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# Evolution of Landforms

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The lithosphere is divided into several large and small rigid plates called lithospheric plates. These plates move slowly, a few millimetres per year, due to the circular movement of molten magma inside the Earth. This movement causes changes on the Earth's surface known as Earth movements.

Earth movements are classified based on the forces causing them:

## Endogenic Forces

Endogenic forces originate from within the Earth and cause changes such as earthquakes, volcanoes, and mountain building. They can be sudden or slow.

### Sudden Endogenic Forces

These include:

- **Earthquakes:** Sudden shaking of the Earth's surface caused by underground rock movements.
- **Volcanoes:** Openings in the Earth's crust through which molten rock, ash, and gases erupt.
- **Landslides:** Rapid downward movement of soil and rocks due to gravity.

### Diastrophic Forces

These are slow movements that cause folding, faulting, and elevation of the Earth's crust, leading to mountain formation.

### Exogenic Forces

Exogenic forces act on the Earth's surface and include weathering, erosion, and deposition. They wear down landforms and redistribute materials.

Agents of exogenic forces include:

- **Rivers:** Erode and deposit sediments, shaping valleys and plains.
- **Wind:** Transports fine particles, shaping deserts and dunes.
- **Sea Waves:** Erode coastlines and form coastal landforms.
- **Glaciers:** Slow-moving ice masses that carve valleys and deposit moraines.

**Activity:** Observe the movement of a coloured paper pellet in heated water to understand magma convection currents inside the Earth.

## Exam Questions

**Q1:** What are endogenic forces? Give two examples.

**Answer:** Endogenic forces are forces originating inside the Earth that cause movements such as earthquakes and volcanoes.

**Q2:** How do exogenic forces affect the Earth's surface?

**Answer:** Exogenic forces wear down landforms through weathering, erosion, and deposition, reshaping the Earth's surface.

## Earthquakes

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Earthquakes are sudden vibrations of the Earth's surface caused by movements of lithospheric plates. The point inside the Earth where the movement starts is called the **focus**, and the point on the surface directly above it is the **epicentre**. Seismic waves radiate outward from the focus, causing shaking.

Earthquakes often occur near plate boundaries where plates collide, slide, or move apart.

## Seismic Waves

There are three types of earthquake waves:

- **P waves (Primary waves):** Longitudinal waves that travel fastest.
- **S waves (Secondary waves):** Transverse waves that arrive after P waves.
- **L waves (Surface waves):** Travel along the Earth's surface causing most damage.

## Measuring Earthquakes

Earthquake strength is measured by a seismograph and expressed on the Richter scale. Magnitude below 2.0 is barely felt; above 6.0 is strong and can cause damage.

## Case Study: Bhuj Earthquake 2001

On January 26, 2001, a 6.9 magnitude earthquake struck Bhuj, Gujarat, causing massive destruction, loss of lives, and disruption of infrastructure. Relief efforts faced challenges due to damaged communication and fires.

## Earthquake Preparedness

Safe spots during an earthquake include under sturdy furniture or against inside walls. Avoid fireplaces, windows, and chimneys. Awareness and preparedness can reduce damage and save lives.

## Exam Questions

**Q1:** Define focus and epicentre.

**Answer:** The focus is the underground point where an earthquake starts; the epicentre is the surface point directly above the focus.

**Q2:** What safety measures should be taken during an earthquake?

**Answer:** Take shelter under tables or against inside walls, stay away from windows and chimneys, and be prepared through awareness.

## Volcanoes

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A volcano is an opening in the Earth's crust through which molten rock (magma), gases, and ash erupt. Magma originates in the mantle and collects in a magma chamber before rising through a vent to the surface.

Key parts of a volcano include:

- **Crater:** The opening at the top where eruptions occur.
- **Vent:** The passage through which magma travels.
- **Magma Chamber:** Underground pool of molten rock.
- **Crust and Mantle:** Layers of the Earth through which magma moves.

## Exam Questions

**Q1:** What causes volcanic eruptions?

**Answer:** Pressure builds up in the magma chamber causing magma to rise through vents and erupt at the surface.

**Q2:** Name the main parts of a volcano.

**Answer:** Crater, vent, magma chamber, crust, and mantle.

## Major Landforms

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Landforms are shaped by weathering, erosion, and deposition. Weathering breaks rocks; erosion wears away the landscape; deposition lays down sediments forming new landforms.

## Work of Rivers

Rivers erode land and create features such as:

- **Waterfalls:** Formed where hard rock overlays softer rock that erodes faster.
- **Meanders:** Large bends formed by erosion and deposition.
- **Ox-bow Lakes:** Formed when meander loops are cut off.
- **Floodplains:** Flat fertile land formed by sediment deposition during floods.
- **Levees:** Raised banks formed by sediment deposits.
- **Deltas:** Landforms at river mouths formed by sediment deposition as rivers slow down.

## Work of Sea Waves

Sea waves erode coastlines creating:

- **Sea Caves:** Hollowed out areas in cliffs.
- **Sea Arches:** Formed when caves on opposite sides meet.
- **Stacks:** Isolated rock columns after arch collapse.
- **Sea Cliffs:** Steep rocky coasts.
- **Beaches:** Formed by sediment deposition.

## Work of Glaciers

Glaciers are slow-moving ice masses that erode land by bulldozing soil and rocks, carving valleys, and depositing moraines. Meltwater fills hollows forming lakes.

## Work of Wind

Wind shapes deserts by moving sand to form sand dunes and mushroom rocks. Fine sand carried over long distances forms loess deposits.

## Exam Questions

**Q1:** How is a waterfall formed?

**Answer:** Waterfalls form where hard rock overlays softer rock that erodes faster, causing water to fall vertically.

**Q2:** What are sand dunes?

**Answer:** Sand dunes are hills of sand formed by wind deposition in deserts.

## Solved Examples

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**Example 1:** Explain the difference between endogenic and exogenic forces.

**Solution:** Endogenic forces originate inside the Earth and build landforms (e.g., earthquakes, mountain building). Exogenic forces act on the surface and wear down landforms through weathering and erosion.

**Example 2:** Describe how an ox-bow lake is formed.

**Solution:** Meanders in a river become exaggerated by erosion and deposition. Eventually, the river cuts through the narrow neck of a meander, isolating the loop and forming an ox-bow lake.

## Practice Set

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Easy

- What is the focus of an earthquake?
- Define a volcano.

## Moderate

- Explain how sea arches are formed.
- Describe the formation of a delta.

## Challenging

- Discuss the role of glaciers in shaping landforms.
- Explain the causes and effects of the Bhuj earthquake.

## Answer Key

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- **Focus of an earthquake:** The underground point where the earthquake starts.
- **Volcano:** An opening in the Earth's crust through which magma and gases erupt.
- **Sea arches** form when sea caves on opposite sides of a headland erode and meet, creating an arch.
- **Deltas** form at river mouths where sediment is deposited as the river slows down.
- **Glaciers** erode land by moving ice that bulldozes soil and rocks, carving valleys and depositing moraines.
- The Bhuj earthquake was caused by tectonic plate movement, resulting in massive destruction, loss of life, and disruption of infrastructure.

## Quick Reference

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- **Endogenic forces:** Internal Earth forces causing earthquakes, volcanoes, mountain building.
- **Exogenic forces:** Surface forces causing weathering, erosion, deposition.
- **Focus:** Earthquake origin point underground.
- **Epicentre:** Surface point above focus.

- **Seismograph:** Instrument measuring earthquake vibrations.
- **Waterfall:** Vertical drop of river water over hard rock.
- **Delta:** Sediment landform at river mouth.
- **Glacier:** Slow-moving ice mass shaping land.
- **Sand dunes:** Hills of sand formed by wind.

## Glossary

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### Lithospheric plates

Rigid plates that make up the Earth's crust and carry continents and ocean floors.

### Volcano

An opening in the Earth's crust through which molten rock and gases erupt.

### Earthquake

Sudden shaking of the Earth's surface caused by underground movements.

### Focus

The underground point where an earthquake originates.

### Epicentre

The point on the Earth's surface directly above the focus.

### Seismograph

An instrument that records the vibrations caused by earthquakes.

### Waterfall

A vertical drop of water formed where hard rock overlays softer rock.

### Delta

A landform created by sediment deposition at the mouth of a river.

### Glacier

A large, slow-moving mass of ice that shapes the landscape.

### Sand dunes

Hills of sand formed by wind deposition in deserts.