Chapter 2: Shaping of the Earth's Surface

Questions — Questions and activities

Q1 What are the sources of energy that are required to cause movements associated with the internal forces of the Earth?

SOLUTION

The internal forces of the Earth, also called endogenic forces, are powered by heat energy generated within the Earth itself.

The primary source is the heat from the Earth's core, which is extremely hot and dense. This heat drives convection currents in the mantle — hot molten material rises while cooler material sinks, creating a continuous cycle of movement.

These convection currents in the mantle push and pull the tectonic plates, causing them to move. The movement of tectonic plates is the fundamental mechanism behind internal forces such as earthquakes, volcanic eruptions, folding, and faulting.

In summary, the heat energy stored deep within the Earth — especially from the core — is the ultimate source that drives all movements associated with internal (endogenic) forces.

Answer: The internal forces of the Earth are powered by heat energy from within the Earth, especially from its core. This heat drives convection currents in the mantle, which in turn push and pull the tectonic plates, causing earthquakes, volcanic eruptions, folding, and faulting.

Q2 Relate various physiographic divisions you have studied in the earlier grades with various endogenic forces responsible for their origin.

SOLUTION

India's major physiographic divisions are linked to the endogenic forces described in the chapter.

The Himalayan Mountains were formed by convergent plate movement — when the Indo-Australian Plate collided with the Eurasian Plate, the crust was folded and pushed upward, creating these fold mountains. This is a classic example of an endogenic force (plate collision and folding) producing a major physiographic division.

The Northern Plains were formed partly as a result of the same plate collision — the land between the rising Himalayas and the old Peninsular Plateau became a sedimentary basin, later filled with alluvial deposits brought by rivers. The subsidence of crust in this zone is linked to endogenic movements.

The Peninsular Plateau is composed of ancient hard igneous and metamorphic rocks. It is the exposed part of the old stable landmass (Gondwana). Faulting and rifting (endogenic forces) led to the formation of some features within it, such as rift valleys (for example, the Narmada and Tapi valleys, formed by faulting).

The Coastal Plains and Islands — volcanic activity (an endogenic force) contributed to the formation of the Andaman and Nicobar Islands and the Lakshadweep Islands (of coral origin, linked to submarine volcanic platforms).

In short, folding created the Himalayas; faulting shaped some plateau features and rift valleys; volcanic activity shaped island formations — all driven by endogenic forces.

Answer: The Himalayas were formed by the collision (convergent movement) of the Indo-Australian and Eurasian plates — an endogenic folding force. The Northern Plains occupy a basin formed by crustal subsidence linked to the same collision. The Peninsular Plateau's rift valleys (Narmada, Tapi) were created by faulting. Volcanic activity (endogenic) contributed to island formations. Each major physiographic division is thus tied to a specific endogenic process.

Q3 Why and where do earthquakes occur frequently? Is it possible to predict earthquakes?

SOLUTION

Earthquakes occur when tectonic plates move and the stress built up along plate boundaries is suddenly released as seismic energy. They happen most frequently along plate boundaries — convergent, divergent, and transform boundaries — where plates are in contact and constantly moving.

The area around the Pacific Ocean, known as the 'Ring of Fire', is the most earthquake-prone zone in the world because many major plate boundaries run along it. Transform fault boundaries, such as the San Andreas Fault in the United States, also experience frequent earthquakes. India is also at risk: the Indo-Australian Plate continues to push against the Eurasian Plate, making the Himalayan region seismically active. The Gujarat earthquake of 2001 is a notable example of destructive earthquake activity in India.

As for prediction: currently, scientists cannot precisely predict when and where an earthquake will strike. Instruments can detect early seismic waves (P-waves) seconds to minutes before stronger shaking arrives, allowing short early warnings. However, long-term accurate prediction — giving days or weeks' notice — is not yet scientifically possible. Research continues, but earthquakes remain largely unpredictable.

Answer: Earthquakes occur along plate boundaries where tectonic plates collide, separate, or slide past each other. The Ring of Fire around the Pacific Ocean and the Himalayan belt are major earthquake-prone zones. Precise prediction of earthquakes is not yet possible, though early warning systems can detect the first seismic waves and provide seconds of alert before strong shaking arrives.

Q4 "Plate movements are responsible for the distribution of earthquakes and volcanoes." Explain.

SOLUTION

The statement is accurate and well-supported by plate tectonics theory.

Tectonic plates are constantly moving — colliding, separating, or sliding past each other at plate boundaries. These movements build up enormous stress and heat, which are released as earthquakes and volcanic eruptions.

At convergent boundaries, where two plates move towards each other, the oceanic plate sinks

beneath the continental plate (subduction). This sinking generates intense heat, melting rock into magma, which rises to form volcanoes. The collision also produces powerful earthquakes. The Himalaya formed from continental-plate collision at a convergent boundary.

At divergent boundaries, plates move apart and magma rises from below to fill the gap, forming new crust and creating features like mid-ocean ridges with volcanic activity. The Mid-Atlantic Ridge is a prime example.

At transform boundaries, plates slide past each other, building up friction that is released suddenly as earthquakes. The San Andreas Fault is a classic example.

Because most movement occurs at plate boundaries, earthquakes and volcanoes are concentrated there. The Ring of Fire — encircling the Pacific Ocean — coincides with the edges of the Pacific Plate and related plates, explaining why most of the world's earthquakes and volcanoes are found there.

Answer: Plate movements at convergent, divergent, and transform boundaries release energy as earthquakes and create volcanic activity. At convergent boundaries, subduction melts rock into magma (volcanoes) and causes earthquakes. Divergent boundaries produce volcanic mid-ocean ridges. Transform boundaries generate earthquakes through friction. Because most tectonic activity happens at plate boundaries, earthquakes and volcanoes are concentrated along them — especially around the Pacific Ring of Fire.

Q5 Draw and label a diagram of a meander and a delta.

SOLUTION

Guidance for Meander diagram: Draw a winding S-shaped or C-shaped river bend in the middle course of a river. Label the following parts — (1) Oxbow Lake: a crescent-shaped lake cut off from the main river when a meander is abandoned; (2) Steep Bank (outer bank): the eroded, concave side of each bend; (3) Bar (inner bank): the deposited, convex side where sediment accumulates; (4) River: the main channel flowing through the curves.

Guidance for Delta diagram: Draw the mouth of a river splitting into multiple channels as it meets the sea. The overall shape should be triangular or fan-shaped. Label the following parts — (1) River: the main upstream channel; (2) Distributaries: the smaller branching channels the river splits into as it slows down; (3) Islands/Bars: sediment deposits between distributaries; (4) Sea: the water body into which the river empties.

Both diagrams are based on Figs. 2.11 and 2.12 in the textbook. Draw neatly with arrows showing direction of water flow.

Answer: Guidance — Meander: Draw a winding river bend; label Oxbow Lake, Steep Bank (outer/eroded side), Bar (inner/deposited side), and River. Delta: Draw river splitting into distributaries at its mouth; label River, Distributaries, Islands/Bars, and Sea. Refer to Figs. 2.11 and 2.12 in the textbook for reference shapes.

Q6 How are deforestation and erosion associated with each other? Explain.

SOLUTION

Deforestation and erosion are closely linked: trees and their roots bind the soil together and reduce the speed of rainwater flowing over the surface. When forests are cleared, this protective cover is lost.

Without plant roots to hold the soil, rainwater flows rapidly over the exposed surface, carrying away the topsoil — this is water erosion. Similarly, with no vegetation to break the force of wind, fine soil particles are easily picked up and carried away — this is wind erosion.

The chapter notes that deforestation is one of the human activities that disturbs the natural balance of slopes and contributes to landslides. Sparse vegetation cover, often due to deforestation and overgrazing, also leaves land exposed to dust storms.

For farmers, the loss of fertile topsoil caused by this erosion directly reduces crop yields. Roads, buildings, and riverbanks become unstable. In hilly areas, deforestation accelerates slope failure and landslides.

In short, deforestation removes nature's soil-protection system, making the land far more vulnerable to both water and wind erosion.

Answer: Trees bind soil with their roots and slow surface water flow. When forests are cut, this protection is lost: rain washes away topsoil (water erosion) and wind carries away fine particles (wind erosion). Deforestation thus directly accelerates erosion, leading to loss of fertile land, landslides on slopes, and increased dust storms in arid areas.

Q7 Develop a plan to protect the land in your local area from erosion.

SOLUTION

This is a personal/applied activity. Below is a model plan based on the chapter's concepts.

Step 1 — Identify the type of erosion: Observe whether the main agent is water (heavy rainfall, slope run-off) or wind (dry, exposed land) in your locality.

Step 2 — Plant vegetation: Tree plantation and grass cover are the most effective measures. Roots bind soil and canopy reduces raindrop impact.

Step 3 — Terracing and bunding on slopes: If your area has hilly terrain, construct earthen bunds or terraces along contour lines (as the Zabo system in Nagaland and ancient Indian practices described in the chapter). This slows run-off and holds water.

Step 4 — Check dams on small streams: Build small check dams across seasonal streams to slow water velocity, trap sediment, and allow it to settle rather than washing away.

Step 5 — Reduce overgrazing and improper land use: Encourage rotational grazing and sustainable farming to keep vegetation cover intact.

Step 6 — Awareness: Educate the community about not clearing vegetation on slopes or riverbanks.

Answer: Model plan: (1) Identify whether water or wind is the main erosion agent locally. (2) Plant trees and grass to bind soil. (3) Construct earthen bunds and terraces on slopes along contour lines to slow run-off. (4) Build small check dams on streams to trap sediment. (5) Prevent overgrazing and deforestation. (6) Raise community awareness about sustainable land use. Adapt specific measures to your local terrain and rainfall pattern.

Q8 Which disasters do you think you might experience in your region? Discuss a mitigation plan in your classroom.

SOLUTION

This is a personal and discussion-based activity. Below is a model response for a student in a hilly/Himalayan region such as Uttarakhand, followed by general guidance for other regions.

Model answer (hilly region): The likely disasters are landslides, avalanches, and GLOFs (Glacial Lake Outburst Floods) — all discussed in the chapter. A mitigation plan would include: (a) avoiding construction on steep, unstable slopes; (b) planting trees to stabilise hillsides; (c) monitoring glacial lakes regularly for rising water levels; (d) establishing early-warning systems and evacuation routes for villages in flood-prone valleys; (e) not disturbing slopes through unplanned road construction or mining.

For a student in a desert/semi-arid region (e.g., Rajasthan): Dust storms are the primary hazard. Mitigation: plant shelter-belt trees, use sand fences, adopt drip irrigation to keep soil moist, and follow community early-warning protocols.

Classroom discussion should map the local terrain to the type of disaster and produce a community-specific action plan.

Answer: Model answer: Students in hilly/Himalayan areas may face landslides, avalanches, and GLOFs; those in desert regions may face dust storms; coastal students may face coastal erosion or flooding. A mitigation plan includes identifying vulnerable areas, planting vegetation, avoiding construction on unstable slopes, setting up early-warning systems, and planning evacuation routes. Discuss and adapt to your specific region in class.

Q9 Prepare a model of landforms created by underground water.

SOLUTION

Guidance for the model: Underground water acting on limestone and other soluble rocks creates Karst topography. Your model should show the following landforms from the chapter:

1. Cave: A hollow space inside rock, formed as acidic water dissolves the limestone. Show this as a large chamber underground.
2. Stalactites: Icicle-shaped formations hanging down from the cave ceiling — form as mineral-rich water drips and deposits calcium carbonate over time.
3. Stalagmites: Formations that rise upward from the cave floor, directly below stalactites, built up by the same dripping water.
4. Pillar/Column: Where a stalactite and stalagmite meet and join.
5. Sinkhole (Doline): A circular depression on the ground surface formed when the

underground cavity collapses.

6. Underground river: A stream flowing through the cave system.

Materials you can use: Clay or papier-mâché for the cave structure; toothpicks or twisted paper for stalactites/stalagmites; blue paint/thread for the underground river. Label all parts clearly. Refer to Figs. 2.24 and 2.25 in the textbook.

Answer: Guidance — Build a cross-section model showing a cave with stalactites (hanging from ceiling), stalagmites (rising from floor), a pillar where they meet, a sinkhole (surface depression above a collapsed cavity), and an underground river flowing through the cave. Use clay or papier-mâché; label all parts. Refer to Figs. 2.24 and 2.25 in the textbook for the correct arrangement.

Q10 What precautionary measures will you take if you are staying in an earthquake-prone region?

SOLUTION

Living in an earthquake-prone region requires both preparedness before an earthquake and correct action during and after one.

Before an earthquake: Ensure buildings are constructed following earthquake-resistant (seismic) codes. Identify safe spots indoors (under sturdy tables, against interior walls) and unsafe spots (near windows, heavy furniture). Keep an emergency kit with water, food, a first-aid box, torch, and important documents. Know the evacuation routes from your home and school.

During an earthquake: Drop, Cover, and Hold On — drop to hands and knees, take cover under a sturdy table or against an interior wall, and hold on until shaking stops. Stay away from windows, heavy objects, and outer walls. If outdoors, move away from buildings, trees, and power lines. If driving, pull over safely and stay inside the vehicle.

After an earthquake: Check for injuries and provide first aid. Be cautious of aftershocks, which may follow. Avoid damaged buildings. Do not use open flames (gas leaks may occur). Listen to official instructions via radio or local authorities.

Answer: Before: Live in earthquake-resistant buildings; know safe indoor spots (under sturdy tables); keep an emergency kit; plan evacuation routes. During: Drop, Cover, and Hold On; stay away from windows and heavy objects; if outdoors, move away from buildings. After: Watch for aftershocks; avoid damaged structures; do not use open flames (risk of gas leaks); follow official instructions.

Q11 Prepare a map showing landform-associated disasters that happened in the current calendar year.

SOLUTION

Guidance for the map project: This is a research and map-making activity. Use an outline map of India (or the world, as required by your teacher).

Step 1 — Research: Using newspapers, news websites, and atlases, collect information about landform-associated disasters that occurred in 2026 (the current calendar year). Look for events such as: landslides (hilly regions — Uttarakhand, Himachal Pradesh, northeast India), GLOFs (glacial regions), avalanches (Himalayan states), dust storms (Rajasthan, northwest India), coastal erosion or flooding (coastal states).

Step 2 — Mark on the map: Use different symbols or colours for each type of disaster (e.g., a triangle for landslide, a wave for flood, a cloud for dust storm). Place each symbol at the approximate location of the disaster.

Step 3 — Add a legend: Clearly show what each symbol/colour represents.

Step 4 — Title and date: Give the map a title such as 'Landform-Associated Disasters in India, 2026' and note the data sources used.

Connect each marked disaster to the landform that caused it (e.g., GLOF linked to glacial terrain, dust storm linked to desert/semi-arid region).

Answer: Guidance — On an outline map of India (or world), mark locations of landform-associated disasters from the current year (2026): use distinct symbols for landslides, GLOFs, avalanches, dust storms, and coastal erosion. Add a legend, title, and data sources. Research from current newspapers or news websites. Link each disaster location to its associated landform (e.g., landslide → hilly terrain; dust storm → arid/desert region).

Q12 Create a poster showing landforms that are considered to be sacred or important in your region, and add the folk stories associated with them.

SOLUTION

Guidance for the poster project: This is a cultural and creative activity drawing on local knowledge.

Step 1 — Identify sacred or culturally significant landforms in your region. Examples: rivers (Ganga, Yamuna, Brahmaputra — revered as goddesses in Hindu tradition), mountains (Kailash — sacred in Hindu, Buddhist, and Jain traditions; Tirumala Hills in Andhra Pradesh), caves (Amarnath cave in Jammu & Kashmir — sacred pilgrimage site), ghats and coastal features (Rameshwaram coast).

Step 2 — Collect folk stories: Interview elders, consult local books or your school library for the folk stories, myths, or legends associated with these landforms. For example, the Ganga is associated with the story of King Bhagiratha's penance to bring the river down from heaven.

Step 3 — Design the poster: Draw or print pictures of each landform. Write a short folk story (3-4 sentences) beside each. Use attractive colours and a clear heading.

Note: The chapter itself mentions that waterfalls and caves often hold cultural or religious

significance. Use this as a starting point.

Answer: Guidance — Identify 2-3 landforms in your region that are considered sacred or culturally important (e.g., a river, hill, or cave). Draw or print their images on the poster. Write a short folk story or legend associated with each (collected from elders or local sources). Add a title and decorative border. Examples: River Ganga (Bhagiratha legend), Amarnath cave (Shiva's abode), or any locally revered hill or water body.

Q13 Document a case of a disaster that hit your region in the past, highlighting its effects on various human activities.

SOLUTION

Guidance for the documentation activity: This requires local research. Below is a model case study based on information in the chapter.

Model case: The Gujarat Earthquake, 2001. The chapter specifically mentions this earthquake as a major disaster that caused extensive damage in India.

Date and location: January 26, 2001, Bhuj district, Gujarat.

Cause: The earthquake was triggered by movement along a fault in the region, associated with the ongoing northward movement of the Indo-Australian Plate.

Effects on human activities: (a) Loss of life: Thousands of people died and many more were injured. (b) Damage to settlements: Houses, schools, hospitals, and public buildings collapsed. (c) Infrastructure: Roads, bridges, and water pipelines were destroyed, cutting off remote areas. (d) Economy: Local industries and businesses were disrupted; agricultural fields and equipment were damaged. (e) Social disruption: Communities were displaced; people lost livelihoods and were housed in temporary relief camps.

Mitigation applied after the event: Stricter building codes were enforced; earthquake-resistant construction was promoted; community disaster preparedness programmes were started.

For your own region, replace this with a locally relevant disaster, gathering details from newspapers, school records, or community elders.

Answer: Model case — Gujarat Earthquake (January 26, 2001, Bhuj): Caused by fault movement related to Indo-Australian Plate movement. Effects: thousands killed, homes and infrastructure (roads, bridges, pipelines) destroyed, industries disrupted, communities displaced. Post-disaster, stricter building codes and disaster preparedness programmes were introduced. Replace with a locally relevant disaster using details from newspapers or community sources.

Q14 Translate the given poster on landslide into your native language and display it in your home.

SOLUTION

Guidance for the translation activity: The textbook contains a poster on landslide safety (Fig. 2.27 section). Translate its key messages into your native/regional language (Hindi, Tamil, Telugu, Kannada, Marathi, Bengali, or any other mother tongue).

Key messages to translate typically include: (a) What a landslide is — a sudden movement of rock, soil, and debris down a slope; (b) Warning signs — unusual cracks in the ground, tilting trees, unusual sounds, sudden change in stream colour; (c) What to do — move away from the slope quickly, go to higher ground, call local emergency services, do not return until authorities declare it safe; (d) How to prevent — plant trees on slopes, avoid construction on steep hillsides, ensure proper drainage.

Write or print the translated text clearly. You may add simple illustrations for each point to make it easy for all family members — including younger children and elders — to understand.

Display the poster in a visible location at home such as the kitchen or entrance wall.

Answer: Guidance — Read the landslide safety poster in the textbook. Translate its key points (definition, warning signs, do's and don'ts, prevention tips) into your native language. Add simple illustrations for each point to aid understanding. Write or print clearly and display at home in a prominent place (entrance or kitchen wall) so all family members can refer to it.

Q15 Divide the class into three groups. Each group will work on one project (water, wind, and glacier). The project should highlight the causes, impact on human life and the environment, and mitigation measures.

SOLUTION

Guidance for the group project activity:

Group 1 — Water: Causes: rivers, rainfall, ocean waves erode soil and rock; deforestation accelerates run-off. Landforms created: V-shaped valleys, waterfalls, meanders, oxbow lakes, deltas, floodplains. Impact on humans: loss of fertile topsoil reduces crop yields; coastal and riverbank erosion destroys houses and roads; flooding in delta areas. Environment: rivers carry nutrients to plains (positive) but also cause soil loss and habitat disruption. Mitigation: terracing, bunding, contour trenches, check dams, plantation, watershed management.

Group 2 — Wind: Causes: strong dry winds in arid/desert areas lift loose sand and soil. Landforms created: yardangs, ventifacts, deflation hollows, dunes, desert pavements. Impact on humans: dust storms bury farmland and reduce visibility; desertification threatens agriculture; dunes can encroach on settlements. Environment: removes topsoil, reduces fertility, increases aridity. Mitigation: shelter-belt plantation, sand fences, fixing dunes with vegetation, drip irrigation to keep soil moist.

Group 3 — Glacier: Causes: slow movement of glacial ice scrapes and carries rock material; melting accelerated by climate change. Landforms created: U-shaped valleys, cirques, aretes, moraines, fjords, hanging valleys. Impact on humans: glaciers are freshwater reserves — their retreat threatens river flow; GLOFs endanger downstream communities; glacial valleys support trekking and tourism. Environment: glacial retreat alters river regimes and affects biodiversity. Mitigation: reduce greenhouse gas emissions to slow glacier retreat; monitor glacial lakes; enforce buffer zones around glacial lake dams; community early-warning systems.

Each group should present findings with labelled diagrams, a map of affected regions, and a list of recent examples.

Answer: Guidance — Group 1 (Water): Cover river/rainfall erosion causes, landforms (valleys, meanders, deltas), impact (topsoil loss, flooding, coastal damage), and mitigation (terracing, check dams, plantation). Group 2 (Wind): Cover dry-wind erosion causes, landforms (dunes, yardangs), impact (dust storms, desertification), and mitigation (shelter belts, sand fences, vegetation). Group 3 (Glacier): Cover glacial erosion causes, landforms (U-valleys, moraines, cirques), impact (GLOF risk, freshwater loss), and mitigation (emission reduction, lake monitoring, early-warning systems). Each group: use labelled diagrams, a regional map, and recent examples.