



Key Terms

continental drift : the slow movement of continents towards and away from each other
 crater : a large hole at the top of a volcano
 epicentre : the point of the Earth's surface directly above the focus
 fissure : a long deep crack in the rock or in the Earth

focus : the point where the earthquake originates
 landforms : natural forms on the Earth's surface
 Pangaea : original structure of the continents
 seismic waves : the vibrations caused by earthquakes
 seismograph : an instrument that measures earthquakes

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The landforms that we see today have been modified gradually but continuously by external forces such as heat and cold, running water, moving ice, wind waves and even plants and animals.

In the words of famous geologist J Tuzo Wilson, "The earth, instead of appearing as an inert statue, is a living mobile thing." This clearly tells us that the nature of our Earth is dynamic. Since the time it came into being it is undergoing several changes. For thousands of years, people believed that the continents were fixed in their positions. The distribution of land and water, however, has not always been the same on the Earth's surface, as it is today.

Today we observe millions of geological changes on the face of the Earth. To explain the current position of the continents and the oceans, several scientists put forth different theories.

The foremost attempt was made by Alfred Wegener in 1912. He was a German meteorologist. He tried to explain the present division of the continents and the oceans. According to his theory, a supercontinent called Pangaea broke into different continents 200 million years ago and the continents drifted to their present locations. This theory is called the Continental Drift theory. This theory was improved

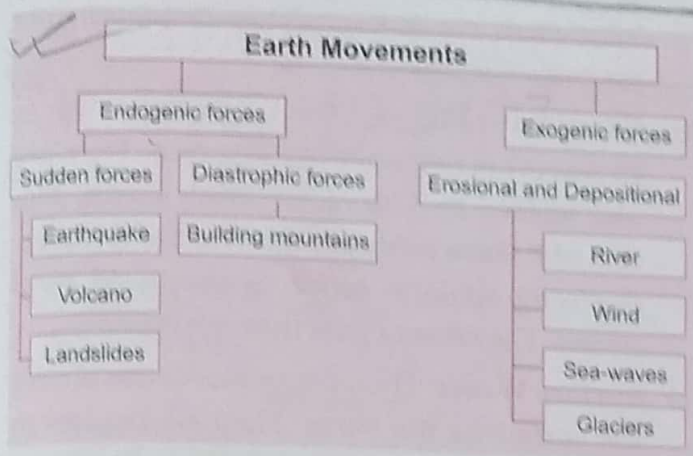


Continental Drift

by the theory of 'Plate Tectonics' which was put forth in 1968. According to it, the outer layer of the Earth is made up of rock plates known as lithospheric or tectonic plates. These plates move extremely slow and each year they move about a few millimetres.

Various changes on the surface of the Earth are caused by the movements of lithospheric plates.

Movements of the plates occur due to the various forces acting upon it. Two broad categories of these forces are endogenic and exogenic. Endogenic forces act in the interior of the Earth. Exogenic forces work on the surface of the Earth.



Evolution Of Landforms

✓ Endogenic forces produce slow as well as sudden movements like earthquakes and volcanoes which cause mass destruction over the surface of the Earth. Horizontal and vertical movements are also produced by them, which result in variety of relief features like mountain building.

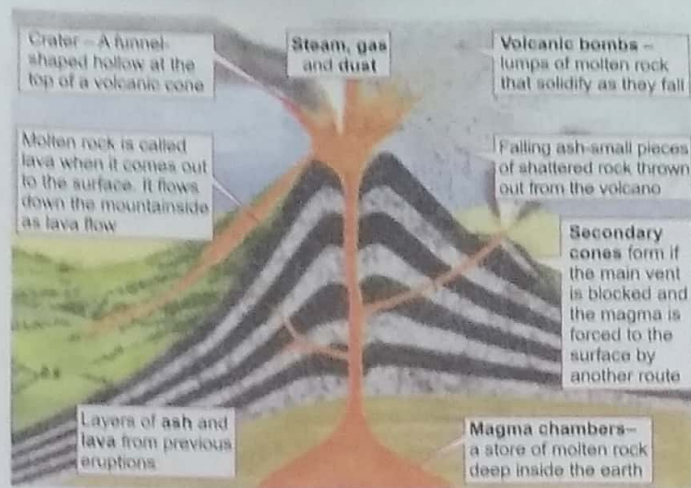
✓ Erosional and depositional works are done by exogenic forces like rivers, wind, glaciers and sea waves.

VOLCANOES

Volcanoes can be simply defined as an opening in the Earth's crust through which molten material comes out from the interior of the Earth. This material consists of lava, ash, hot molten rocks, steam, gas and solid rock particles. The opening of the volcano is called a vent. A conical mountain may be formed around it. Crater of the volcano is a funnel-shaped basin surrounding the vent.

✓ On the basis of nature and frequency of eruptions, volcanoes are classified into three types :

- ✓ 1. Active Volcanoes
- ✓ 2. Dormant Volcanoes
- ✓ 3. Extinct Volcanoes



Components Of Volcano

Active Volcanoes

Active volcanoes are also termed as living volcanoes. They erupt frequently and hurl out gases, ashes, lava and rocks. A belt of such active volcanoes are found around the Pacific Ocean and is called the Ring of Fire. Some famous active volcanoes are Mt Etna in Italy and Barren Island in the Andaman Sea (India).

Dormant Volcanoes

Dormant volcanoes are those volcanoes which have not erupted from a long period. They are also termed as sleeping volcanoes. Mt Vesuvius in Italy is a dormant volcano. Dormant volcanoes become destructive when they come to life.

Extinct Volcanoes

Extinct volcanoes are inactive and therefore, called dead volcanoes. Kilimanjaro in Africa and Rainier in the USA are examples of extinct volcanoes. Calderas are lakes which are formed from extinct volcanoes. However, volcanoes cannot be addressed as extinct with complete certainty.

Distribution Of Volcanoes

Most of the world's active and dormant volcanoes are located in two distinct belts.

- (a) The Circum-Pacific Belt : It encircles the Pacific Ocean. It is also known as 'Pacific Ring of Fire.' Most of the volcanoes are located in the Andes of South America and the Rockies of North America.

(b) **The Mid-World Mountain Belt** : It consists of the extinct and dormant volcanoes that lie along the Mediterranean Sea.

Multiple Choice Questions (Quick Revision)

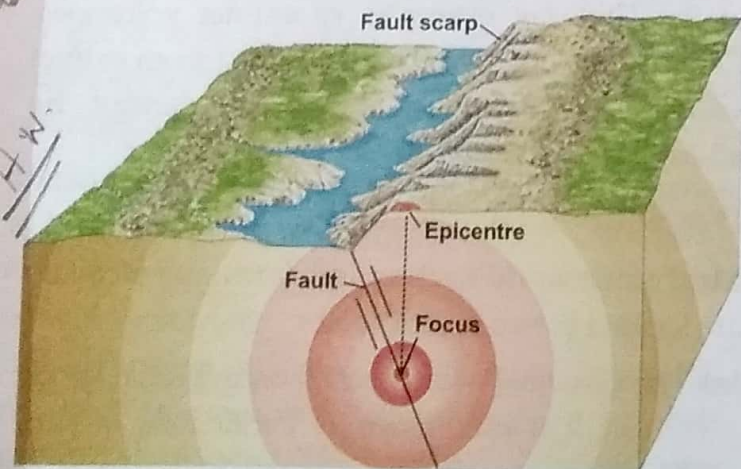
Tick (✓) the correct options.

- Which force acts in the interior of the earth?
 - (a) endogenic force
 - (b) exogenic force (c) none of these
- Mt.....is a dormant volcano.
 - (a) Etna (b) Vesuvius
 - (c) Kilimanjaro

EARTHQUAKES

The sudden shaking of the Earth caused by internal forces of the Earth is called the earthquake. It originates from the interior of the Earth and the **point of origin is called the focus**. The point on the surface of the Earth, exactly above the focus, is called the **epicentre**. The earthquakes send **shock waves** all around and cause widespread destruction to life and property.

The **vibrations of an earthquake** spread out as concentric waves from the focus. These vibrations are called **seismic waves**. The intensity of the earthquake is maximum near its epicentre. The surface of the Earth can shake due to movements of the lithospheric plates, volcanic eruptions or even bomb explosions.



Origin Of Earthquake

KINDS OF EARTHQUAKE WAVES

- Primary Waves:** The fastest and foremost waves are primary waves (P waves), which are also called push waves. These waves generally travel at a speed of about 6 kilometres per second. Small displacements are caused by these waves.
- Secondary Waves:** The secondary waves (S waves) arrive after the P waves. They are also termed as S waves or shock waves. The **rate of P wave is higher than that of S waves**. A strong shaking action is produced by S waves. They do not pass through liquids.
- Surface Waves:** The surface waves travel over the surface of the Earth. They are the last to arrive. Most of the damage is caused by these waves, as they are very powerful. Their effect is not observed at great depths.

How To Measure Earthquakes

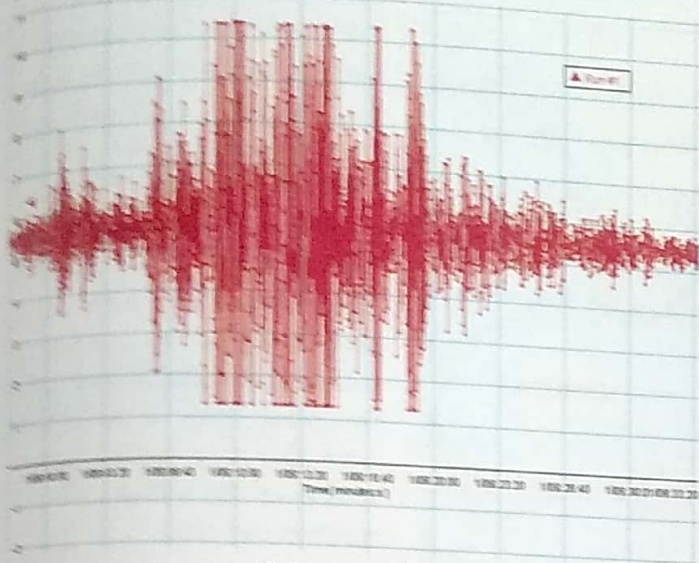
The science that deals with earthquakes is called **seismology**, and the earthquake scientists are called **seismologists**. They are experts who study the pattern of the earthquakes.



Richter Scale Seismograph

Seismograph is the instrument which records the **intensity of the earthquake waves**. American seismologist Charles Richter designed the 'Richter scale.' It was invented in 1935. The Richter scale has the **range of 0 to 9**. The Richter scale clearly states that the force of the earthquake is ten times greater than that of the previous one if there is an increase

of one point. All the earthquakes that measure six and above are termed as destructive.



Seismograph

According to an estimate, one million earthquakes are recorded every year.

In India, we have experienced many earthquakes in the Himalayan region. The Deccan plateau was considered relatively safe from earthquakes as it had experienced some earthquakes of low intensity only. Yet, it later experienced a major earthquake in 1993.



Major Earthquakes In India

Given below is a list of some destructive earthquakes that have rocked India :

- ✓ • 1991 – Uttarkashi (Uttarakhand) ✓
- ✓ • 1993 – Latur (Maharashtra) ✓
- ✓ • 1997 – Jabalpur (Madhya Pradesh) ✓
- ✓ • 1999 – Chamoli (Uttarakhand) ✓
- ✓ • 2001 – Bhuj (Gujarat) ✓
- ✓ • 2005 – Jammu and Kashmir ✓

Multiple Choice Questions (Quick Revision)

Tick (✓) the correct options.

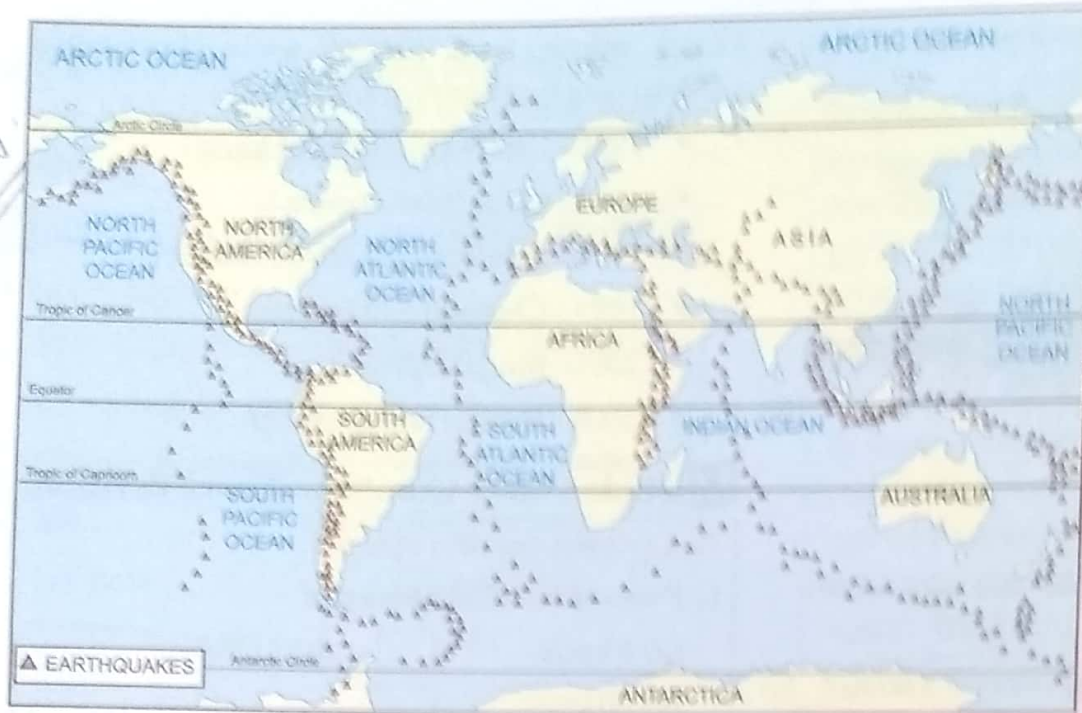
1. P waves travel at a speed of
 - (a) 6 km/s
 - (b) 8 km/s
 - (c) 20 km/s
2. The experts who study the pattern of the earthquakes are called
 - (a) scientists
 - (b) seismologists
 - (c) artists

Distribution Of Earthquakes

Earthquakes frequently occur in different parts of the world. However, they occur more frequently in some specific areas. Three major belts of earthquake prone regions are as follows :

- (a) **Circum-Pacific Belt:** This belt consists of East Asia, South America and the coastal margins of North America. 65 per cent of the total earthquakes of the world occur in this belt. It also coincides with the 'Pacific Ring of Fire'.
- (b) **Mid-Continental Belt:** It includes northern and eastern Africa, Alpine Mountains, Himalayas and the Mediterranean Sea. 25 per cent of the seismic events occur in this belt.
- (c) **Mid-Atlantic Ridge Belt:** This particular belt includes Mid-Atlantic Ridge and the adjoining islands. Moderate earthquakes are recorded over here. These are caused due to the moving of lithospheric plates in the opposite direction.

★ Amaravati is the capital city of the Indian state of Andhra Pradesh. The foundation stone of the city was laid at Uddandarayunipalem village of Guntur district by Prime Minister Narendra Modi in October 2015.



Global— Distribution Of Earthquake Belts

In India, the earthquake belt is mainly confined to the Ganga-Brahmaputra Valley and the Himalayan region. About two-third of the area in India is prone to earthquakes.

CASE STUDY—BHUJ EARTHQUAKE 2001

A powerful earthquake of magnitude about 7.7 on Richter scale rocked the western Indian state of Gujarat on 26 January, 2001. It caused extensive damage to life and property. This earthquake was so devastating in its scale and suffering that the likes of it had not been experienced in the past 50 years.

The epicentre of the earthquake was located at 23.6° north latitude and 69.8° east longitude, about 20 km north-east of Bhuj town of the Kutchh district in western Gujarat. At a depth of only 23 km below surface, this earthquake generated intense shaking which was felt in 70 per cent of India and far beyond in neighbouring Pakistan and Nepal.



Bhuj Earthquake

Other urban areas such as Gandhidham, Morvi, Rajkot and Jamnagar also suffered damages to major structures. Ahmedabad, the largest city of Gujarat, was also severely affected.

Gujarat earthquake is very significant from the point of view of earthquake disaster mitigation in India. The problems observed in this disaster are no different from other major recent earthquakes in the world.

Points To Remember

- The theory of continental drift given by Alfred Wegener is about the positioning of continents and oceans.
- The forces which act in the interior of the Earth are called endogenic force.
- The forces which work on the surface of the Earth are called exogenic forces.
- Volcanoes are openings in the Earth's crust through which material comes out from the interior of the Earth.
- Volcanoes are of three types—active, dormant and extinct.

21 of the total 25 districts of the state were affected by this earthquake. Around 18 towns, 182 talukas and 7,904 villages in the affected district saw large scale devastation. The affected areas spread up to even 300 km from the epicentre. More than 30,000 people died and 150,000 were injured. In the Kutchh district four major urban areas Bhuj, Anjar, Bachau and Ropar, suffered near total destruction. The rural areas in the region were also very badly affected with over 450 villages almost totally destroyed.

- Active volcanoes are living volcanoes and erupt frequently.
- Dormant volcanoes have not erupted from a very long period of time.
- Extinct volcanoes are dead and inactive.
- Earthquake is the sudden shaking of the Earth's crust.
- Richter scale is used to measure the intensity of an earthquake wave.
- The main earthquake belts are Circum-Pacific, Mid-Continental Belt and Mid-Atlantic Belt.

Exercise

Quick Revision

Use **Cordova Smart Class Software** on the smart board in class to do these exercises.

A. Multiple Choice Questions (MCQs)– Tick (✓) the correct options.

- It is an active volcano.

| | | |
|--------------------------------------|--|--|
| (a) Mt Etna <input type="checkbox"/> | (b) Mt Vesuvius <input type="checkbox"/> | (c) Crater Lake <input type="checkbox"/> |
|--------------------------------------|--|--|
- Richter Scale, the instrument that measures the intensity of an earthquake, was invented by

| | | |
|--|---|--|
| (a) Charles Richter <input type="checkbox"/> | (b) Thomas Richter <input type="checkbox"/> | (c) Bobby Richter <input type="checkbox"/> |
|--|---|--|

B. Fill in the blanks.

- Millions of years ago, there were no continents but a supercontinent called
- A belt of active volcanoes around the Pacific Ocean is called the
- Kilimanjaro in Africa and Rainier in USA are volcanoes.
- was considered as a safe zone against the earthquakes in India.

C. Match the following.

- | | |
|----------------------------------|-----------------------------|
| 1. Extinct and dormant volcanoes | (a) Primary waves |
| 2. Extinct Volcano | (b) Ring of Fire |
| 3. Circum-Pacific Belt | (c) Kilimanjaro |
| 4. P Waves | (d) Mid-World Mountain Belt |

Answer The Following

A. Multiple Choice Questions (MCQs)– Tick (✓) the correct options.

- He proposed the Theory of Continental Drift.

| | | |
|---|--|--|
| (a) Alfred Wegener <input type="checkbox"/> | (b) Charles Richter <input type="checkbox"/> | (c) None of these <input type="checkbox"/> |
|---|--|--|
- The place of origin of an earthquake is called

| | | |
|--|------------------------------------|------------------------------------|
| (a) epicentre <input type="checkbox"/> | (b) focus <input type="checkbox"/> | (c) waves <input type="checkbox"/> |
|--|------------------------------------|------------------------------------|

B. Short Answer Questions

- What is an active volcano?
- Distinguish between extinct and dormant volcanoes.
- What are the different types of waves?
- List some of the most destructive earthquakes in India.

C. Long Answer Questions

1. What are volcanoes? What are the different types of volcanoes? Give examples of each.
2. Define earthquake. Discuss the main earthquake belts on the earth.
3. Write a short note on the Theory of Continental Drift.
4. Describe the process of measuring earthquake.

D. HOTS (Higher Order Thinking Skills) Questions

1. Do you think that the continents are drifting away from one another? Give reasons to support your answer.
2. Is there adequate awareness among people of India about the natural calamities, like earthquake and tsunami?

E. Value Corner

Our Earth is changing drastically. Do you think, the changes which are taking place are bad? How?

Activity

- Collect information about different types of volcanoes. Categorise them into active, dormant and extinct volcanoes. Prepare a presentation on it and discuss in your class.
- **To make an Erupting Volcano**
 - ❖ **Materials required:**

| | | |
|-----------------------------|----------------------------|-----------------|
| (a) dough or modelling clay | (b) a small plastic bottle | (c) paint |
| (d) warm soapy water | (e) red food colouring | (f) baking soda |
| (g) vinegar | | |
 - ❖ **Procedure :** Mix 6 cups of flour (*atta*), 2 cups of salt, 4 tablespoons of cooking oil and 2 cups of warm water together. Knead all the ingredients into a dough. Wrap the dough around the plastic bottle in the shape of a mountain. Now, fill the bottle with warm soapy water. Add some red colour to the water. Add 2 tablespoons of baking soda also. Now, slowly add vinegar to the bottle. The soapy water will bubble and froth and pour out of the bottle onto the sides of the bottle, like lava pours out of a volcano. This is because carbon dioxide is evolved when you mix vinegar and baking soda together. It causes lava to bubble during a volcanic eruption.

Surfing is Interesting

To know more about earthquakes and volcanoes, visit:

http://www.globalchange.umich.edu/globalchange1/current/lectures/nat_hazards/nat_hazards.html

Life Skill

In case you feel an earthquake suddenly, what will you do? Tick (✓) the correct options.

1. Keep silent and wait for confirmation.
2. Create havoc among people.
3. Inform others about it.
4. Co-operate with disaster management team.

POLITICAL MAP OF INDIA

(as created on October 31, 2019)

