes, magma rises slowly to the surface and spreads over a vast area. This is known as fissure eruption. Some plateaus and plains have been formed in this way, e.g., Deccan Plateau in India and the Colombian Plateau in North America. If the magma rises quickly to the surface, lava is thrown high into the atmosphere. Besides lava, ash, steam, gases and pieces of rocks are also thrown out. This type of eruption is known as explosive eruption. The terrible explosion on 27th August 1883 in the island of Krakatoa, Indonesia is an example for explosive type of eruption.

The viscosity of lava is determined by the amount of silica and water in magma. Highly viscosity lava is rich in silica and has little water. Low viscosity lava has little silica, but a lot of water. It moves rapidly forming smooth flows.

DO YOU KNOW?

Barren island is situated in the Andaman Sea, and lies about 138 km northeast of the territory's capital. It is only in active volcano along the chain from sumatra to myanmar. Last eruption occurred in 2017.

Types of Volcanoes

Volcanoes are classified according to their periodicity of eruptions and the state of activity such as

1. Active Valcano
2. Dormant Valcano
3. Extinct Valcano

1. Active Valcano

Valcanoes that erupt frequently are called active volcanoes. Most of the active volcanoes lie in the Pacific Ring of Fire belt which lies along the Pacific coast. There are about 600 active

volcanoes in the world, such as Mt. Stromboli in Mediterranean Sea, St.Helens in USA, Pinatubo in Philippines. Mauna Loa in Hawaii is the world's biggest active volcano.

DO YOU KNOW?

Stramboli is known as the 'light house of Mediterranean sea'

2. Dormant Valcano

These volcanoes have shown no sign of activity for many years but they may become active at any time. These are called Sleeping Volcanoes. Vesuvius mountain of Italy, Mt Fujiyama of Japan, Mt. Krakatoa of Indonesia are famous examples of this types.

3. Extinct volcano

A Volcano has not erupted in past 1000 years is often listed as Extinct volcanoes. The top of extinct volcanic mountains have been eroded. Mt Popa of Myanmar and Mt. Kilimanjaro and Mt. Kenya of Africa are examples of extinct volcanoes.

Distribution of Volcanoes in the world

Volcanoes are located in a clearly-defined pattern around the world. They are closely related to regions that have been intensely folded or faulted. There are about 600 active volcanoes and thousands of dormant and extinct ones. They occur along the coastal mountain ranges, as off-shore islands and in the midst of oceans, but there are a few in the interior of continents. The volcanic belts are also the principal earthquake belts of the world. There are three major zones of volcanic activities in the world. They are:

1. The Circum – Pacific belt
2. The Mid continental belt
3. The Mid Atlantic belt

1. Circum Pacific Belt

This is the volcanic zone of the convergent oceanic plate boundary. It includes the volcanoes of the eastern and western coastal areas of Pacific Ocean. This zone is popularly termed as the Pacific Ring of Fire which has been estimated to include two-thirds of the world's volcanoes.

Pacific Ring of Fire

2. Mid continental belt

This is the volcanic zone of convergent continental plate boundaries that includes the volcanoes of *Alpine mountain chains*, the *Mediterranean Sea and the fault zone of eastern Africa*. The important volcanoes are Vesuvius, Stromboli, Etna, Kilimanjaro and Kenya. Surprisingly, the Himalayas have no active volcanoes at all.

3. Mid Atlantic Belt

This belt represents the divergent boundary of plates located along the mid-Atlantic ridges. Volcanoes of this area are mainly of fissure eruption type. Iceland is the most active volcanic area and is located on the mid-Atlantic ridge. St. *Helena* and *Azores* Island are other examples.

Summary

- The Earth's interior structure is compared with that of an apple
- The crust is the outer-most layer of the earth.
- The upper part of the earth crust is SIAL.
- The lower part of the earth crust is SIMA.
- The mantle is about 2900km thick.
- The lithosphere is broken into a number of plates known as the lithospheric plates
- The earthquake waves are recorded by an instrument known as seismograph.
- Tsunami is caused by an underwater earthquake.
- A Volcano is vent or opening in the earth crust through which magma comes out.
- The Shape of a volcano depends on the type of lava and force of the eruption.
- There are three major zone of volcanic activity in the world.

Glossary		
Core	The inner most layer of the earth	கருவம்
Mantle	The second layer beneath the crust	கவசம்
Mohorovicic discontinuity	Boundary that separated the mantle from the crust	மோஹோரோவிசிக் எல்லை
Land slide	Downward movements of rock debris of the mountain	நிலச்சரிவு
Seismograph	Instrument to measures the magnitude of an earthquake	சீஸ்மோகிராப்
Tsunami	Sea waves caused by an underwater earthquake or a volcanic eruption under sea.	ஆழிப்பேரலை
Vent	An opening a the earth surface from which volcanic material is emitted	எரிமலைவாய்
Magma	The molten state of rocks	பாறைக்குழம்பு
Lava	The solidified form of magma after it reaches the surface of the earth	எரிமலைக்குழம்பு

Evaluation

I. Choose the correct answer

1. Nife is made up of _____ .
   a) Nickel and ferrous
   b) Silica and aluminum
   c) Silica and magnesium
   d) Iron and magnesium

2. Earthquake and volcanic eruption occur near the edges of _____.
   a) Mountain b) Plains
   c) Plates d) Plateaus

3. The magnitude of an earthquake is measured by _____.
   a) Seismograph b) Richter scale
   c) Ammeter d) Rotameter

4. The narrow pipe through which magma flow out is called a _____.
   a) Vent b) Crater
   c) Focus d) Caldera

5. _____ Volcano is known as light house of Mediterranean Sea.
   a) Stromboli b) Krakota
   c) Fujiyama d) Kilimanjaro

6. _____ belt is known as the "Ring of Fire".
   a) Circum - Pacific b) Mid-Atlantic
   c) Mid - Continental d) Antarctic

II. Fill in the blanks

1. The core is separated from the mantle by a boundary called _____.
2. The earthquake waves are recorded by an instrument known as _____.
3. Magma rises to the surface and spreads over a vast area is known as _____.
4. An example for active volcano is _____.
5. Seismology is the study of _____.

III. Circle the odd one

1. crust, magma, core, mantle
2. focus, epicenter, vent, seismic waves
3. Uttar Kashi, Chamoli, Koyna, Krakatoa
4. lava, caldera, silica, crater
5. Stromboli, Helens, Hawaii, Fujiyama

IV. Match the following

1.	Earth quake	-	Japanese term
2.	Sima	-	Africa
3.	Pacific Ring of Fire	-	Sudden movement
4.	Tsunami	-	Silica and magnesium
5.	Mt. Kenya	-	World volcanoes

V. Consider the following statement and (✓) Tick the appropriate answer

1. **Assertion (A):** There structure of the earth may be compared to that of anApple.
   Reason (R): The interior of the earth consists of crust, mantle and core.
   a) A and R are correct and R explains A
   b) A and R are correct but R does not explain A
   c) A is incorrect but R is correct
   d) Both A and R are incorrect

2. **Assertion (A):** The Pacific Ocean includes two thirds of the world's volcanoes.
   Reason (R): The boundary along the Eastern and Western coast areas of the Pacific Ocean is known as the Pacific Ring of Fire.
   a) A and R are correct and R explains A
   b) A and R are correct but R does not explain A
   c) A is incorrect but R is correct
   d) Both A and R are incorrect

VI. Answer in a word

1. Name the outer most layer of the earth.
2. What is SIAL?
3. Name the movement of the Earth's lithospheric plates?
4. Give an example of extinct volcano.

VII. Answer the following briefly

1. What is mantle?
2. Write note on the core of the earth?
3. Define Earthquake.
4. What is Seismograph?
5. What is a volcano?
6. Name the three types of volcanoes based on periodicity of eruption.

VIII. Give reason

1. No one has been able to take samples from the interior of the earth
2. The Continental crust is less dense than the oceanic crust

IX. Distinguish between

1. SIAL and SIMA
2. Active volcano and dormant volcano

X. Answer the following in detail

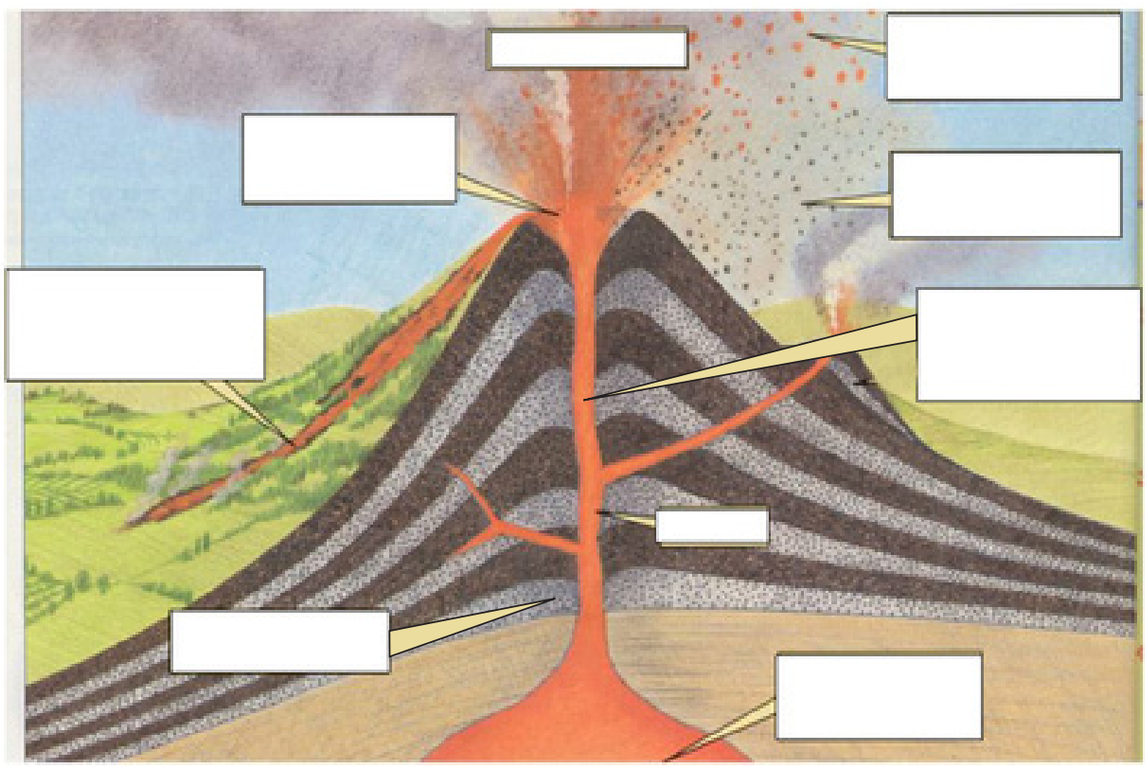
1. Write about the effects of an earthquake?
2. Describe the classification of volcanoes based on the eruptions.
3. Name the major zones of volcanic activity and explain any one.

XI. HOTs

1. The earth's interior is very hot. Why?
2. Are Volcones Destructive (or) Constructive?
3. How does volcaone make an Island?

XII. Activity

1. Prepare an album on earthquake and volcanoes.
2. Label the parts of volcano.



3. On an outline map of the world, mark the Pacific Ring of Fire

Reference Books

1. Majid Husain, *Physical Geography,* Anmol Publication Pvt Ltd
2. A Das Gupta, A.N. Kapoor, *Principles of Physical Geography*, S. Chand & Company Ltd., New Delhi
3. Goh Cheng Leong, *certificate Physical and Human Geography*, Oxford University press.
4. Savindra Singh (2015) *physical Geography,* Pravalika publications Allahabad.

ICT CORNER

Interior of the Earth

select full screen mode and play the game with descriptions

PROCEDURE

Step 1: Open the Browser and type the URL given below (or) Scan the QR Code.

Step 2: Click on the Map to start

Step 3: select full screen mode and play the game with descriptions

Interior of the Earth URL:

http://world-geography-games.com/earth/index.html