NO PREP

Tundra

The Frozen Frontier of Earth's Biomes

Includes: Student reading, case study, differentiated questions, teacher key

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Name: Period: Date:

Tundra: The Frozen Frontier of Earth's Biomes

Cold, Windy, and Treeless Plains

Tundras mark Earth's harsh cold biome, found primarily in the Arctic and atop high mountains (alpine tundra). Characterized by permafrost—permanently frozen ground—these landscapes feature short growing seasons, low precipitation, and biting winds. Temperatures may rise above freezing in summer, allowing a burst of plant growth in a brief window of daylight and mild conditions. However, trees cannot establish roots in the shallow, frozen soil, resulting in a stark, treeless panorama. The vegetation includes hardy species like mosses, lichens, and small shrubs that cling to the thin active layer of soil above the permafrost. Wildlife—caribou, arctic hares, and even musk oxen—migrate or adapt to the cold. Many animals turn white in winter for camouflage. Despite appearing barren, the tundra supports crucial breeding grounds for migratory birds, which take advantage of abundant insects and near-constant summer daylight.

Low Biodiversity and Seasonal Changes

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Low Biodiversity and Seasonal Changes

Compared to rainforests or grasslands, tundras host relatively few species due to extreme conditions. Yet the species that do live here exhibit specialized adaptations. Plants grow close to the ground to avoid wind damage, and dark, fuzzy leaves can help absorb heat. Insects like mosquitoes and blackflies can appear in massive swarms during the short summer, providing food for birds. Seasonal transformations are dramatic. In winter, the sun barely rises, and temperatures plummet. In summer, the land softens, revealing pools of meltwater. Migratory animals arrive to feed and breed, then depart as autumn cold sets in. Climate change threatens to alter these cycles: if permafrost thaws, habitats shift, and invasive species could move in, reshaping the tundra.

Permafrost and Climate Impact

The frozen ground—permafrost—locks in not only water but also vast amounts of carbon. When it thaws, previously trapped organic matter decomposes, releasing greenhouse gases like methane and CO_2. This can accelerate global warming. Infrastructure in tundra regions (roads, pipelines, buildings) must account for permafrost stability; thawing can cause ground collapse. Indigenous communities in Arctic tundras face cultural and economic challenges as ice roads become unreliable and traditional hunting patterns shift. At higher elevations, alpine tundra experiences similar conditions. Mountain slopes above the tree line mimic Arctic tundra's short growing season and cold winds. These delicate ecosystems respond quickly to temperature changes, making them indicators of broader climate shifts. Monitoring tundra health has become a key facet of global climate research.

Key Information: Quick Reference Table

Tundra Type	Location	Characteristic
Arctic Tundra	High latitudes near the Arctic	Permafrost, long winters, short summers
Alpine Tundra	High mountain regions worldwide	Similar to Arctic tundra but above tree line

Case Study Excerpt (Alpine Tundra Restoration)

In a high-elevation region of the Andes, overgrazing by introduced livestock damaged the fragile alpine tundra. Grass cover shrank, soil eroded, and meltwater streams carried sediment downhill, affecting communities relying on clean water. Ecologists partnered with local herders to reduce grazing intensity, allow pasture recovery, and reintroduce native plants. They also built small stone terraces and planted vegetation to stabilize slopes against erosion. Over a few seasons, the alpine tundra began to rebound: grasses and wildflowers returned, and water quality improved downstream. This restoration project highlights how delicate mountain ecosystems are—and how targeted efforts can revive them.

1. What problems arose in the high Andes due to overgrazing?

_____

_____

2. Which restoration efforts helped the alpine tundra recover?

_____

_____

Multiple Choice

1. A key characteristic of tundra regions is:
    a) Treeless terrain with short growing seasons
    b) Frequent monsoons and extreme heat
    c) Warm winters with heavy rainfall
    d) Deep, nutrient-rich soil for dense forests

2. Permafrost is:
    a) A thick layer of solid ice on lakes
    b) Melted ground that refreezes daily during winter seasons
    c) Frozen soil that never fully thaws, even in summer
    d) Always found in tropical valleys

3. Alpine tundra occurs:
    a) Above the tree line in mountainous regions
    b) Only at the poles in the northernmost extreme latitudes
    c) Near the ocean's surface
    d) Under dense rainforest canopies

Matching

Write the letter of the correct definition on the line next to each term.

Term	Definition
1. ___ Caribou	A) Process of permafrost melting, risking carbon release
2. ___ Permafrost	B) High elevation area with tundra conditions above tree line
3. ___ Alpine Tundra	C) Arctic deer-like animal migrating across tundra landscapes
4. ___ Thawing	D) Region of no trees, low vegetation, very short summers
5. ___ Arctic Tundra	E) Frozen ground storing large amounts of carbon

Fill-in-the-Blank

1. _____ animals often change coat color in winter to blend with the snowy tundra environment.

2. _____ stores organic matter beneath frozen soils; when it melts, greenhouse gases can be released.

3. _____ tundra develops in mountain regions, mirroring Arctic conditions but due to altitude rather than latitude.

Short Answer

Answer each question in 2-4 complete sentences.

1. How does the tundra's permafrost layer affect both plants and human structures?

_____

_____

_____

2. Why is climate change particularly concerning for tundra regions?

3. What role can local communities play in preserving tundra ecosystems?