



ENVE203

**Environmental Engineering Ecology
(Nov 26, 2012)**

Environmental Engineering Department

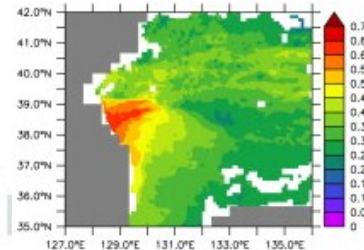
Elif Soyer

‘Major Ecosystems of the World’

Earth's Major Biomes

Earth has many climates based primarily on

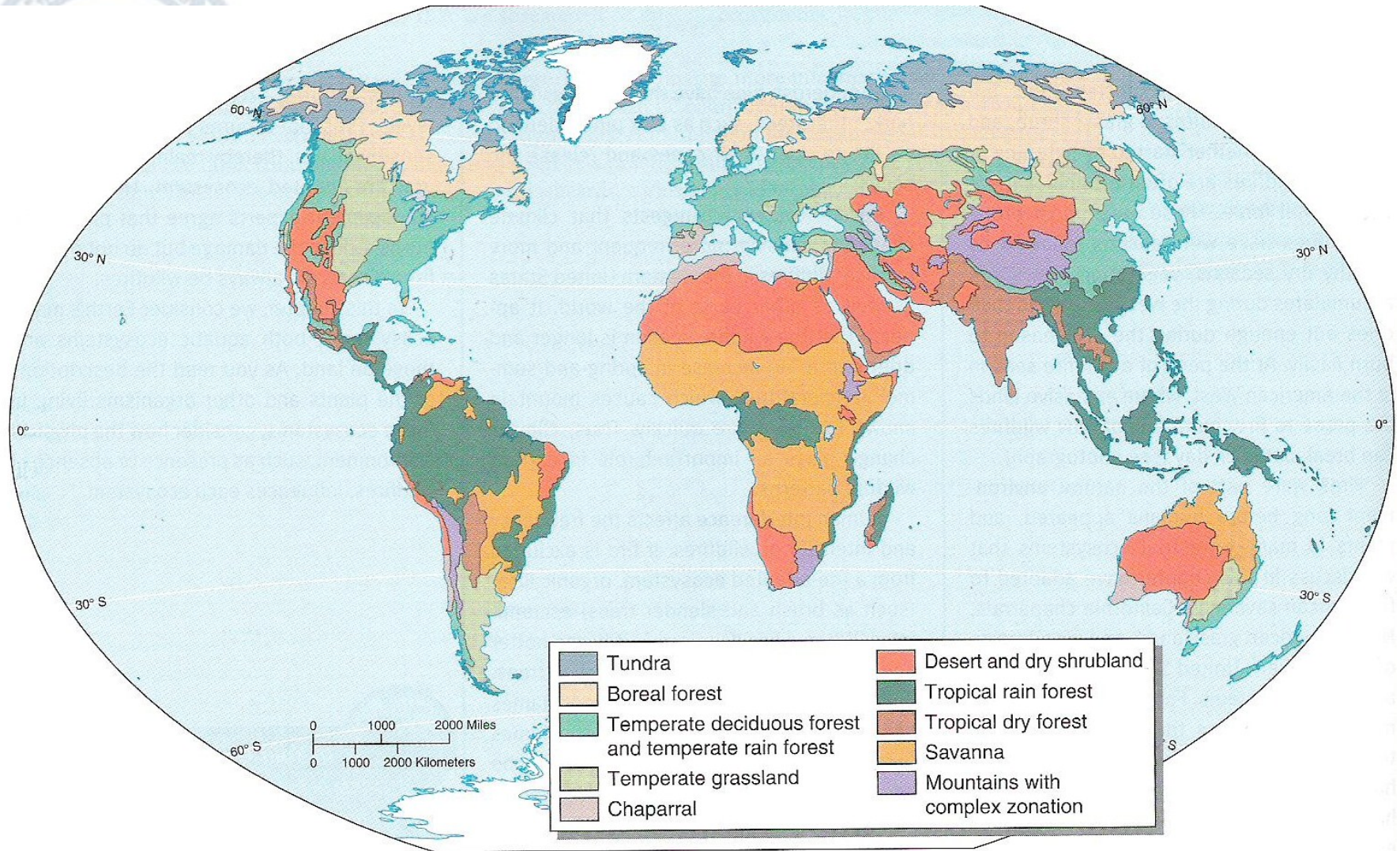
- temperature &
- precipitation differences



Characteristic organisms have adapted to each climate

A **BIOME** is quite large area and encompasses interacting ecosystems

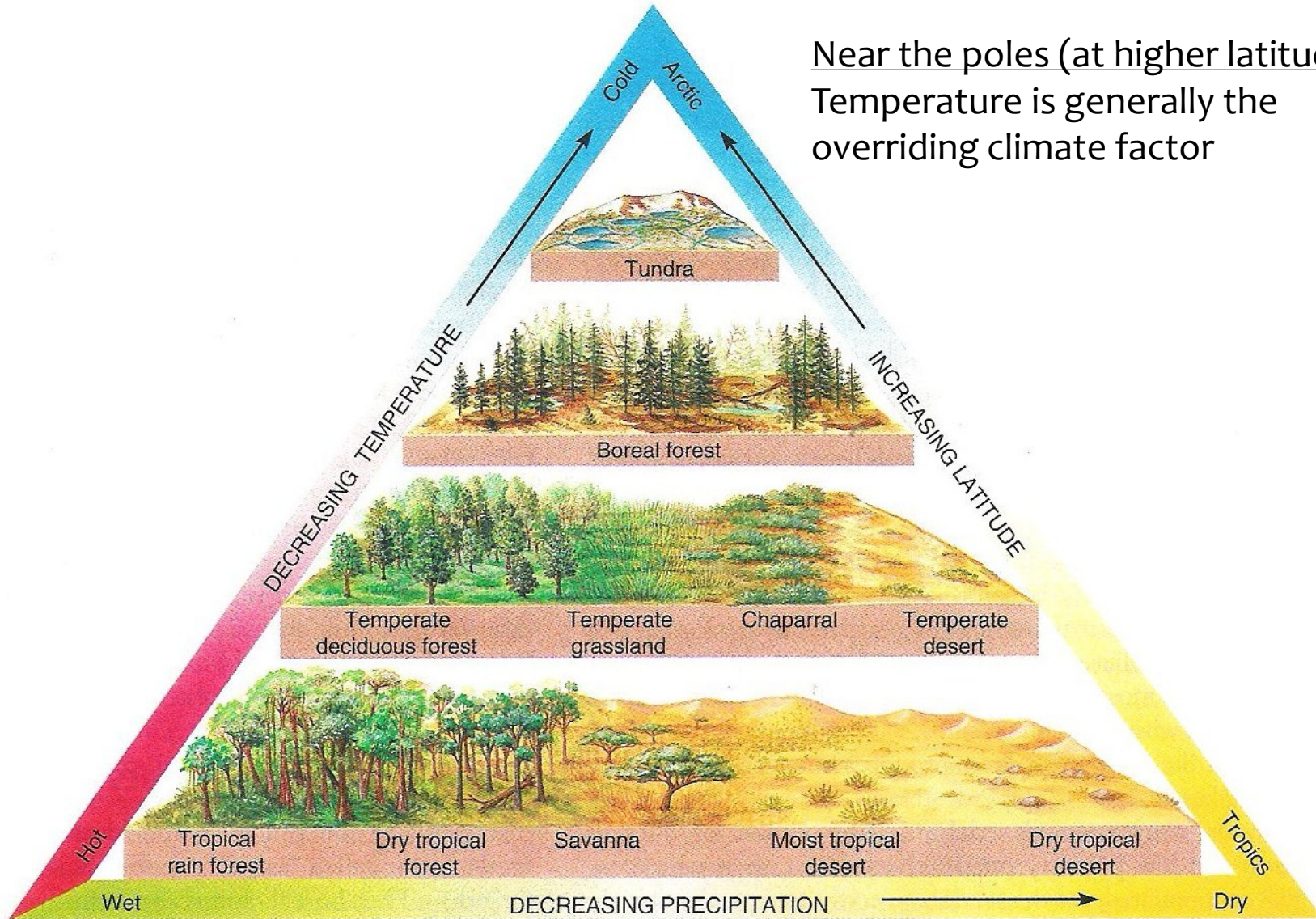
Biomes



Distribution of the world's terrestrial biomes

This is a highly simplified graph; biomes actually blend together at their boundaries (no sharp boundaries)

Biomes



Near the poles (at higher latitudes)
Temperature is generally the
overriding climate factor

In temperate & tropical regions
Precipitation becomes more significant than temperature

Biomes

Abiotic factors to which certain biomes are sensitive

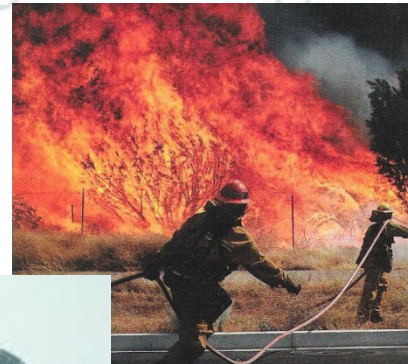
- Light

Relatively plentiful in biomes, except in certain environments such as rainforest floor



- Temperature extremes, rapid temperature changes

- Fires



- Floods

- Droughts

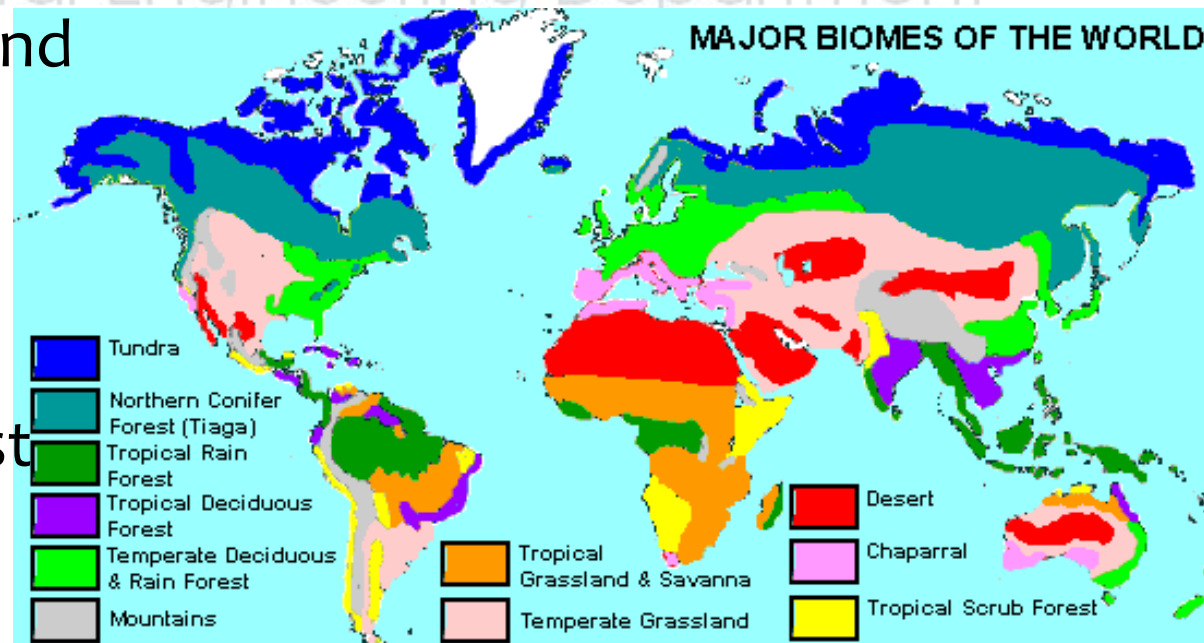


- Strong winds

Earth's Major Biomes

Nine major biomes:

1. Tundra
2. Boreal Forest
3. Temperate Rain Forest
4. Temperate Deciduous Forest
5. Temperate Grassland
6. Chaparral
7. Desert
8. Savanna
9. Tropical Rain Forest



Earth's Major Biomes

TUNDRA: COLD BOGGY PLAINS OF THE FAR NORTH

Also called ARCTIC TUNDRA

Occurs in the extreme latitudes wherever the snow melts seasonally

Long & harsh winters

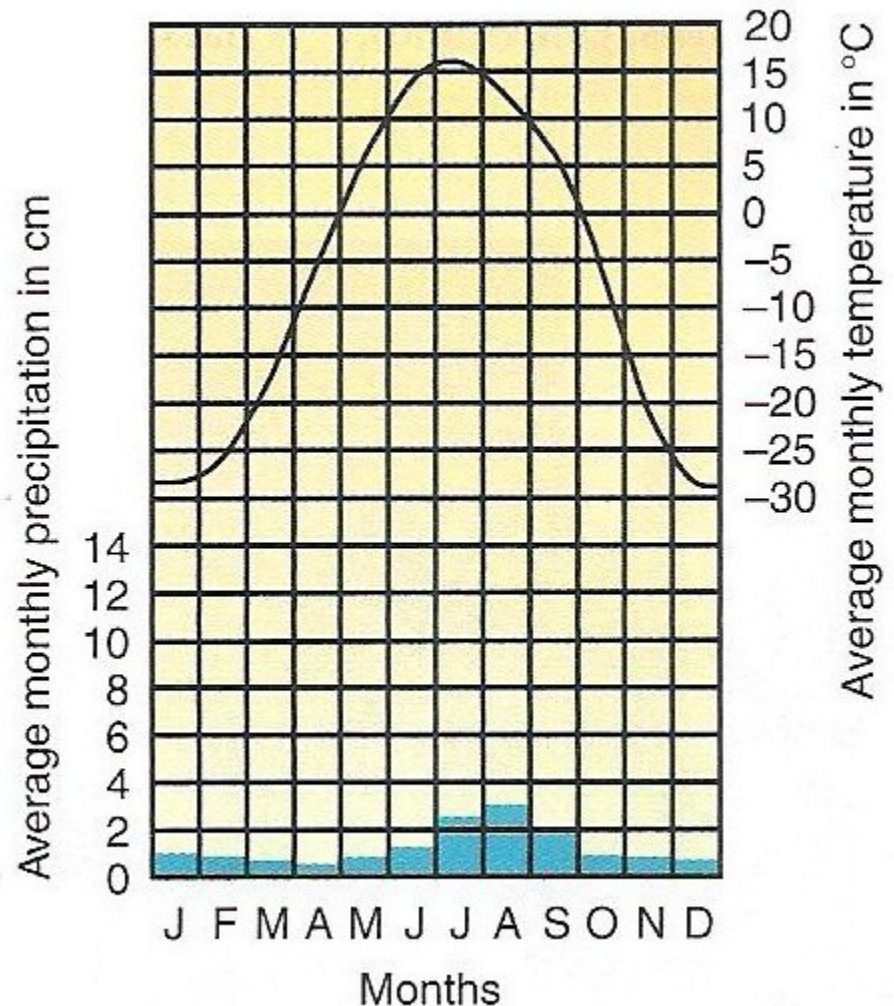


Earth's Major Biomes

TUNDRA: COLD BOGGY PLAINS OF THE FAR NORTH

During how many months each year is the Alaskan tundra at or above freezing?

If climate warming continues, how would you expect the climate graph to change in 50 years?



Arctic Tundra

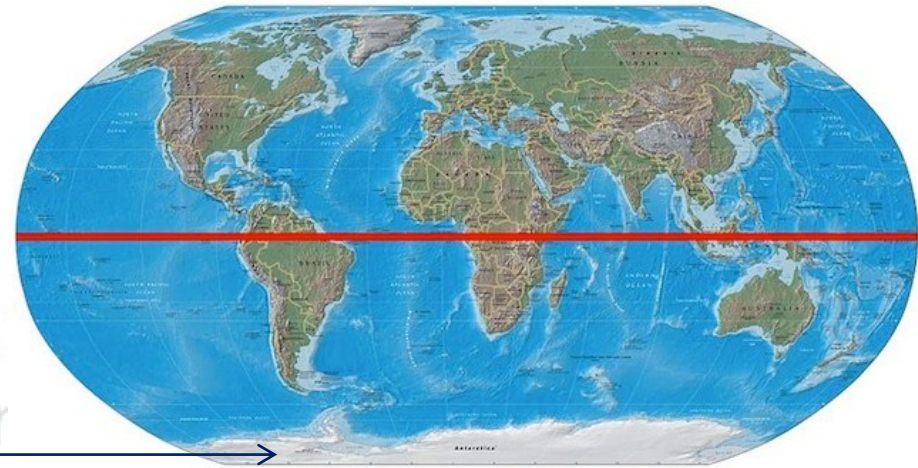


Earth's Major Biomes

TUNDRA: COLD BOGGY PLAINS OF THE FAR NORTH

Southern hemisphere

No arctic tundra because it has no land in the corresponding latitudes



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ALPINE TUNDRA

Located at higher elevations of mountains, above the tree line

Alpine tundra can occur at any locations, even in the tropics

Earth's Major Biomes

TUNDRA: COLD BOGGY PLAINS OF THE FAR NORTH

- Growing season is short but the days are long
- Little precipitation, most of it during the summer months (10-25 cm per year)
- Tundra soils are usually nutrient-poor and have little organic litter (dead leaves, animal droppings, remains of organisms)
- Although the soil melts at the surface during summer, tundra has a layer of permafrost



Earth's Major Biomes

TUNDRA: COLD BOGGY PLAINS OF THE FAR NORTH

- Low species richness (the number of different species)
- Low primary productivity (the rate at which energy is accumulated)
- Few plants occur, but individual species often exist in great numbers



No readily recognizable trees or scrubs

As a rule tundra plants seldom grow taller than 30 cm

Animals adapted to the extreme cold, with coats of thick fur

The logo of Marmara University is a circular seal. It features a central figure, possibly a lion or a similar mythical creature, standing on a pedestal. The text "MARMARA UNIVERSITY" is written around the top inner edge of the circle, and "1883" is at the bottom. The logo is semi-transparent and serves as a background for the title.

Earth's Major Biomes

TUNDRA: COLD BOGGY PLAINS OF THE FAR NORTH

Tundra regenerates slowly after it has been disturbed.

- Even hikers can cause damage
- Oil and natural gas exploration & military use: long lasting injury

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- Climate change is beginning to affect the arctic tundra
Permafrost melts → trees replaces the tundra vegetation
→ The trees have lower albedo (reflectivity) than snow, ice, or tundra vegetation: causing additional warming

Positive feedback mechanism

Earth's Major Biomes

BOREAL FORESTS: CONIFER FORESTS OF THE NORTH

Located in the Northern Hemisphere, south of the tundra:

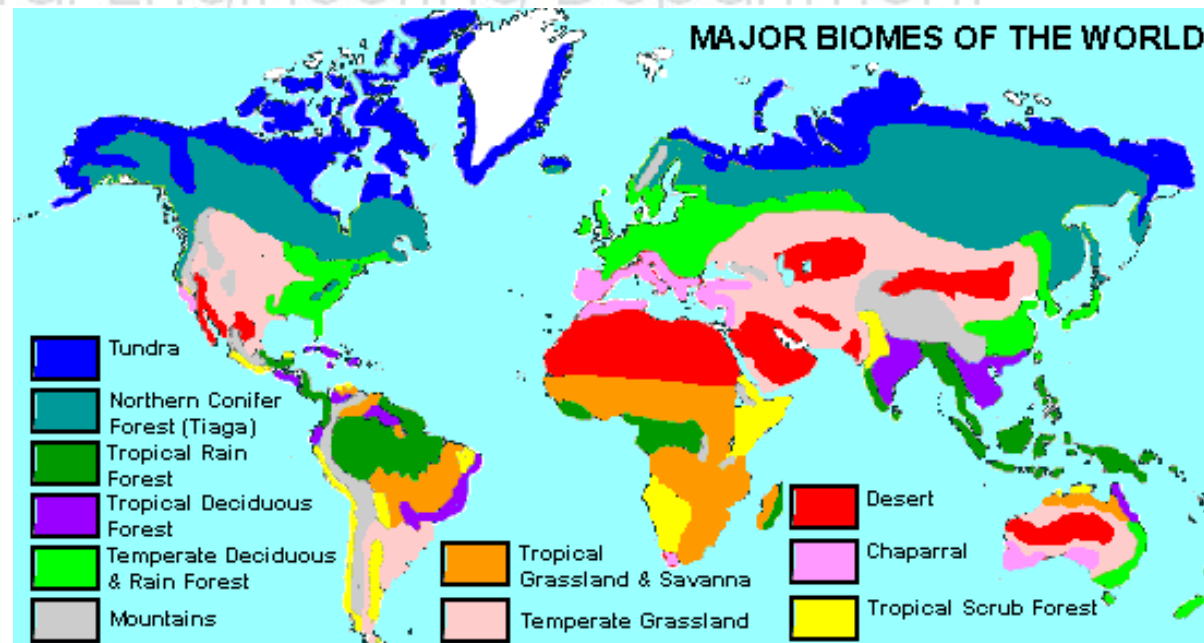
BOREAL FOREST

Also called TAIGA

Boreal forest stretches across North America and Eurasia

Covers approximately 11% of the Earth's land

A biome comparable to boreal forest is not found in the Southern Hemisphere



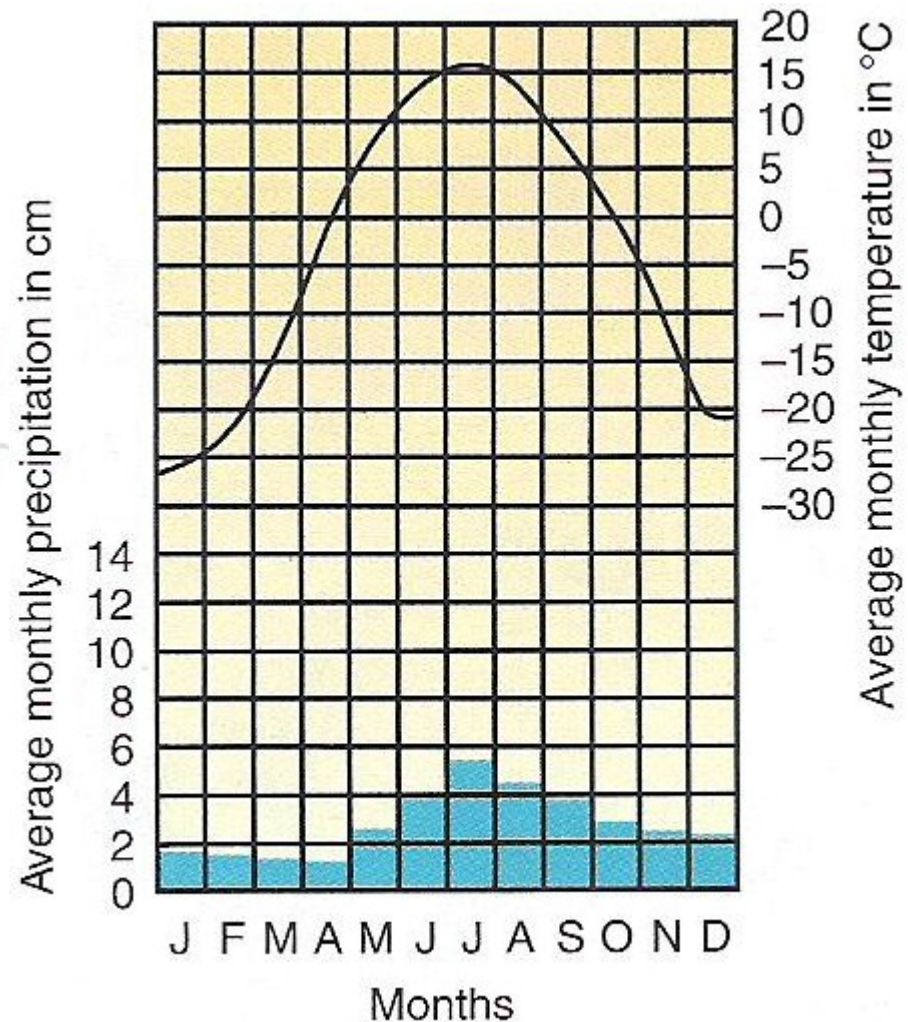


Earth's Major Biomes

BOREAL FORESTS: CONIFER FORESTS OF THE NORTH



How does average monthly precipitation vary with average monthly temperature?





Earth's Major Biomes

BOREAL FORESTS: CONIFER FORESTS OF THE NORTH

Winters are extremely cold and severe, but not as harsh as in the tundra

Growing season is longer than that of the tundra

Little precipitation

Its soil is typically acidic and mineral-poor, with a deep layer of partly decomposed pine and spruce needles at the surface



Earth's Major Biomes

BOREAL FORESTS: CONIFER FORESTS OF THE NORTH

Currently, boreal forest is the world's primary source of industrial wood and wood fiber

Extensive logging

Mining, drilling for gas and oil, and farming have also contributed to loss of boreal forest

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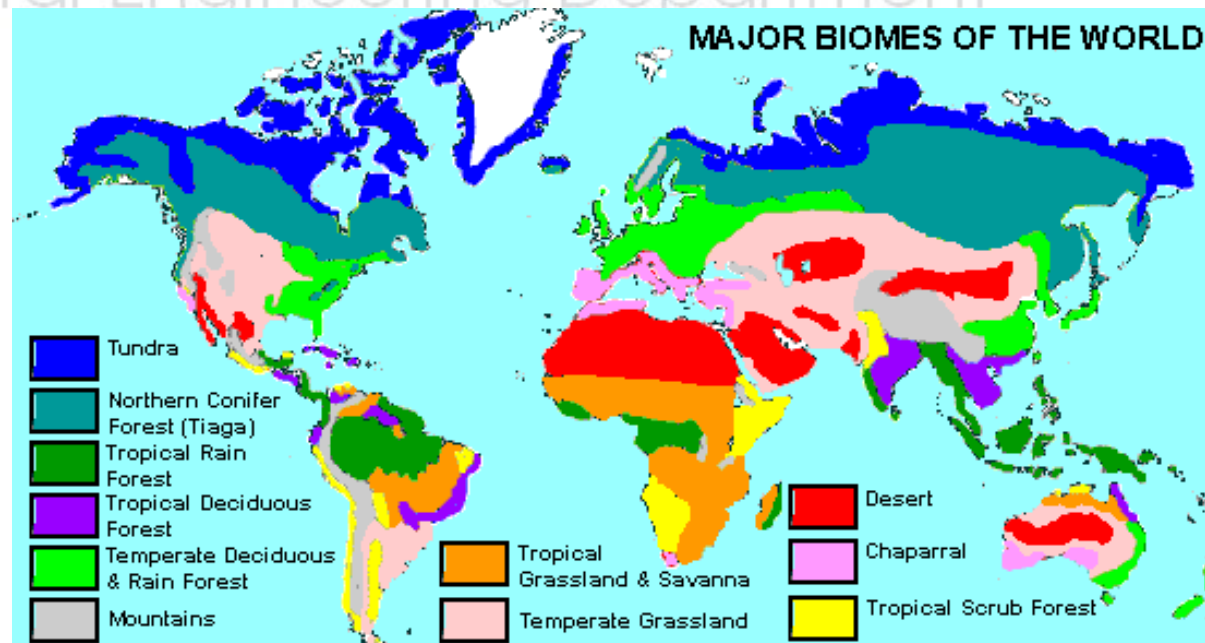
Earth's Major Biomes

TEMPERATE RAIN FORESTS: LUSH TEMPERATE FORESTS

A coniferous biome with cool weather, dense fog, and high precipitation

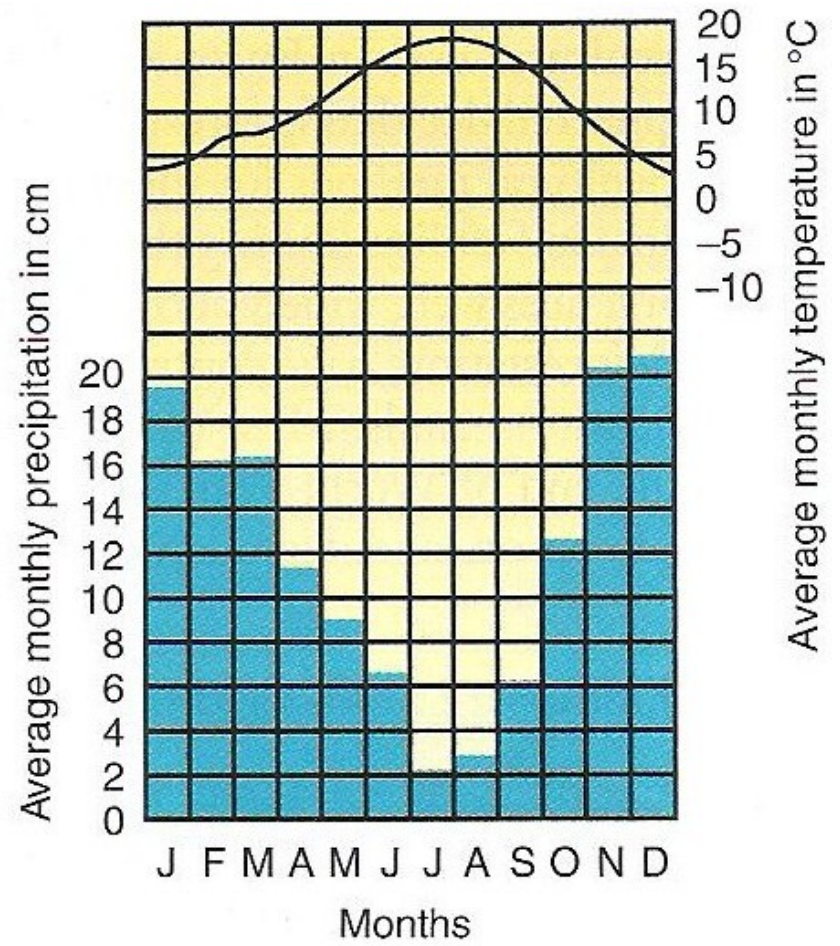
Occurs on the northwest coast of North America.

Similar vegetation exists in southeastern Australia and Southern America



Earth's Major Biomes

TEMPERATE RAIN FORESTS: LUSH TEMPERATE FORESTS



What is the average monthly temperature for this biome? and how does it compare to the range of average monthly temperatures in the boreal forest?

Earth's Major Biomes

TEMPERATE RAIN FORESTS: LUSH TEMPERATE FORESTS

- Annual precipitation is high (> 127 cm)
- The proximity to the coastline moderates the temperature so that the seasonal fluctuation is narrow: Winters are mild and summers are cool.
- Relatively nutrient-poor soil, although its organic content may be high.

Earth's Major Biomes

TEMPERATE RAIN FORESTS: LUSH TEMPERATE FORESTS

- A rich wood producer, supplying us with lumber and pulpwood
- It is also one of the world's most complex ecosystems in terms of species richness
- Such an ecosystem takes hundreds of years to develop
- The old-growth forest ecosystem, once harvested, never has a chance to redevelop
- A small fraction of the original old-growth temperate rain forest in Washington, Oregon, and northern California remains untouched
- Stable forest ecosystems provide biological habitats for many species, including 40 endangered and treated species

Earth's Major Biomes

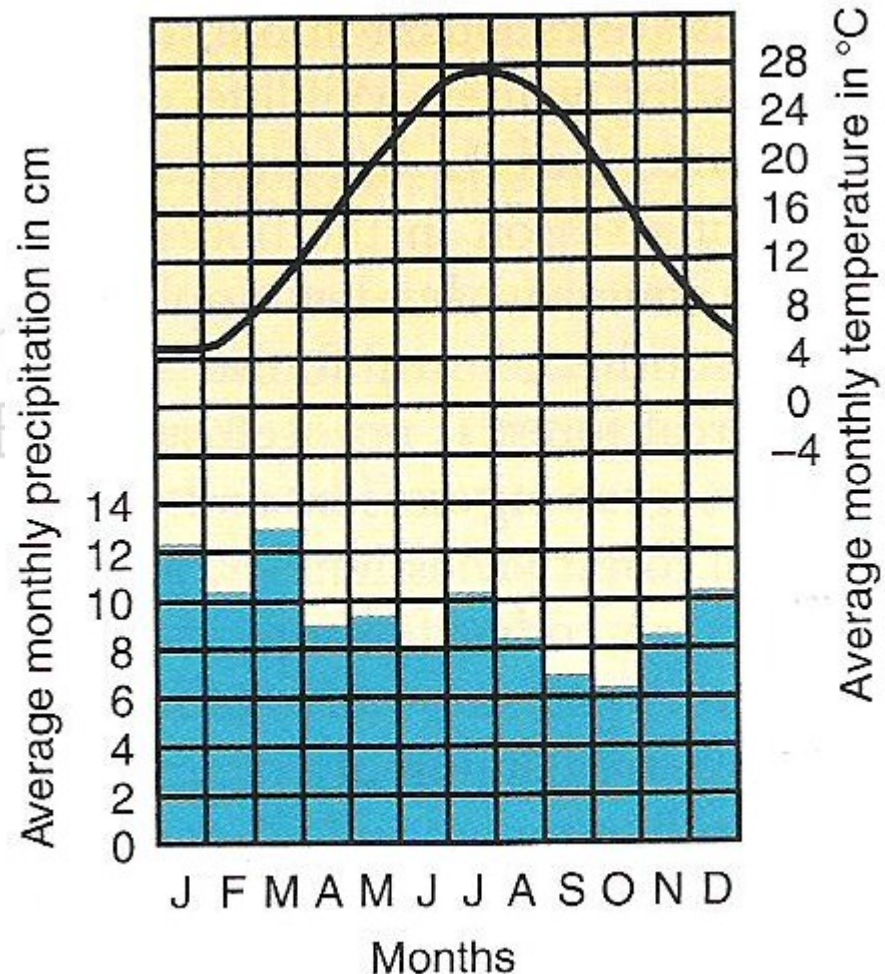
TEMPERATE DECIDUOUS FORESTS: BROAD-LEAVED TREES THAT SHED THEIR LEAVES

A forest biome that occurs in temperate areas with a moderate amount of precipitation

- Hot summers and cold winters
- Precipitation ranges from about 75 to 150 cm annually
- Topsoil rich in organic material
- A deep clay-rich lower layer
- Organic materials decay → mineral ions are released → ions not absorbed by tree roots leach into the clay

Earth's Major Biomes

TEMPERATE DECIDUOUS FORESTS: BROAD-LEAVED TREES THAT SHED THEIR LEAVES



What is the range of average monthly precipitation for this biome and how does it compare to the range of average monthly precipitation in temperate grasslands?

The logo of Marmara University is a circular seal with a central emblem and the text 'MARMARA UNIVERSITY' and '1983' around the perimeter.

Earth's Major Biomes

TEMPERATE DECIDUOUS FORESTS: BROAD-LEAVED TREES THAT SHED THEIR LEAVES

- Originally contained a variety of large mammals, such as puma, wolves, and bison, which are now absent
- Other animals: deer, bears, and many small mammals, and birds

In Europe and North America, logging and land clearing for farms, tree plantations, and cities have removed much of the original temperate deciduous forest.

First biomes converted to agricultural use

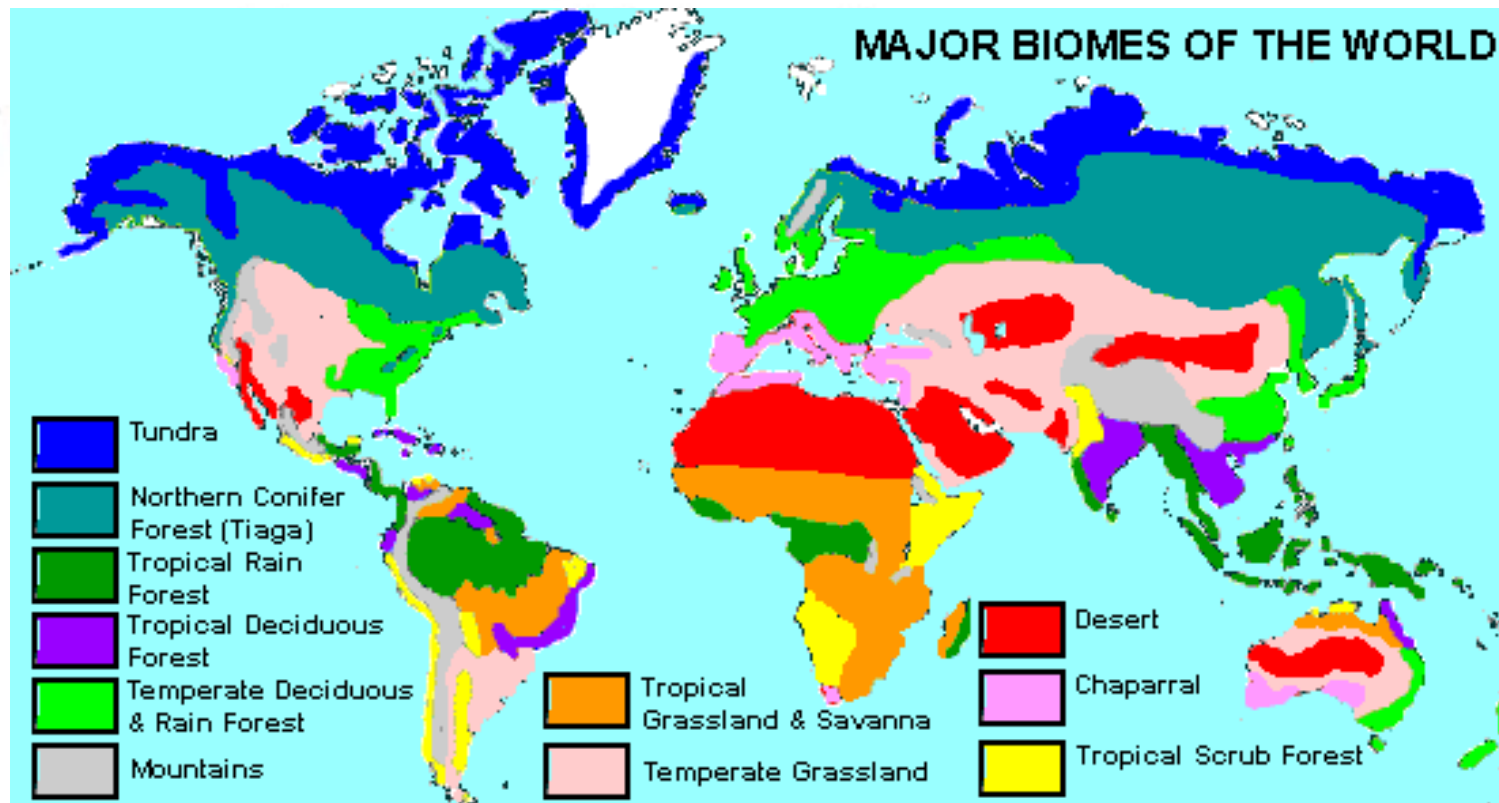
Earth's Major Biomes

GRASSLANDS: TEMPERATE SEAS OF GRASS

A grassland with hot summers, cold winters, and less rainfall than the temperate deciduous forest biome

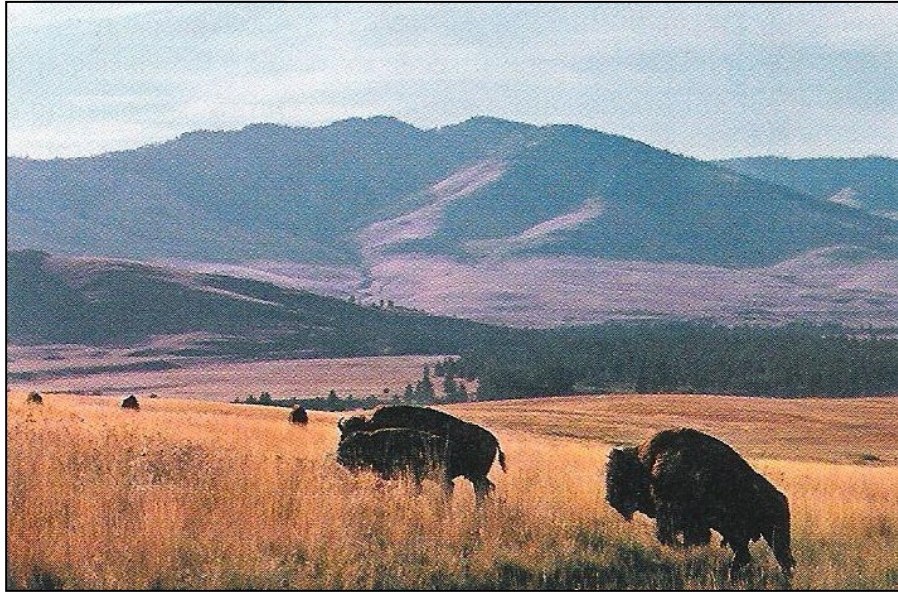
Rainfall is often uncertain; average annual precipitation 25-75 cm

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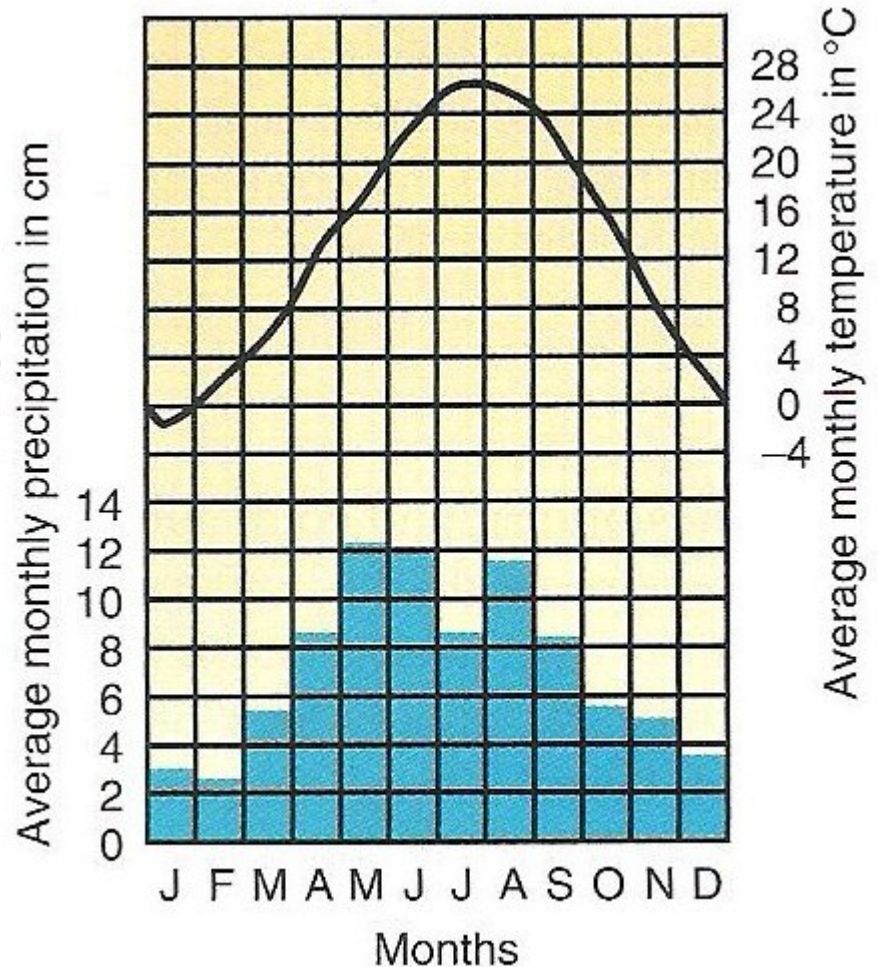


Earth's Major Biomes

GRASSLANDS: TEMPERATE SEAS OF GRASS



When is the rainy season in temperate grasslands? the dry season?



The logo of Marmara University is a circular seal. It features a central figure, possibly a lion or a similar mythical creature, standing on a base. The text "MARMARA UNIVERSITY" is written around the top inner edge of the circle, and the year "1883" is at the bottom. The logo is semi-transparent and serves as a background for the title.

Earth's Major Biomes

GRASSLANDS: TEMPERATE SEAS OF GRASS

Seasons are regulated by temperature

Grassland soil has considerable organic material, because of die off of upper portions of many grasses each winter and their contribution to the organic content of the soil

Ideal growing conditions for crops such as corn and wheat, which are also grasses

Because this biome well suited to agriculture, most of the grasslands have vanished.

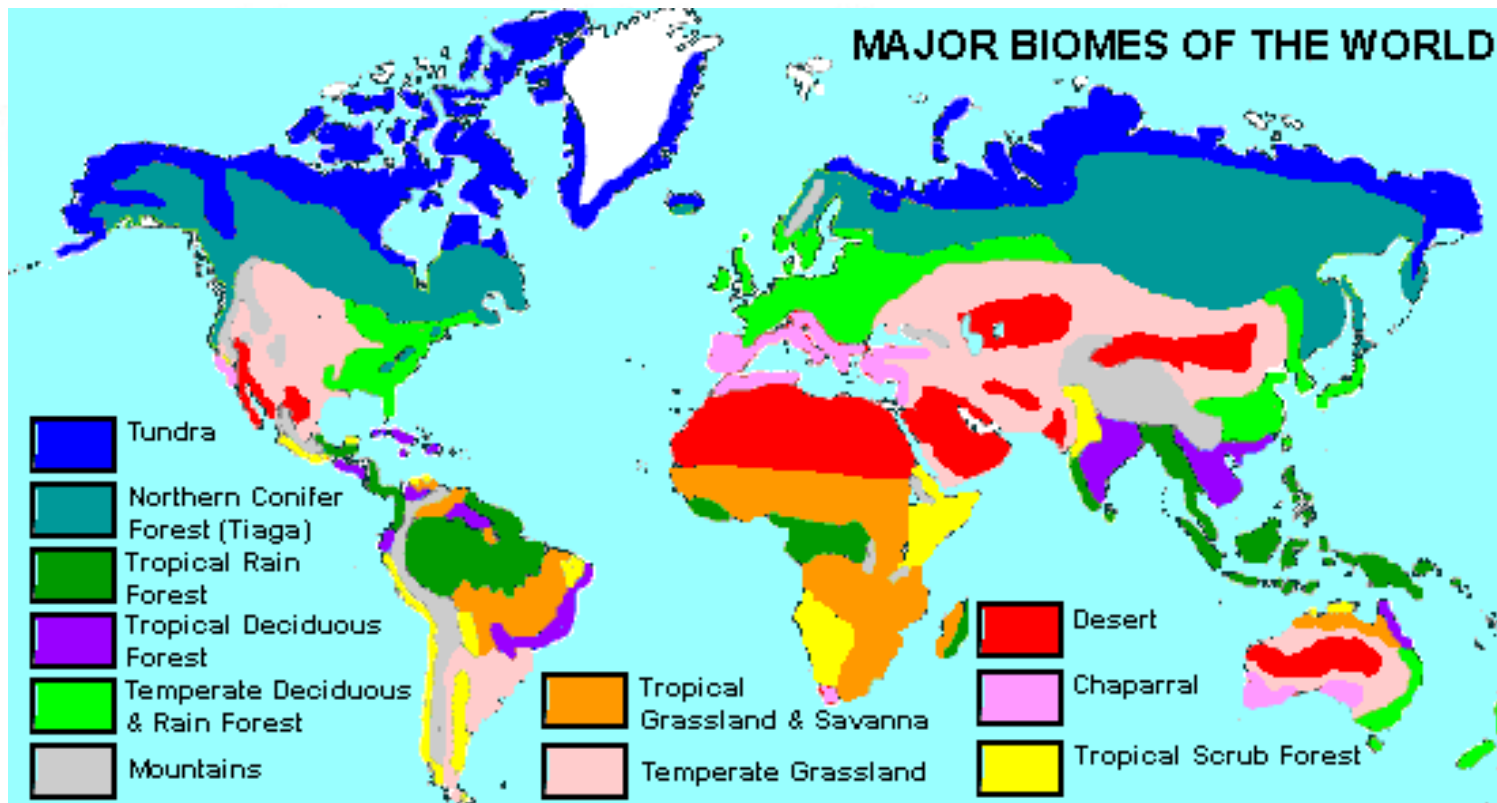
Earth's Major Biomes

CHAPARRAL: THICKETS OF EVERGREEN SHRUBS AND SMALL TREES

A biome with mild, moist winters and hot and dry summers; vegetation is typically small-leaved evergreen shrubs & small trees

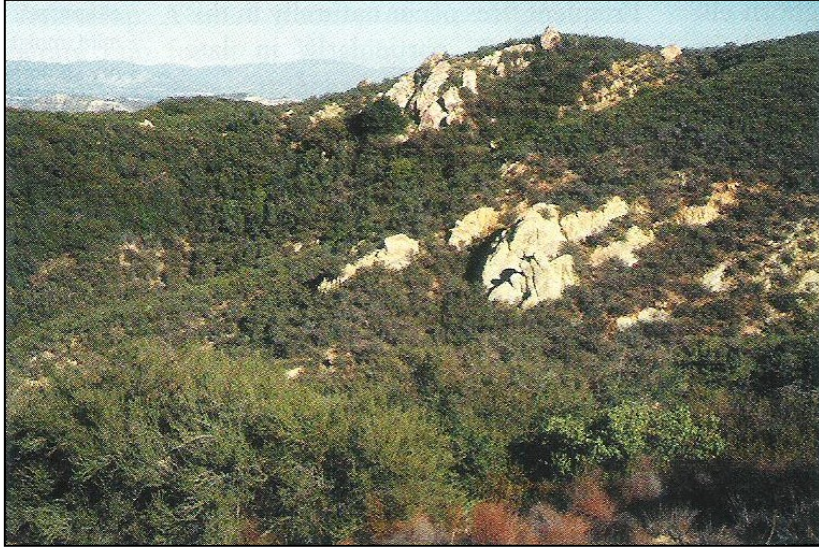
Mediterranean climates

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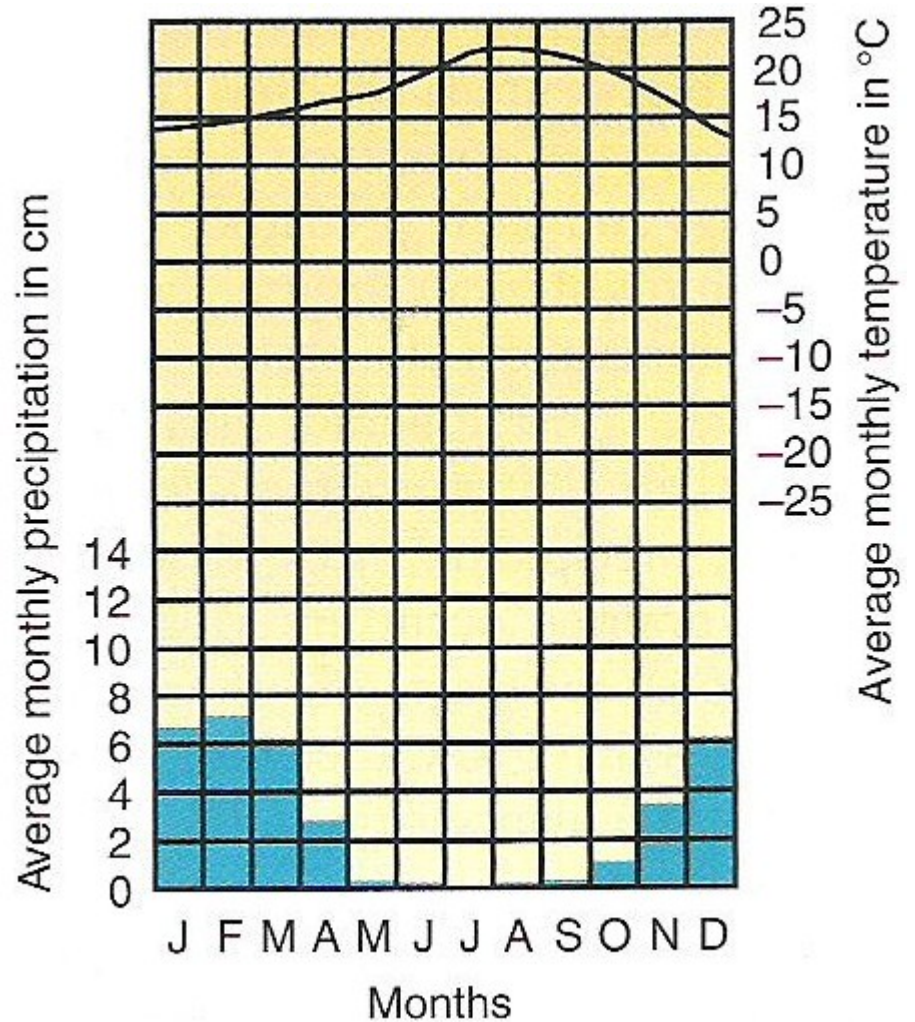


Earth's Major Biomes

CHAPARRAL: THICKETS OF EVERGREEN SHRUBS AND SMALL TREES



What is the average *annual* precipitation?



Earth's Major Biomes

CHAPARRAL: THICKETS OF EVERGREEN SHRUBS AND SMALL TREES

Thin and often not fertile.

Frequent fires occur naturally in this environment, particularly in late summer and autumn.

Trees and shrubs often have hard, small, leathery leaves that resist water loss.

Many plants are also fire-adapted and grow best in the months following a fire.

Fire releases nutrient minerals from aerial parts of the plants that burned (fire does not kill the underground parts and seeds of many plants).

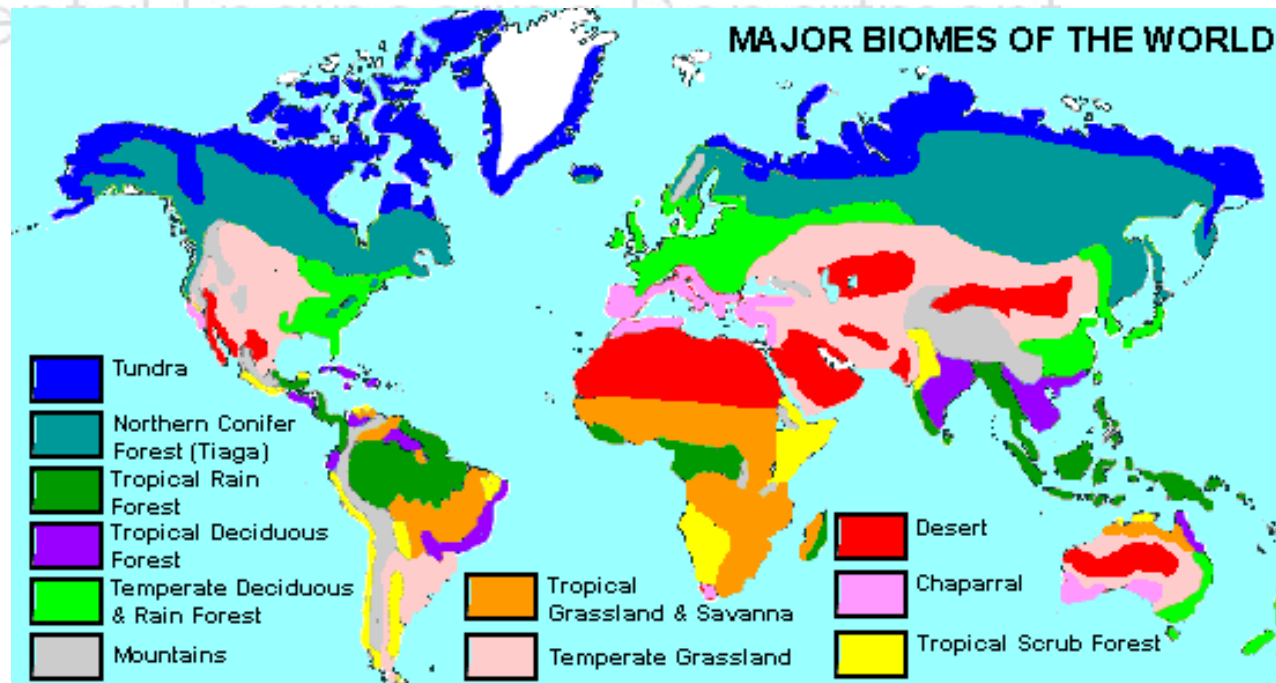
Earth's Major Biomes

DESERTS: ARID LIFE ZONES

A biome in which the lack of precipitation limits plant growth

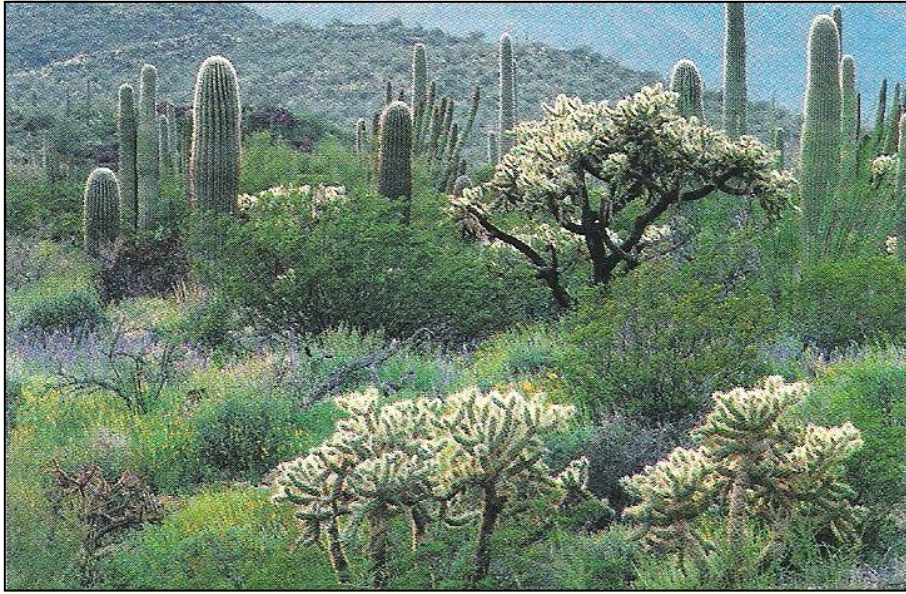
Dry areas

Found in both temperate (cold deserts) and subtropical regions (warm deserts)

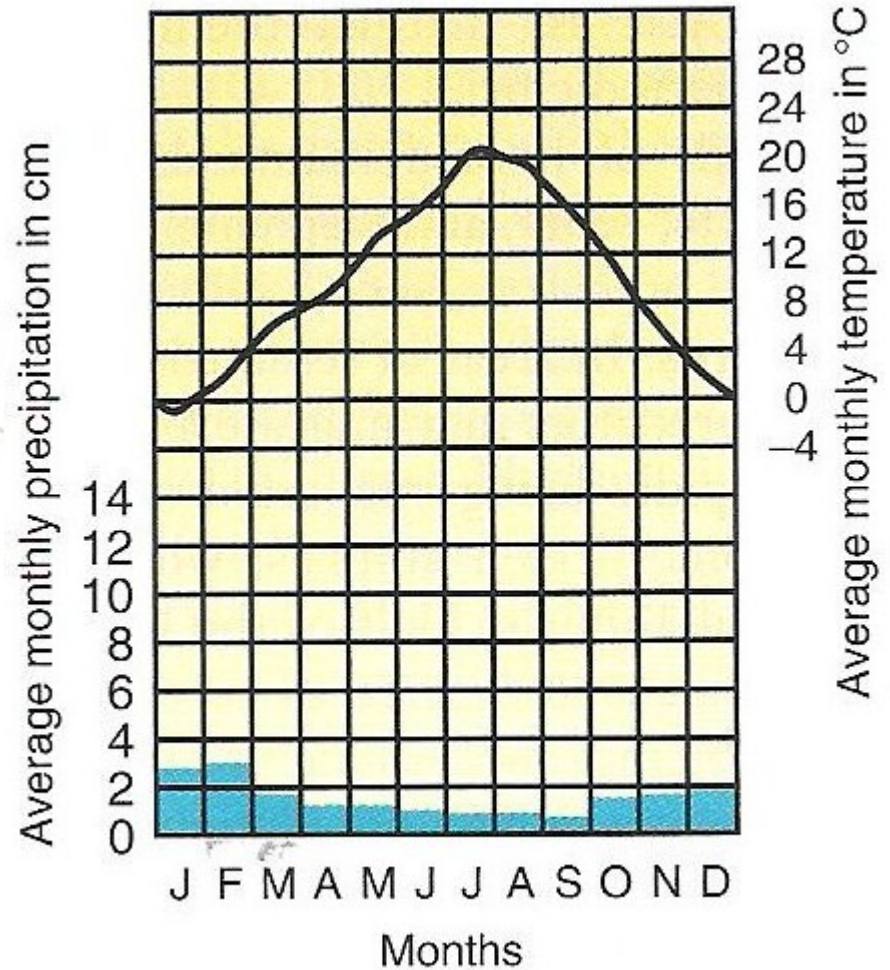


Earth's Major Biomes

DESERTS: ARID LIFE ZONES



Based on average monthly temperatures, is the desert a warm or a cold desert?



The logo of Majmaah University is a circular seal. It features a central emblem with a book and a quill, surrounded by the text "MAJMAAH UNIVERSITY" at the top and "1983" at the bottom.

Earth's Major Biomes

DESERTS: ARID LIFE ZONES

Houses, factories, and farms built in desert areas require vast quantities of water, which is imported from distant areas.

Increased groundwater consumption by many desert cities has caused groundwater levels to drop.

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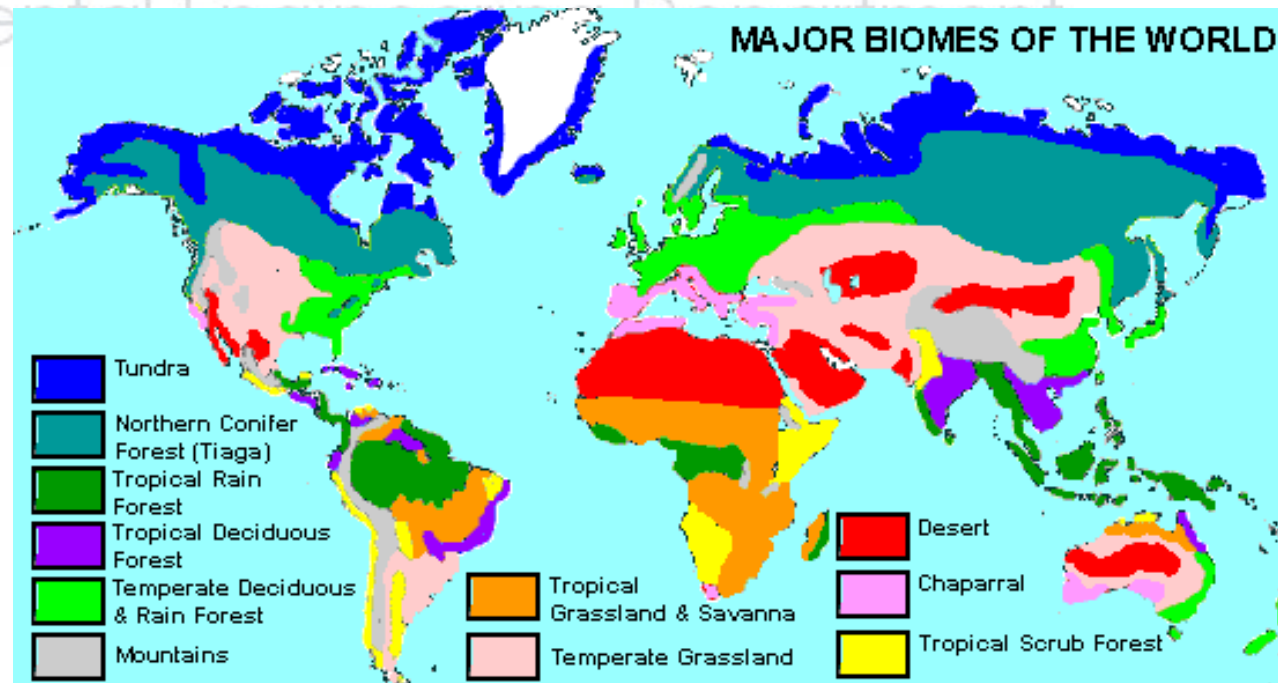
Earth's Major Biomes

SAVANNA: TROPICAL GRASSLANDS

A tropical grassland with widely scattered trees or clumps of trees

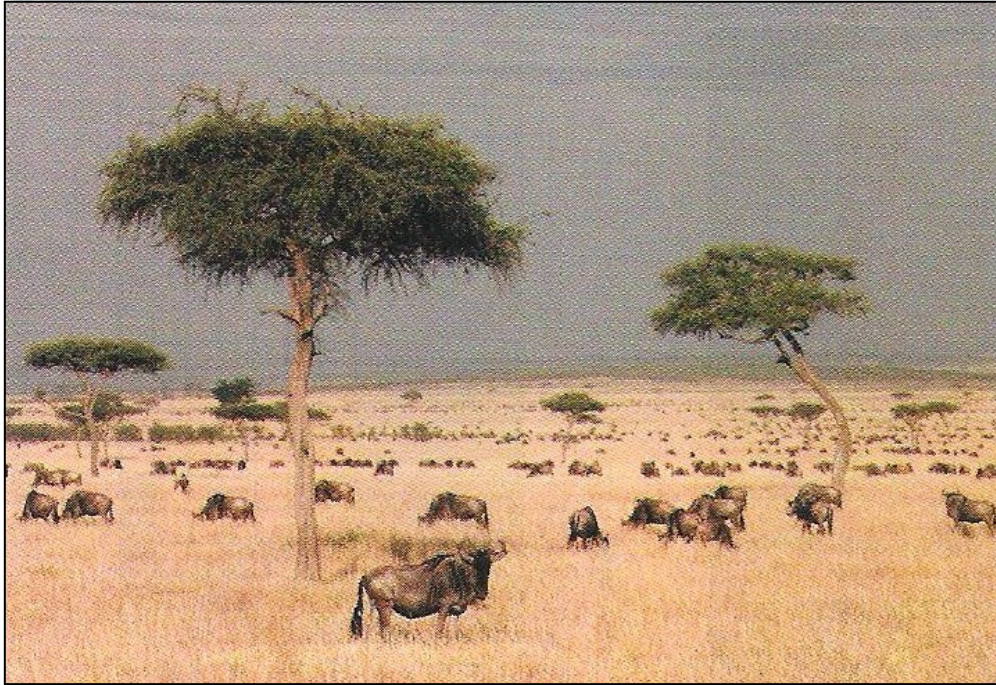
Occurs in areas of low rainfall or seasonal rainfall with prolonged dry periods

Temperatures vary little throughout the year

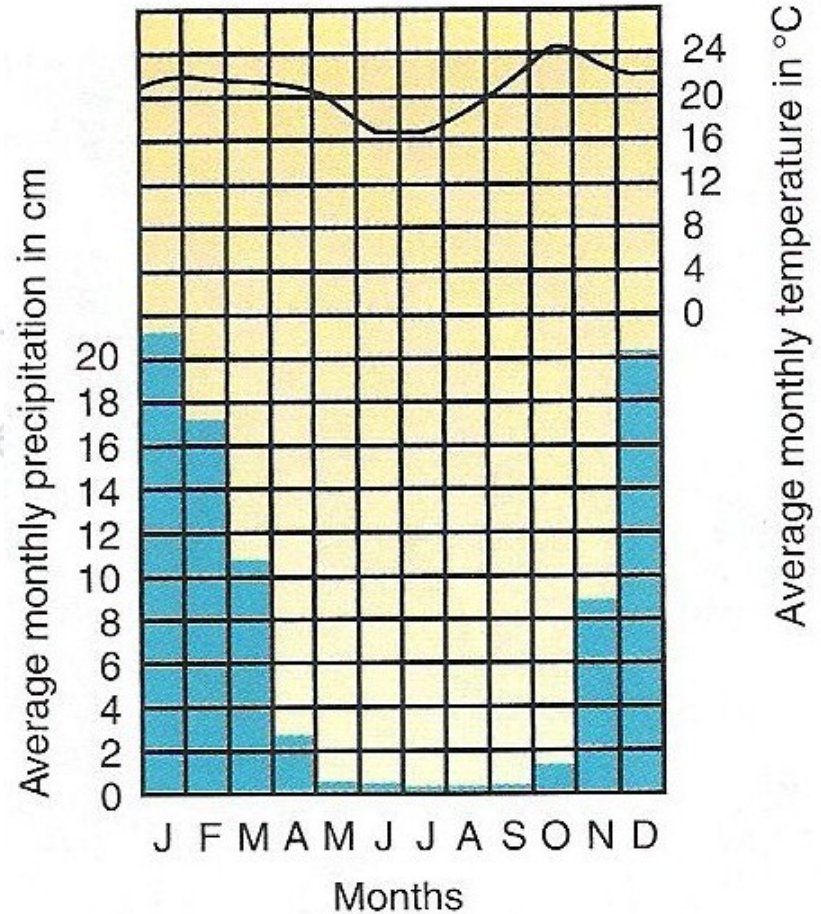


Earth's Major Biomes

SAVANNA: TROPICAL GRASSLANDS



From the average monthly precipitation data, when do you think grazing animals would migrate to find food?



The logo of Marmara University is a circular seal. It features a central figure, possibly a scholar or a religious figure, surrounded by the text 'MARMARA UNIVERSITY' at the top and '1883' at the bottom. The seal is light blue and semi-transparent.

Earth's Major Biomes

SAVANNA: TROPICAL GRASSLANDS

- Seasons are regulated by precipitation, not by temperature
- Annual precipitation is 76-150 cm
- Savanna soil is low in essential nutrient minerals, because it is strongly leached
- Aluminum resists leaching, savanna soil is often rich in aluminum (toxic to many plants in some places)
- Both trees and grasses have fire-adapted features, such as extensive root systems, that let them survive seasonal droughts as well as periodic fires

The logo of Marmara University is a circular seal with the text 'MARMARA UNIVERSITY' around the top and '1883' at the bottom. In the center, there is a stylized figure of a person.

Earth's Major Biomes

SAVANNA: TROPICAL GRASSLANDS

- Rapidly being converted into rangeland for cattle and other domesticated animals
- The problem is more acute in Africa because it has the most rapidly growing human population of any continent
- In some places, severe overgrazing and harvesting of trees for firewood have converted savanna to desert, a process called desertification

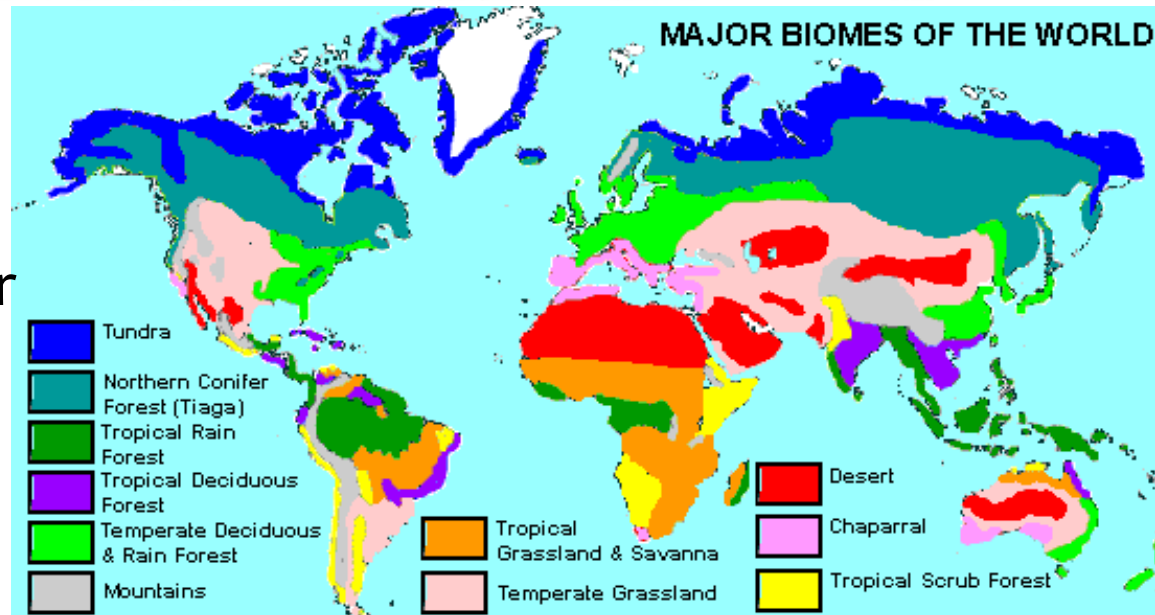
Earth's Major Biomes

TROPICAL RAIN FORESTS: LUSH EQUATORIAL FORESTS

Occurs where temperatures are warm throughout the year & precipitation occurs almost daily.

Annual precipitation: 200-450 cm

Much of this precipitation comes from locally recycled water that enters the atmosphere by transpiration (loss of water vapor from plants) of the forest's own trees

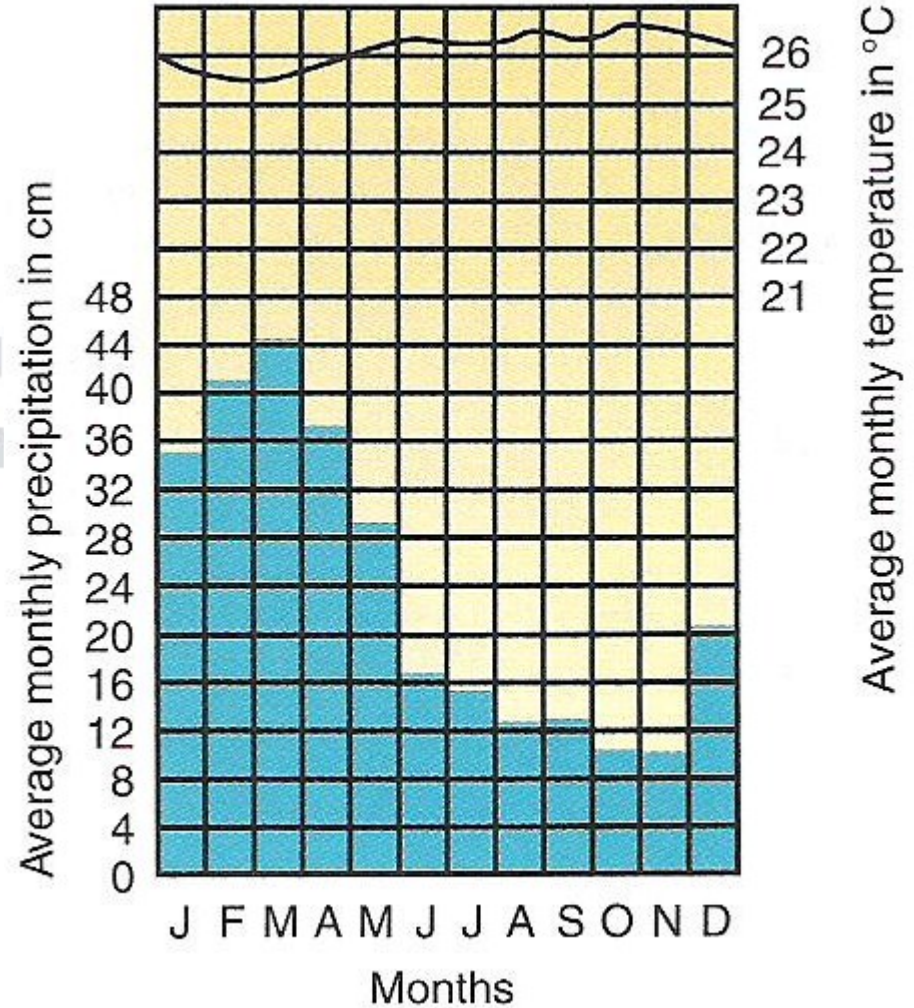


Earth's Major Biomes

TROPICAL RAIN FORESTS: LUSH EQUATORIAL FORESTS



What is the range in average monthly temperatures?



The logo of Mannan University is a circular seal. It features a central emblem with a book and a lamp, surrounded by the text "MANNAN UNIVERSITY" at the top and "1883" at the bottom.

Earth's Major Biomes

TROPICAL RAIN FORESTS: LUSH EQUATORIAL FORESTS

Nutrient minerals of tropical rain forests are tied up in the vegetation rather than the soil

- Little organic material accumulates in such soils because bacteria, fungi, and detritus-feeding ants and termites decompose organic litter quite rapidly.
- Roots quickly absorb nutrient minerals from the decomposing material



Earth's Major Biomes

TROPICAL RAIN FORESTS: LUSH EQUATORIAL FORESTS

Very productive

- Plants capture a lot of energy by photosynthesis

Of the all biomes, the tropical rainforest is unexcelled in species richness and variety

- A person can travel hundreds of meters without encountering two individuals of the same tree species

Earth's Major Biomes

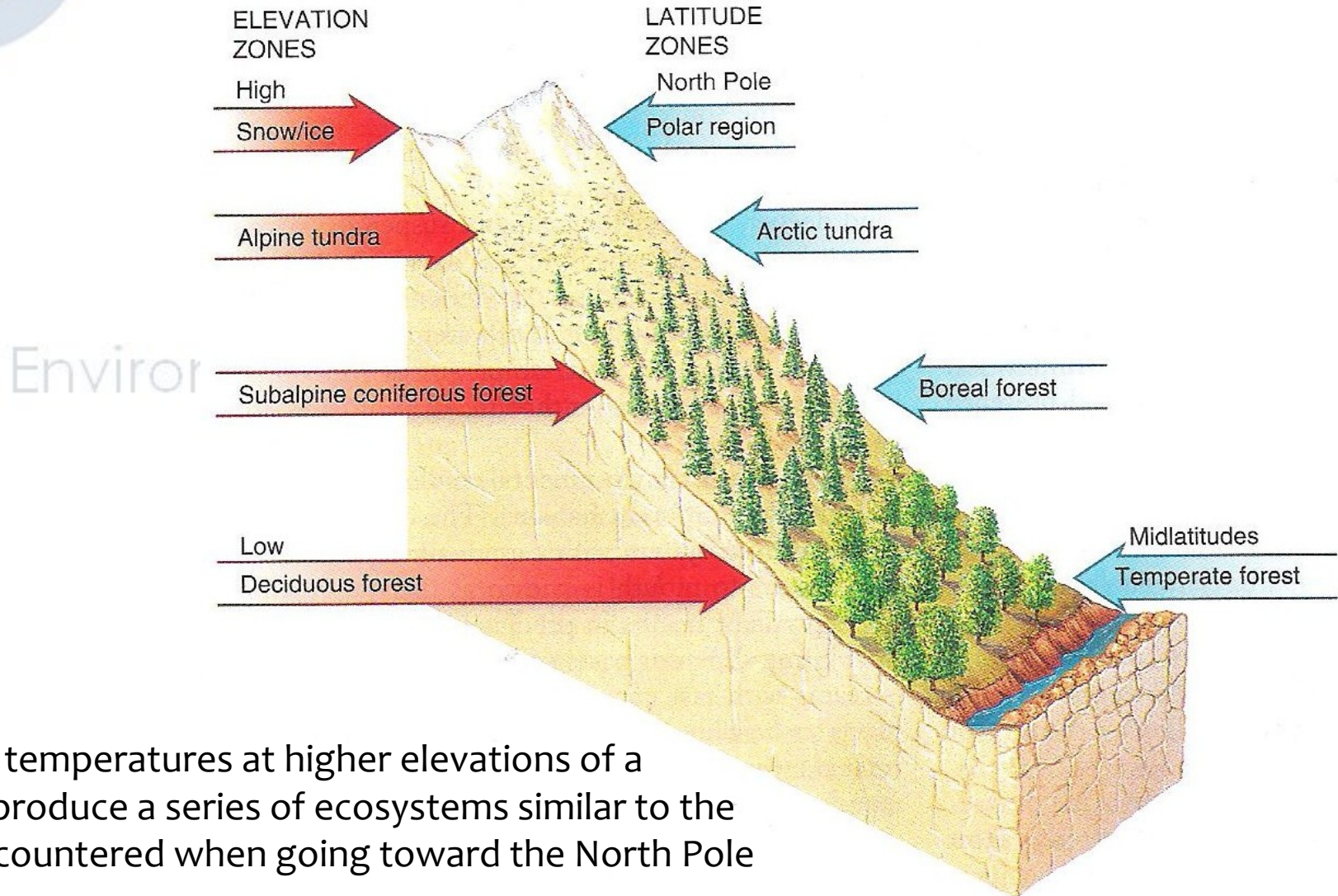
VERTICAL ZONATION: THE DISTRIBUTION OF VEGETATION ON MOUNTAINS

- Temperature drops to the north
- The types of organisms living on the mountain change as the temperature changes

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Earth's Major Biomes

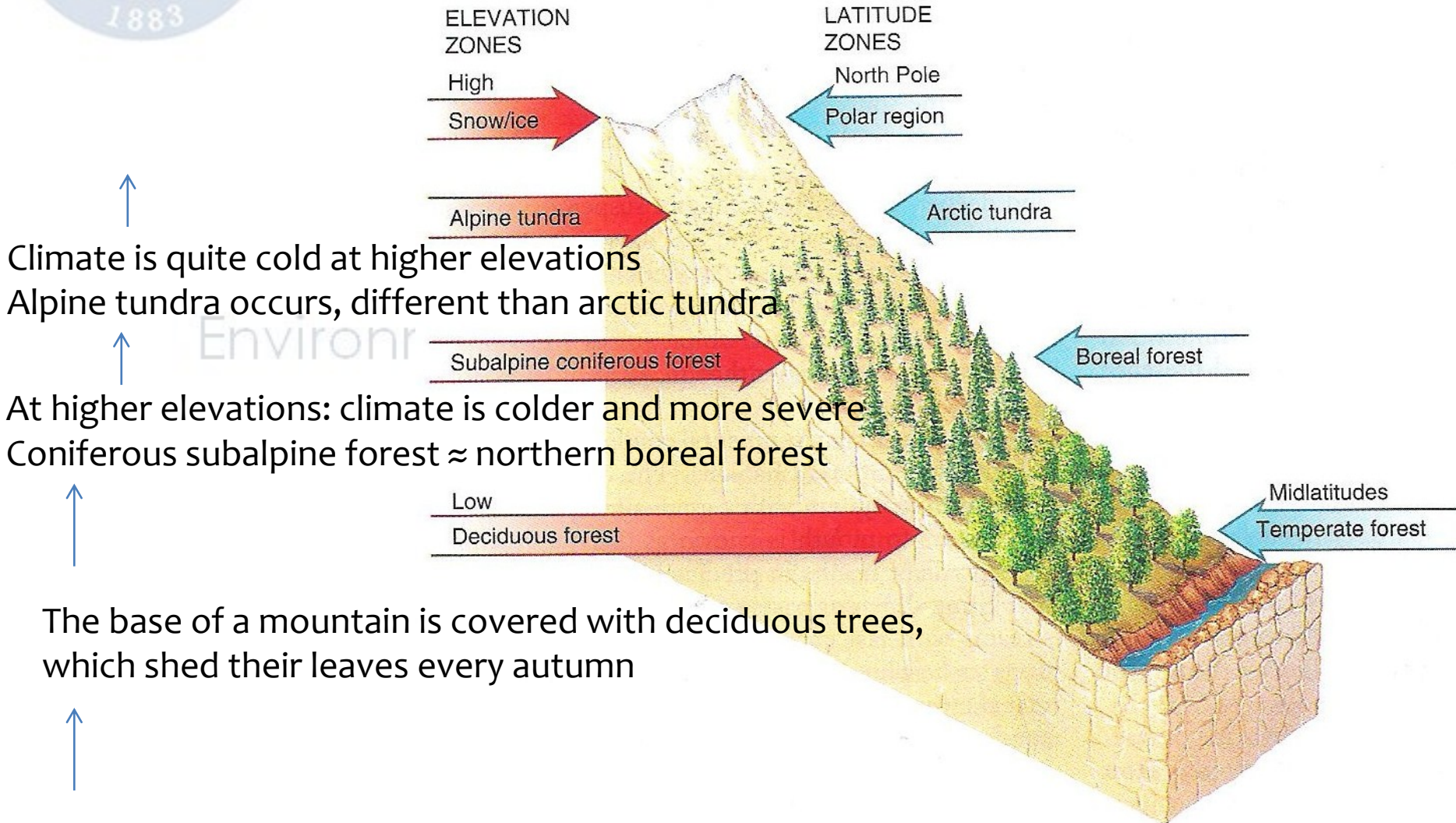
VERTICAL ZONATION: THE DISTRIBUTION OF VEGETATION ON MOUNTAINS



The cooler temperatures at higher elevations of a mountain produce a series of ecosystems similar to the biomes encountered when going toward the North Pole

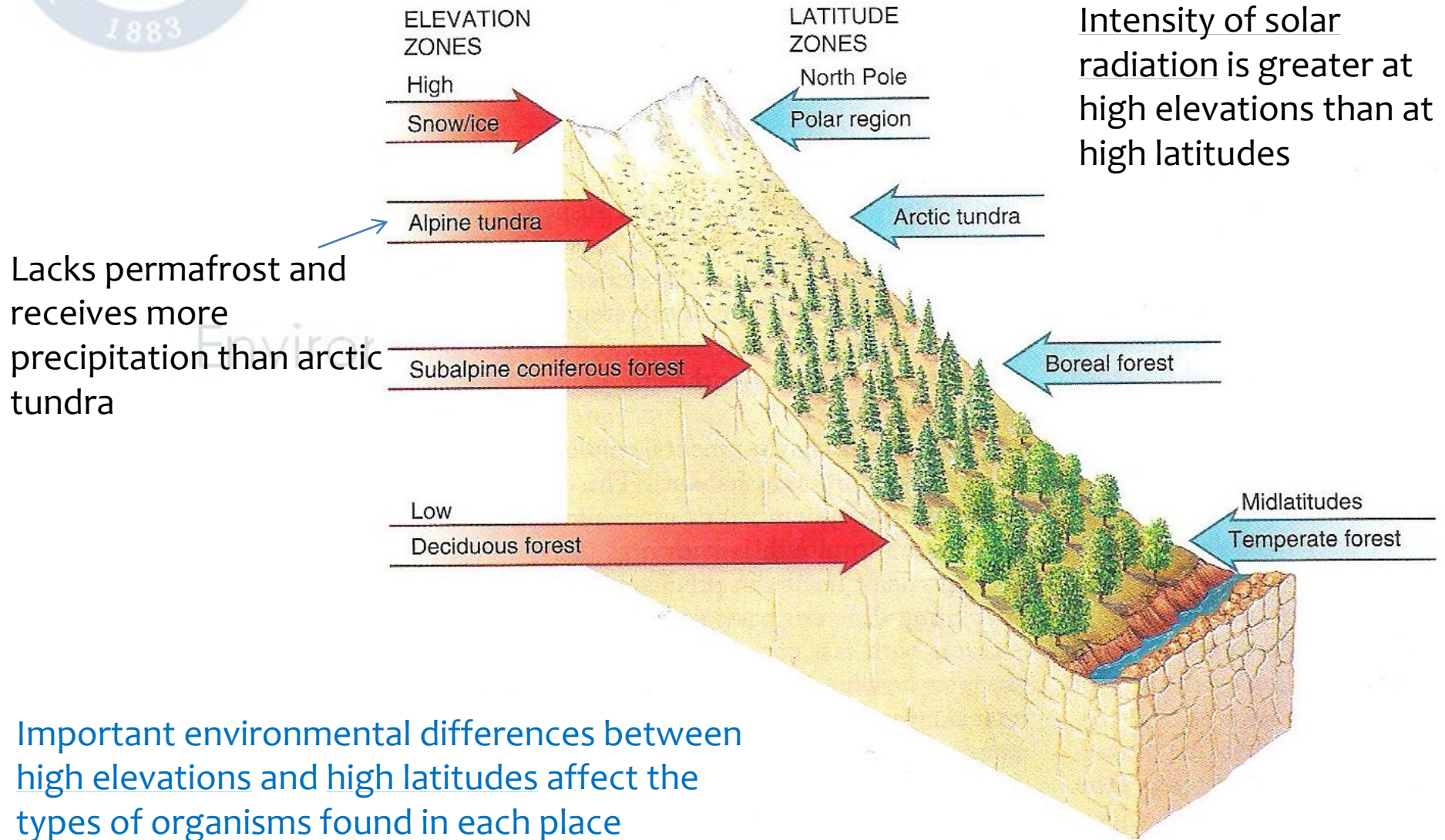
Earth's Major Biomes

VERTICAL ZONATION: THE DISTRIBUTION OF VEGETATION ON MOUNTAINS



Earth's Major Biomes

VERTICAL ZONATION: THE DISTRIBUTION OF VEGETATION ON MOUNTAINS

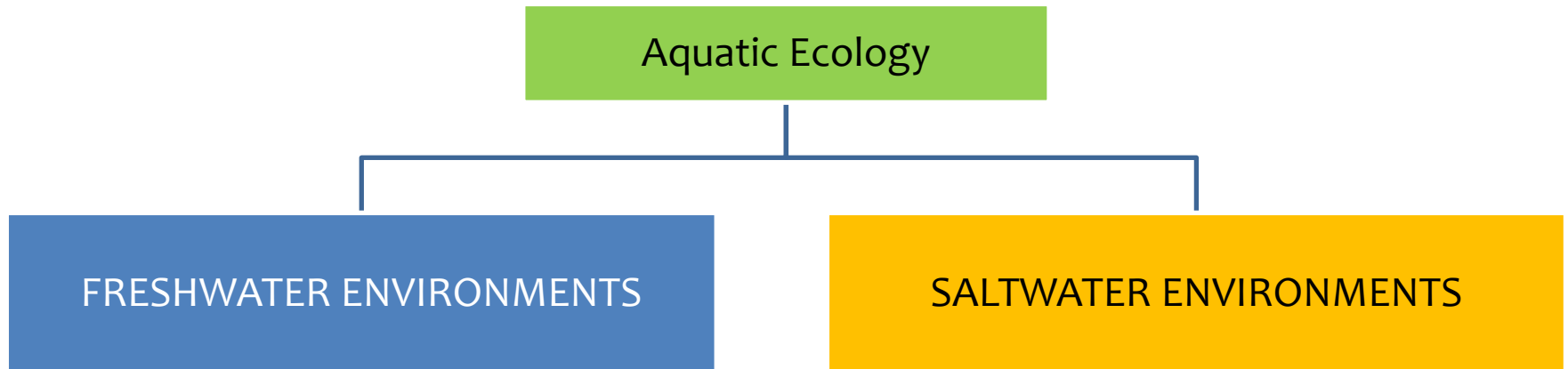


Aquatic Ecosystems

Aquatic life zones differ from terrestrial biomes

Temperature is less important in watery environments because the water itself tends to moderate temperature

The most fundamental division



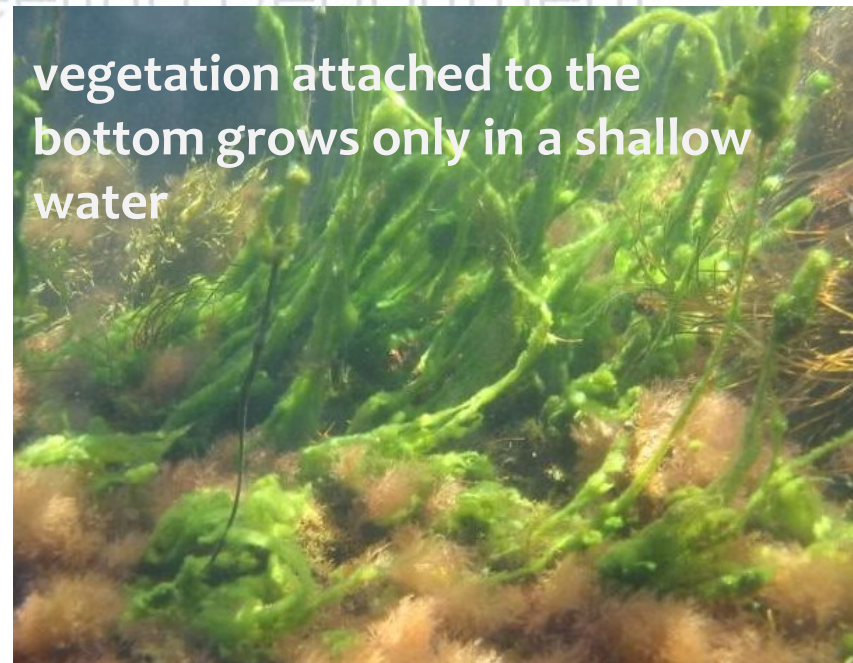
Aquatic Ecosystems

Parameters affect the kinds of organisms present in aquatic systems

SALINITY: conc. of dissolved salts, e.g. NaCl

DISSOLVED OXYGEN

LIGHT: Floating photosynthetic organisms remain near the water surface



vegetation attached to the bottom grows only in a shallow water



Aquatic Ecosystems

Parameters affect the kinds of organisms present in aquatic systems

NUTRIENT MINERALS: Limit the number and distribution of organisms

Other abiotic determinants of species composition in aquatic ecosystems

TEMPERATURE

pH

presence or absence of WAVES and CURRENTS

Aquatic Ecosystems

Aquatic ecosystems contain 3 main ecological categories of organisms

Aquatic
Organisms

Free-Floating
Plankton



Strongly Swimming
Nekton



Bottom-Dwelling
Benthos



Aquatic Ecosystems

PLANKTON

Small and microscopic organisms

Relatively feeble swimmers, carried with waves and currents

PLANKTON

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graph TD; A[PLANKTON] --- B[Phytoplankton]; A --- C[Zooplankton]
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Phytoplankton

- Free-floating photosynthetic algae and cyanobacteria
- Base of most aquatic food webs

Zooplankton

- Nonphotosynthetic organisms
- Protozoa (animal-like protists), tiny shrimplike crustaceans, and the larval (immature) stages of many animals
- Zooplankton feed on algae & cyanobacteria in aquatic food webs



Aquatic Ecosystems

NEKTON

Larger,

More strongly swimming organisms such as fishes, turtles, and whales

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BENTHOS

Bottom-dwelling organisms

Fix themselves to one spot (sponges, oysters, barnacles)

Burrow into the sand (worms, clams, and sea cucumbers)

Or simply walk about on the bottom (crawfish, aquatic insect larvae, and brittle stars)