

The Living World: Cold Environments Knowledge Organiser

The Physical Characteristics of Cold Environments

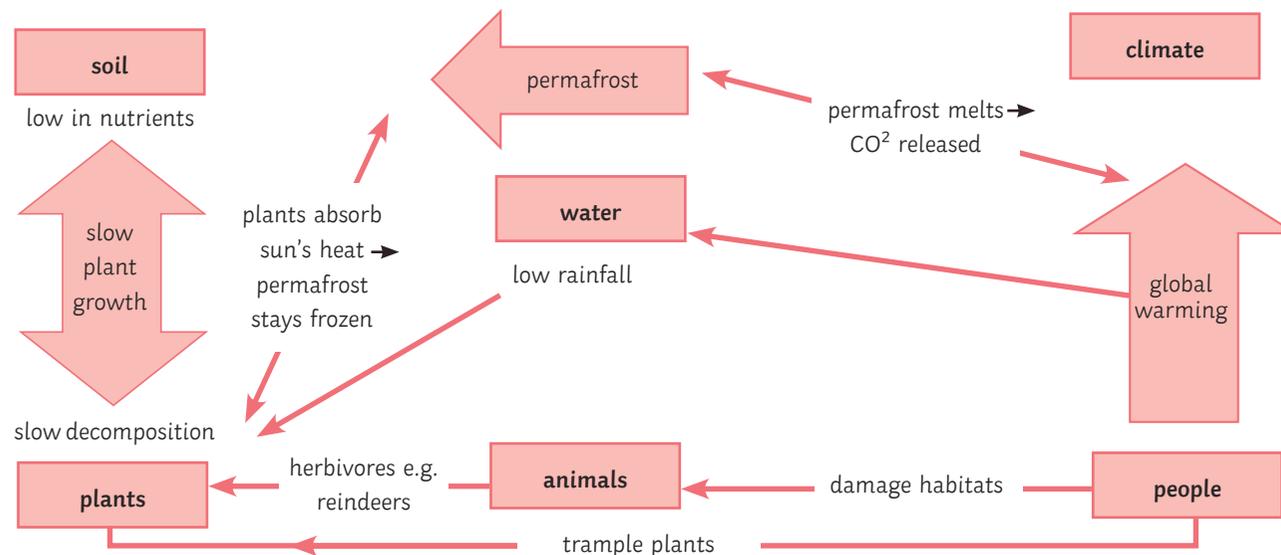
Climate	Water	Soils	Plants	Animals
<ul style="list-style-type: none"> Polar areas are very cold (never normally more than 0°C) with winters normally below -40°C. Tundra areas are cold. The summer maximum temperature is 10°C, and the winter temperature can reach -50°C. clear seasons 	<ul style="list-style-type: none"> Rainfall is low. Less than 100mm in polar areas and less than 380mm in tundra areas. Precipitation is mainly snowfall. 	<ul style="list-style-type: none"> Polar areas are covered in ice sheets. There is no soil. In tundra areas there is a thin layer of acidic soil that is not very fertile. Underneath that is a layer of sub-soil that remains frozen (permafrost). 	<ul style="list-style-type: none"> Very few plants (e.g. lichens and moss) on the edge of polar regions where it is warmer. Plants in tundra areas are low and grow slow (e.g. grass). Small short trees grow occasionally in sheltered spots. 	<ul style="list-style-type: none"> few species Polar areas have polar bears, whales, seals and walrus. Tundra areas have lemmings, reindeer, wolves and Arctic foxes.

Issues Relating to Biodiversity

- Cold environments have a very low species biodiversity (especially in Antarctica).
- Low biodiversity means changes to one species can easily impact other species e.g. if lichen does not grow one year, reindeer will starve.
- Global warming is affecting biodiversity in two ways:
 - Some species are migrating towards the poles. They may become predators of the original inhabitants e.g. the red fox is stronger than the native Arctic fox.
 - Species that are adapted to cold environments may lose their natural habitats. The lemming population is declining in some areas due to changing conditions in their snowy habitat. This also results in less food for the Arctic fox, a natural predator of lemmings.

The Interdependence of Climate, Water, Soils, Plants, Animals and People

Climate, water, soil, plants, animals and people have a fragile and interdependent relationship (they depend on each other). For example:



Plant Adaptations

- Plants adapt to cope with the low temperatures, rainfall and high winds.
- Plants are small and round to survive high winds.
- Plants become dormant (stop growing) to survive the dark and cold winters.
- Most plants have shallow roots because of the thin soil and permafrost.
- Small leaves reduce the amount of water lost through transpiration.
- Plants can only grow in temperatures above 6°C and adapt to the short growing season (50-60 days) during the summer when the sun shines 24 hours a day.
- During summer the soil may be water-logged so plants must adapt to survive.
- Plants reproduce by growing runners and bulbs, rather than seeds. This is due to the high winds and short growing season.



Animal Adaptations

Animals adapt to find food and the harsh climate.

- Animals must be well insulated with a thick layer of blubber (e.g. seals). The musk ox keeps warm with its long, thick and hollow hairs which trap air close to the skin, insulating its body.
- Some animals huddle together to conserve heat (e.g. penguins) during the long winters.
- Many animals hibernate to survive the winter (e.g. Arctic ground squirrels line their burrows with insulators like musk ox hair, leaves, and lichens before winter. While they sleep, body temperatures drop to just above freezing, and breathing and heartbeat slows down to conserve energy).
- Some animals migrate to warmer areas in winter (e.g. caribou spend the summer months grazing in the tundra and migrate to warmer areas in winter.)
- Many animals are camouflaged to protect themselves from predators (e.g. Arctic hares are white to blend in to the snow.)



Case Study: Alaska

Development opportunities include:

Mineral extraction – silver, iron ore, copper and gold (Tintina gold belt) contributed \$2.2 billion to the economy in 2013.

Energy – oil and gas account for over 50% of Alaska's economy. The Trans-Alaska oil pipe transports oil from the Prudhoe Bay oil field (which produces 400,000 barrels per day) to Valdez. Oil is shipped to mainland USA and around the world.

Fishing – 79,000 people are employed in Alaska's fishing industry. Fishing (for salmon, cod, pollock and crab) contributes \$5 billion to the Alaskan economy.

Tourism – Alaska's scenery and wildlife attract 2 million tourists each year. This provides 1:8 jobs and brings \$2.48 billion into the state each year.

Challenges to development include:

Alaska is the least populated state of the USA. It is large and remote, making prices and the cost of living high.

Extreme temperatures – death and injury can result from the extreme climate of Alaska. The lowest recorded temperature was -62.2°C in 1972 in Prospect Creek. The extreme north of Alaska has a tundra ecosystem with long, very cold winters and short, cool summers. Precipitation is low (less than 25cm per year), mostly as snow. Strong winds are also common.

Inaccessibility – the population of Alaska is very small but has the largest state by land area in the USA. About 50% of the population live in the Anchorage metropolitan area. The rest of Alaska is very remote.

In winter, roads become impassable due to snow and ice. Thawing permafrost in the summer months can also cause damage to roads.

Provision of buildings and infrastructure – building on tundra is difficult:

1. The permafrost can thaw easily, releasing CO_2 . Any footprints/tyre tracks on the tundra will remain for several years. They allow more of the sun's heat to be absorbed by the ground, thawing out the permafrost.
2. There are 1000 earthquakes in Alaska each month and six magnitude 6-7 earthquakes a year.

The Trans-Alaskan Pipeline has overcome both of these issues. The pipe is on stilts to prevent the ground being heated up in some places and it is on sliders where the pipeline travels over a tectonic fault line.

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Strategies to Balance the Needs of Economic Development and Conservation

Cold environments need sustainable management strategies, which allow development but do not damage the area for future generations:

Use of Technology – modern building methods can reduce the impact on the environment e.g. building on piles or stilts to prevent buildings thawing the permafrost.

Role of Government – governments must regulate development to prevent irreversible damage to the environment e.g. Russian and Canadian Biodiversity Action Plans (BAP) are internationally recognised programmes which protect/restore threatened habitats.

Laws/Acts can protect wilderness areas, for example the 1964 Wilderness Act protects large areas of Alaska from development.

International Agreements – agreements between countries to protect our planet, for example:

- Antarctic Treaty (1959) prevents large cruise ships (over 500 passengers) and nuclear testing in Antarctica.
- Kyoto Protocol (2005) has been signed by most countries to reduce global warming. This is important for the protection of tundra as global warming threatens this fragile ecosystem.

Conservation Groups – campaign for the protection of fragile ecosystems. In November 2017, Greenpeace took the Norwegian government to court over their plans to open up new areas of the Arctic to oil drilling.



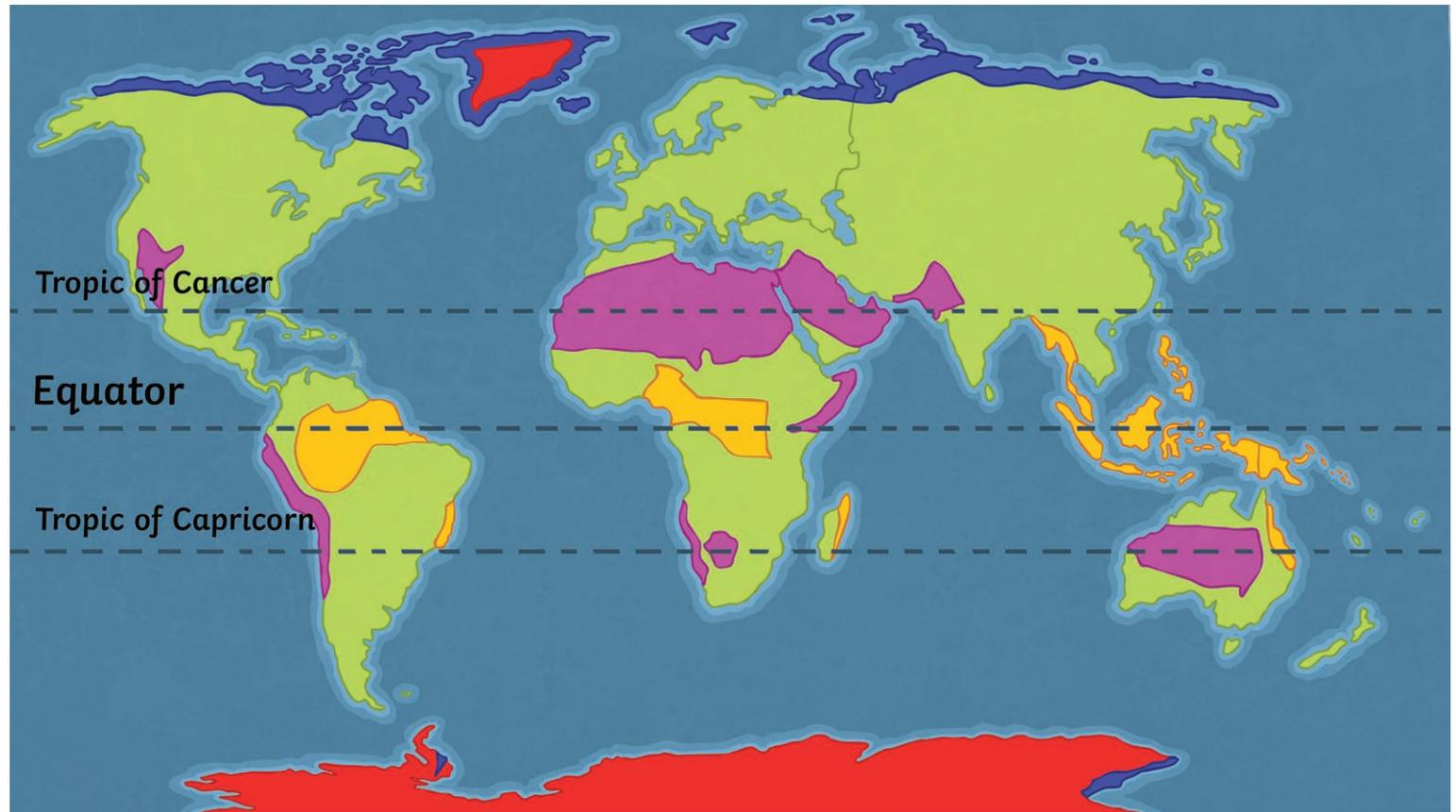
The Value of Cold Environments and Why They Should Be Protected

- Tundra is very fragile; small changes will destroy plant and animal life. Plant growth is very slow; it takes a long time for Tundra to recover from any changes.
- Polar ice is melting. This provides hunting ground for predators (e.g. polar bears) which is being lost and these species face extinction.
- Melting polar ice causes sea levels to rise and can change the temperature of the oceans.
- Oil spills can destroy habitats and kill animals e.g. the Exxon Valdez oil tanker spilt between 257,000 to 750,000 barrels of oil when it ran aground in Alaska's Prince William Sound. Up to 250,000 seabirds, 2,800 sea otters, 300 seals and over 200 bald eagles were killed. The spill damaged over 1000 miles of Alaska's coastline.
- Tundra traps CO² in the permafrost. This is because the cold temperatures do not allow plants and animals to rot when they die, storing CO² in the ground. This CO² is released if the permafrost thaws, which could cause global warming.
- Tundra is a valuable wilderness area which should be conserved to protect the unique biodiversity found there.



Global Distribution of Cold Environments

- All of the world's tundra is found in the northern hemisphere (Antarctica is polar ice).
- Tundra is found within the Arctic circle (66°N).
- Polar ice ecosystems are found near the north pole (90°N) and the south pole (90°S).



Key ■ Hot Desert ■ Tropical Rainforest ■ Tundra ■ Polar

