Chapter 13: Our Home: Earth, a Unique Life Sustaining Planet

Exercises — Keep the Curiosity Alive

Q1 What is one major reason Mars cannot currently support life like Earth?
(i) It has too many volcanoes.
(ii) It is too close to the Sun.
(iii) It lacks a thick atmosphere and liquid water.
(iv) Its magnetic field is too strong.

SOLUTION

Evaluating each option against what we know about Mars:
(i) Too many volcanoes — volcanoes are present on Mars, but they are not a major barrier to life as we know it. INCORRECT.
(ii) Too close to the Sun — Mars is farther from the Sun than Earth, lying at the outer edge of the habitable zone. INCORRECT.
(iii) Lacks a thick atmosphere and liquid water — Mars's atmosphere is about 100 times thinner than Earth's, and no liquid water exists on its surface today. Without a thick atmosphere, temperatures are extreme and water cannot remain liquid, making life as we know it impossible. CORRECT.
(iv) Magnetic field too strong — Mars's magnetic field is extremely weak, not strong. INCORRECT.

Therefore, option (iii) is correct.

Answer: (iii) It lacks a thick atmosphere and liquid water.

Q2 Which of these is an example of geodiversity?
(i) Variety of bird chirping in a forest.
(ii) Different landforms like mountains, valleys, and deserts.
(iii) Changing weather during monsoons.
(iv) Number of different types of fish in a pond.

SOLUTION

Geodiversity refers to the variety of landforms, rocks, soils, and the processes that shape them on Earth.

Evaluating each option:
(i) Variety of bird chirping — this is diversity of animal behaviour, not of landforms or non-living geological features. INCORRECT.

(ii) Different landforms like mountains, valleys, and deserts — these are non-living geographical features; their variety is exactly what geodiversity describes. CORRECT.
(iii) Changing weather during monsoons — weather is an atmospheric phenomenon, not a geological one. INCORRECT.
(iv) Number of different types of fish in a pond — this is biodiversity (variety of living organisms), not geodiversity. INCORRECT.

Therefore, option (ii) is correct.

Answer: (ii) Different landforms like mountains, valleys, and deserts.

Q3 If the Earth were smaller with the same density, what might happen to its atmosphere?
(i) It would become thicker and hotter.
(ii) It would escape into space due to weaker gravity.
(iii) It would become frozen.
(iv) It would cause stronger winds.

SOLUTION

Gravity depends on the mass of a planet. If Earth were smaller but had the same density, its total mass would be less, so its gravitational pull would be weaker.

Evaluating each option:
(i) Thicker and hotter — weaker gravity cannot hold more gas; it would do the opposite. INCORRECT.
(ii) Escape into space due to weaker gravity — with weaker gravity, the planet would be unable to hold gas molecules against their natural tendency to fly off into space, just as Mars (with a much thinner atmosphere) demonstrates. CORRECT.
(iii) Become frozen — the temperature of the atmosphere depends mainly on distance from the Sun and greenhouse gases, not directly on the planet's size. INCORRECT.
(iv) Cause stronger winds — wind patterns are driven by temperature differences and rotation, not by the planet's size in this way. INCORRECT.

Therefore, option (ii) is correct.

Answer: (ii) It would escape into space due to weaker gravity.

Q4 In sexual reproduction, why are offspring different from their parents?
(i) They grow in different climates.
(ii) They eat different food.
(iii) They acquire new instructions after birth.
(iv) They get mixed instructions (genes) from both parents.

SOLUTION

In sexual reproduction, each parent produces specialised reproductive cells called gametes, which carry only half of the parent's genetic material (genes).
When the male and female gametes join during fertilisation, the offspring receives a combination of genes — half from each parent.
This mixing means the offspring shares some traits with each parent but is not identical to either, resulting in differences among siblings and from parents.

Evaluating each option:
(i) Growing in different climates — the environment can influence some traits, but the fundamental reason offspring differ is genetic, not environmental. INCORRECT.
(ii) Eating different food — diet can affect growth but does not change the inherited genetic instructions passed from parents. INCORRECT.
(iii) Acquiring new instructions after birth — genes are inherited at fertilisation; offspring do not acquire new genetic instructions after birth in the ordinary sense. INCORRECT.
(iv) Getting mixed instructions (genes) from both parents — this directly describes what happens in sexual reproduction. The combination of genes from two parents produces a unique set of instructions in the offspring. CORRECT.

Therefore, option (iv) is correct.

Answer: (iv) They get mixed instructions (genes) from both parents.

Q5 You notice tiny green plants growing in cracks on your school wall after the monsoon. Where do you think the seeds came from? What conditions helped these plants grow there?

SOLUTION

Source of the seeds:
Seeds are dispersed in several ways — wind carries lightweight seeds, birds and other animals eat fruits and excrete seeds elsewhere, and rainwater washes

seeds along surfaces.
Seeds of small plants (mosses, ferns, weeds) are very light and can travel long distances through the air. Birds perching on the wall may also have deposited seeds in their droppings.
Rain and wind could also have blown or washed seeds into the cracks from nearby soil or plants.

Conditions that helped the plants grow in the wall cracks:
1. Moisture — the monsoon rains deposited water in the cracks, which is essential for seed germination and seedling growth.
2. Soil and nutrients — dust, soot, and organic matter (such as decayed leaves or bird droppings) accumulate in wall cracks over time, providing a thin layer of nutrient-containing material that acts like soil.
3. Sunlight — the wall surface is exposed to sunlight, which the small plants need for photosynthesis once they germinate.
4. Temperature — monsoon season brings moderate, warm temperatures that are favourable for germination.

Together, the combination of seed arrival (via wind, birds, or water) and the monsoon-provided moisture, warmth, and small amounts of accumulated organic matter in the crack created just enough conditions for the seeds to germinate and the tiny plants to start growing.

Answer: Seeds came from wind dispersal, bird droppings, or rainwater runoff. Monsoon rains provided moisture, accumulated dust and organic matter provided nutrients, and sunlight supported photosynthesis — together enabling germination and growth in the cracks.

Q6 A city has recently cut down a large patch of forest to build new roads and buildings. Discuss the possible effects this could have on the local climate and biodiversity. How might this affect water availability or quality in the area?

SOLUTION

Effects on local climate:
— Trees provide shade and release water vapour through transpiration, keeping the surrounding area cooler. Removing them increases local temperatures (urban heat island effect).
— Forests regulate rainfall by releasing moisture into the atmosphere. Loss of

forest cover can reduce local rainfall, making the region drier.
— Without trees to absorb CO_2, greenhouse gas levels locally rise slightly, contributing to warming.

Effects on biodiversity:
— Forests are habitats for many plants, animals, insects, and microorganisms. Cutting them destroys these habitats, forcing wildlife to move or leading to their local extinction.
— Loss of plant species at the base of the food web disrupts the entire ecosystem: herbivores lose food, predators lose prey, and the food chain weakens.
— Biodiversity loss reduces ecosystem resilience — a diverse ecosystem can recover from disturbances better than a simplified one.

Effects on water availability and quality:
— Tree roots hold soil together and slow rainwater runoff, allowing water to percolate into the ground and recharge groundwater. Without trees, rainwater runs off quickly, reducing groundwater recharge and lowering the water table.
— Less groundwater means wells, springs, and streams in the area may dry up or reduce in flow, making water less available.
— Rapid runoff carries soil, construction debris, and pollutants into rivers and lakes, reducing water quality and harming aquatic life.
— Reduced transpiration means less water vapour in the air, contributing to decreased local rainfall over time.

In summary, deforestation for roads and buildings can set off a chain of interconnected effects across climate, biodiversity, and water systems — illustrating how all Earth's systems are linked.

Answer: Deforestation raises local temperatures, reduces rainfall, destroys wildlife habitats (reducing biodiversity), and decreases groundwater recharge — lowering water availability and degrading water quality through increased runoff and pollution.

Q7 A friend says, "The Earth has always had climate changes in the past, so today's global warming is nothing new." How would you respond using what you've learnt in this and other chapters of your science book?

SOLUTION

Your friend is partly right — Earth's climate has changed naturally in the past due to factors like volcanic eruptions, changes in Earth's orbit, and natural fluctuations in greenhouse gases. Ice ages and warm periods have occurred over millions of years.

However, today's global warming is different in several important ways:

1. Speed: Past natural climate changes happened over thousands or millions of years, giving ecosystems time to adapt. Current warming is happening within decades — far faster than any natural cycle, giving living beings very little time to adjust.

2. Cause — human activity: As we learnt in this chapter, burning fossil fuels (coal, oil, gas) releases CO_2 and other greenhouse gases that were locked underground for millions of years. The Earth's natural carbon cycle (trees and oceans absorbing CO_2) cannot absorb this extra CO_2 fast enough.

3. Greenhouse effect amplified: We learnt that gases like CO_2 trap heat in the atmosphere (greenhouse effect). Adding large amounts of CO_2 rapidly intensifies this effect beyond the natural level, causing temperatures to rise faster than the planet can balance.

4. Consequences already visible: Rising sea levels (melting ice caps), extreme weather events (droughts, floods, storms), and disappearing species are already being observed — the triple planetary crisis of climate change, biodiversity loss, and pollution.

5. Global agreements confirm urgency: The Paris Agreement (2015) set a goal to limit warming to 1.5 °C, yet as of 2025 the world is not on track — indicating scientists and governments recognise this as an unprecedented crisis.

So while climate change is not new, today's rate, cause, and scale make it a serious and urgent problem that requires immediate human action — unlike past natural changes.

Answer: Past climate changes were natural and slow (millions of years); today's warming is human-caused (fossil fuel CO_2), far faster, and already causing measurable harm — making it fundamentally different from historical natural climate variation and requiring urgent action.

Q8 Imagine Earth's magnetic field suddenly disappeared. What kinds of problems could arise for life on Earth? Explain.

SOLUTION

Earth's magnetic field acts as a protective shield against harmful high-energy particles from space — cosmic rays from the universe and the solar wind from the Sun.

If the magnetic field disappeared, the following problems would arise:

1. Atmosphere stripped away: The solar wind (charged particles from the Sun) would gradually strip away the gases in Earth's atmosphere. Mars, which has a very weak magnetic field, has an atmosphere 100 times thinner than Earth's — this is partly why.

2. Ozone layer damaged: High-energy particles and ultraviolet radiation, no longer deflected, would bombard and break down ozone molecules in the ozone layer. The ozone layer currently shields Earth from harmful UV radiation.

3. Increased UV radiation reaching the surface: With the ozone layer reduced or destroyed, harmful UV rays would reach Earth's surface in large amounts, damaging the DNA of living cells. This would increase rates of skin cancer, damage crops, harm aquatic organisms (especially plankton at the ocean surface), and threaten biodiversity.

4. Disruption of navigation in animals: Many animals — birds, fish, sea turtles — use Earth's magnetic field for navigation during migration. Without it, their navigation would be disrupted, affecting feeding, breeding, and survival.

5. Long-term loss of atmosphere and water: Over time, as the atmosphere erodes, water vapour would also escape into space. Without liquid water, life as we know it could not survive.

In short, the magnetic field is a critical, invisible shield without which Earth's atmosphere, ozone layer, and ultimately all life would be at serious risk.

Answer: Without Earth's magnetic field: solar wind would erode the atmosphere and ozone layer, UV radiation would increase and damage living cells, animal navigation would fail, and eventually liquid water would be lost — making Earth increasingly hostile to life.

Q9 You are tasked with designing a new settlement for humans on Mars. Name three things you would need to recreate from Earth to support human life there. Which of these do you think is the hardest to replicate, and why?

SOLUTION

Three things that would need to be recreated from Earth for a human settlement on Mars:

1. Breathable atmosphere (oxygen supply): Mars's atmosphere is made up of about 95% CO_2 and is extremely thin — 100 times thinner than Earth's. Humans cannot breathe it. An enclosed habitat with an artificial oxygen supply (or systems to produce O_2, for example from water electrolysis or converting CO_2) would be essential.

2. Liquid water: Mars has no liquid water on its surface today. Water is essential for drinking, growing food, and all biological processes. Ice exists at Mars's poles and underground, so harvesting and melting it would be needed. Water is also needed to grow crops for food.

3. Protection from radiation and temperature extremes: Mars lacks a strong magnetic field and a thick ozone layer, so it is bombarded by cosmic rays and UV radiation. Temperatures range from about −80 °C at night to 20 °C on a warm day. Settlers would need heavily insulated, radiation-shielded habitats.

Hardest to replicate — breathable atmosphere (option 1):
Creating and sustaining a breathable atmosphere inside habitats is complex — it requires continuous production of O_2, removal of CO_2, regulation of pressure, and ensuring there are no leaks. Unlike water (which can be obtained from ice) or radiation shielding (which can be engineered with thick walls or underground structures), maintaining the right atmospheric composition 24/7 without failure is a life-critical engineering challenge with no margin for error.
Terraforming Mars's entire atmosphere to be breathable is beyond current technology and would take thousands of years even if possible.

Note: Food (agriculture) is also a major challenge and closely related to water and

atmosphere — a complete Mars settlement would need all of these working together.

Answer: Three essentials: (1) breathable oxygen supply, (2) liquid water, (3) radiation shielding and temperature control. Hardest to replicate: a reliable breathable atmosphere — it must be continuously maintained at the right composition and pressure with no margin for failure inside enclosed habitats.

Q10 In a village, the temperature has been increasing and rainfall has become unpredictable over the past few years. What could be causing this change? Suggest two ways the village could adapt to these new conditions.

SOLUTION

Possible causes of the change:

— Global climate change: Burning fossil fuels worldwide releases excess CO_2 and other greenhouse gases that trap more heat, raising average temperatures globally. Villages are not isolated from these global effects.

— Local deforestation: If forests around the village have been cleared for farming or fuel, trees that previously regulated local temperature through shade and transpiration are gone, making the area warmer and drier.

— Land use changes: Replacing natural vegetation with roads, buildings, or bare agricultural land increases heat absorption and reduces water retention in soil, affecting local rainfall patterns.

— Reduced green cover reduces the amount of water vapour released into the atmosphere, which can reduce local rainfall.

Two ways the village could adapt:

1. Rainwater harvesting and water conservation: Since rainfall has become unpredictable, the village can build tanks, ponds, or check dams to collect and store rainwater during heavy rains for use during dry spells. This ensures water availability for drinking and agriculture even when rain is irregular.

2. Shift to drought-resistant crops and diversify agriculture: Farmers can switch to crop varieties that need less water and can tolerate higher temperatures. Planting a variety of crops also reduces the risk of total crop failure if one crop is badly affected by changing conditions.

Additional measures (for context): Planting more trees around the village (afforestation) would help restore shade, reduce local temperature, improve soil

water retention, and gradually improve rainfall patterns.

Answer: Causes: global climate change (excess greenhouse gases) and local deforestation/land-use changes. Two adaptations: (1) build rainwater harvesting structures to store water during unpredictable rains; (2) switch to drought-resistant crops suited to the warmer, drier conditions.

Q11 If there were no atmosphere on the Earth, would it affect life, temperature, and water on the planet? Explain.

SOLUTION

Yes, the absence of an atmosphere would have severe and fatal consequences for life, temperature, and water on Earth.

Effect on life:
— The atmosphere contains oxygen, which almost all living beings need for respiration. Without it, animals and most microbes would not survive.
— The atmosphere contains CO_2, which plants need for photosynthesis. Without photosynthesis, plants cannot make food, and the entire food chain collapses.
— The ozone layer (part of the atmosphere) absorbs harmful UV rays from the Sun. Without it, intense UV radiation would damage the DNA of all living cells, making life on the surface impossible.
— The atmosphere's role as a shield against cosmic rays and solar wind would be lost, further exposing life to radiation damage.

Effect on temperature:
— The atmosphere traps some of the Sun's heat through the greenhouse effect, maintaining Earth's average temperature at about 15 °C — warm enough for liquid water.
— Without an atmosphere, heat absorbed during the day would escape freely into space at night. Daytime temperatures would be scorching (as on the Moon, which reaches ~127 °C in direct sunlight) and nights would be extremely cold (the Moon drops to about −173 °C at night).
— There would be no medium to distribute heat around the planet (no wind circulation), creating extreme temperature differences between day and night sides.

Effect on water:
— The greenhouse effect keeps Earth's temperature above 0 °C over most of the

surface, allowing water to remain liquid. Without an atmosphere, temperatures would drop so severely at night that water would freeze everywhere, and the Sun's direct radiation during the day could cause rapid evaporation.
— Without atmospheric pressure, liquid water cannot exist — it would instantly boil off into water vapour at very low temperatures (just as water boils at lower temperatures at high altitudes where pressure is less).
— Water vapour in the atmosphere would simply escape into space with no atmospheric pressure to retain it.
— Over time, all surface and liquid water would be lost, leaving Earth a dry, barren world similar to Mars.

In conclusion, the atmosphere is essential for maintaining the conditions that allow life, moderate temperatures, and liquid water to exist on Earth.

Answer: Without an atmosphere: all life would die (no O_2 for respiration, no CO_2 for photosynthesis, no ozone UV shield); temperatures would swing between extreme heat and extreme cold (no greenhouse effect or heat distribution); and liquid water would disappear (no atmospheric pressure and temperatures too extreme to keep water liquid).

Q12 Discuss five examples of vegetative propagation.

SOLUTION

Vegetative propagation is a type of asexual reproduction in which a new plant grows from a vegetative part of the parent plant — such as a stem, root, or leaf — without the need for seeds.

Five examples:

1. Money plant (stem cutting): A small piece of stem with at least one node is cut and placed in water or moist soil. Roots grow from the node and a new plant develops. This is a commonly observed example of propagation by stem cuttings.

2. Potato (tubers/eyes): A potato is an underground stem (tuber) that has small buds called 'eyes'. When a piece of potato with an eye is planted in moist soil, the bud grows into a new potato plant. This is why potatoes can be grown without seeds.

3. Ginger (rhizome): Ginger is an underground stem called a rhizome. A piece of ginger with a bud node, when planted in soil, grows into a new ginger plant. This is why ginger plants are grown from pieces of the root-like stem, not from seeds.

4. Sugarcane (stem cutting/nodes): Sugarcane is propagated by planting sections of its stem that contain nodes. Each node can sprout roots and shoots, giving rise to a new sugarcane plant. Sugarcane rarely produces seeds, so this is the main method used by farmers.

5. Bamboo (stem/rhizome): Bamboo spreads through underground rhizomes (horizontal underground stems) from which new shoots emerge. Bamboo is seldom grown from seeds and spreads rapidly through this vegetative method.

Other common examples include rose (stem cuttings), banana (suckers from base), and onion (bulbs) — but the five above are directly illustrated or referenced in the chapter.

Answer: Five examples of vegetative propagation: (1) Money plant — stem cutting in water/soil; (2) Potato — 'eyes' (buds on tubers); (3) Ginger — rhizome pieces; (4) Sugarcane — stem node cuttings; (5) Bamboo — underground rhizomes that send up new shoots.