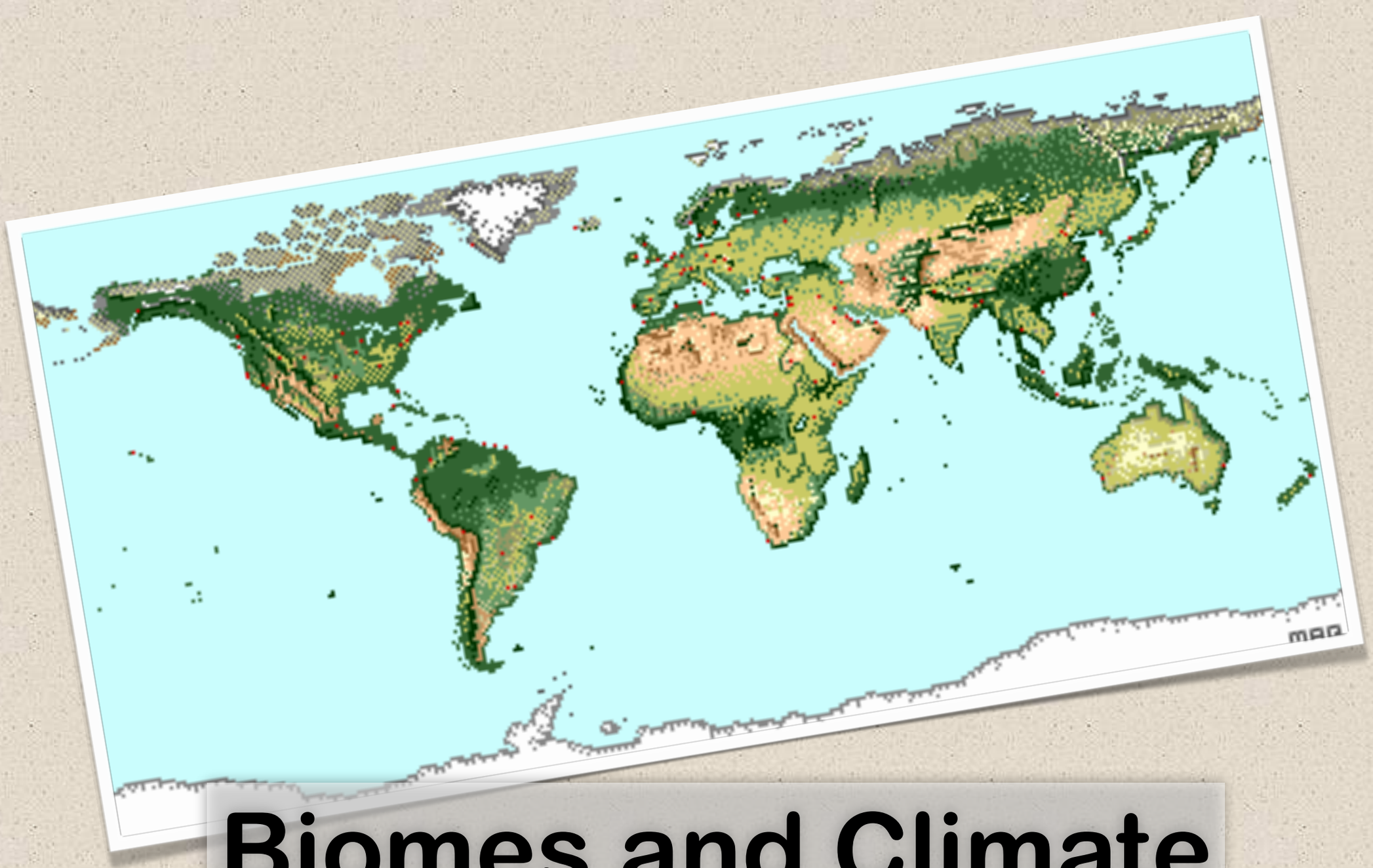


Biomes and Climate

Biome - climatically controlled set of ecosystems that are characterized by distinctive vegetation and among which there exists an exchange of water, nutrients, gases, and organisms within that environment.

Biospheres could be utilized to create microclimates.

Distribution of Biomes

Factors Contributing to Biome Distribution

1) Heat distribution from the sun and seasonality of the different portions of the Earth

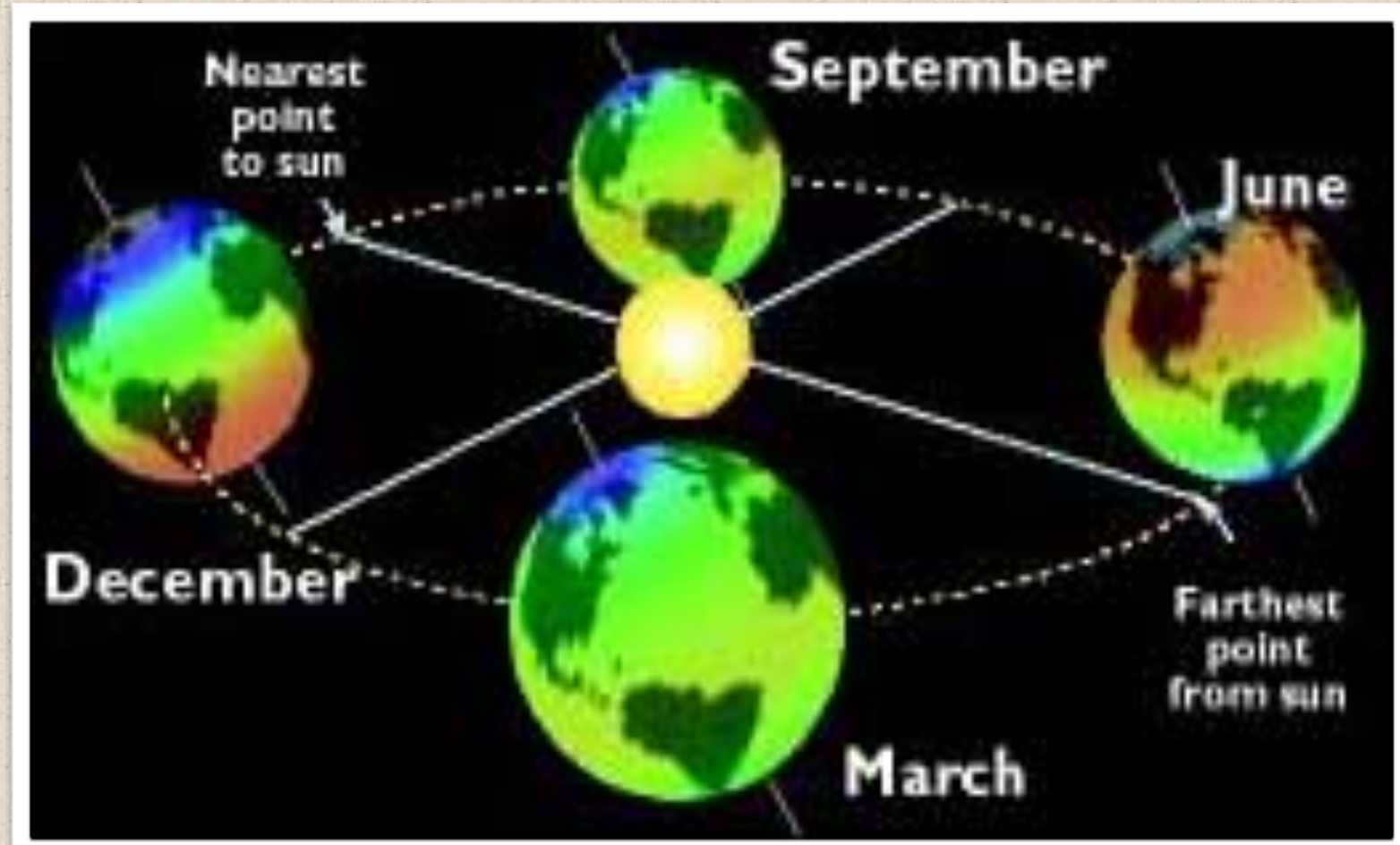
   a. Earths tilt and orbit causes seasons

2) Global patterns of air circulation, particularly the directions of moisture-laden air

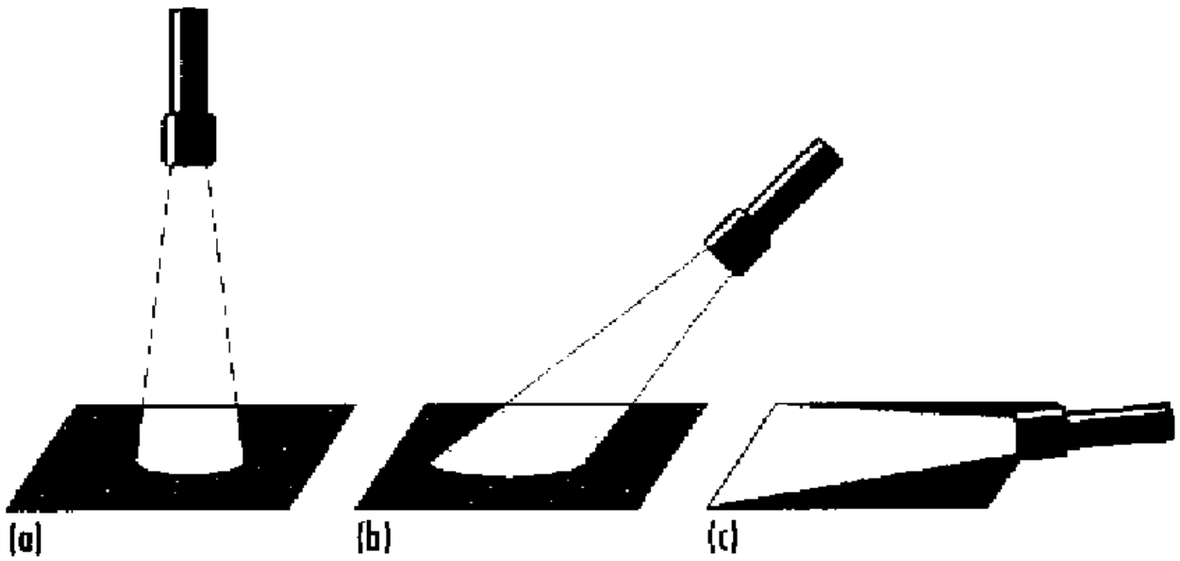
   a. global winds

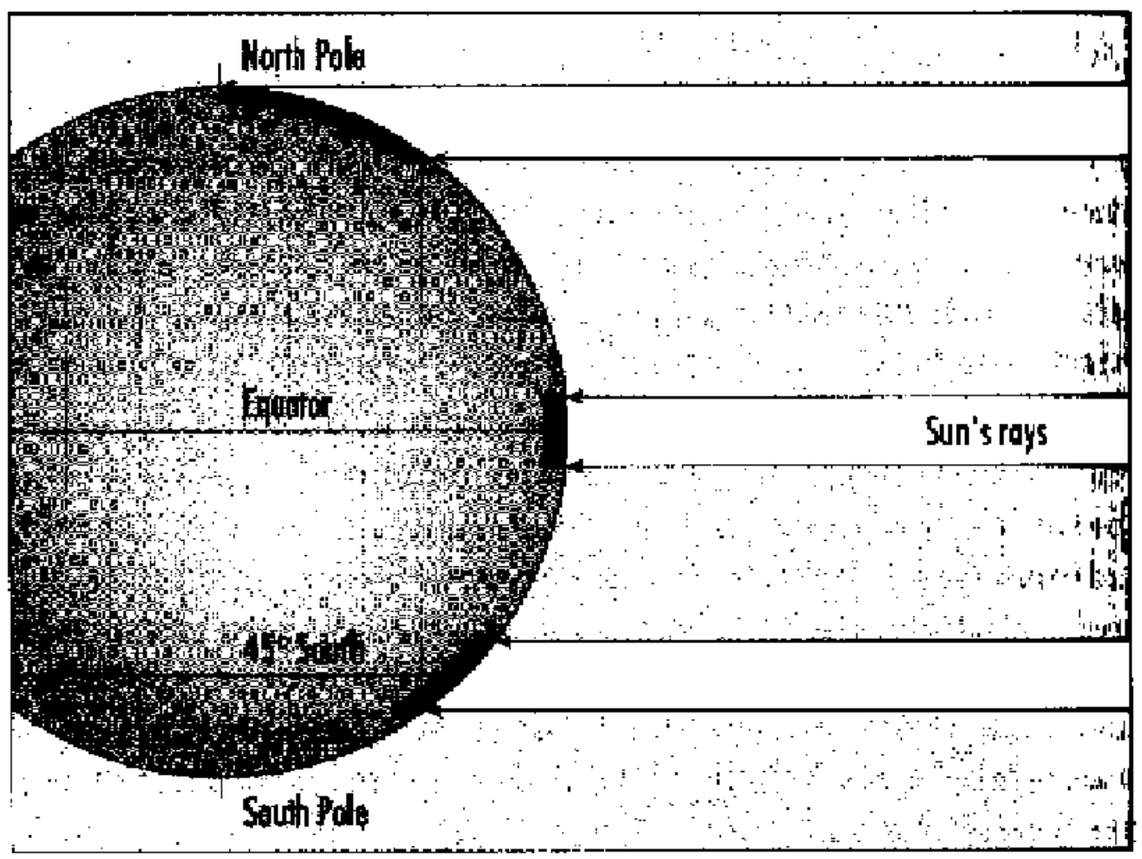
   b. air masses: tropical continental – hot dry, tropical maritime warm wet, polar continental – cold dry, polar maritime- cool wet.

3) Geologic factors such as mountains and their height, orientation, distribution, etc.



Earth is strongly tilted, creating hot summers and cold winters. Summer temperatures in the northern hemisphere, however, are moderated by a long earth-sun distance. Earth's orbit is nearly circular.





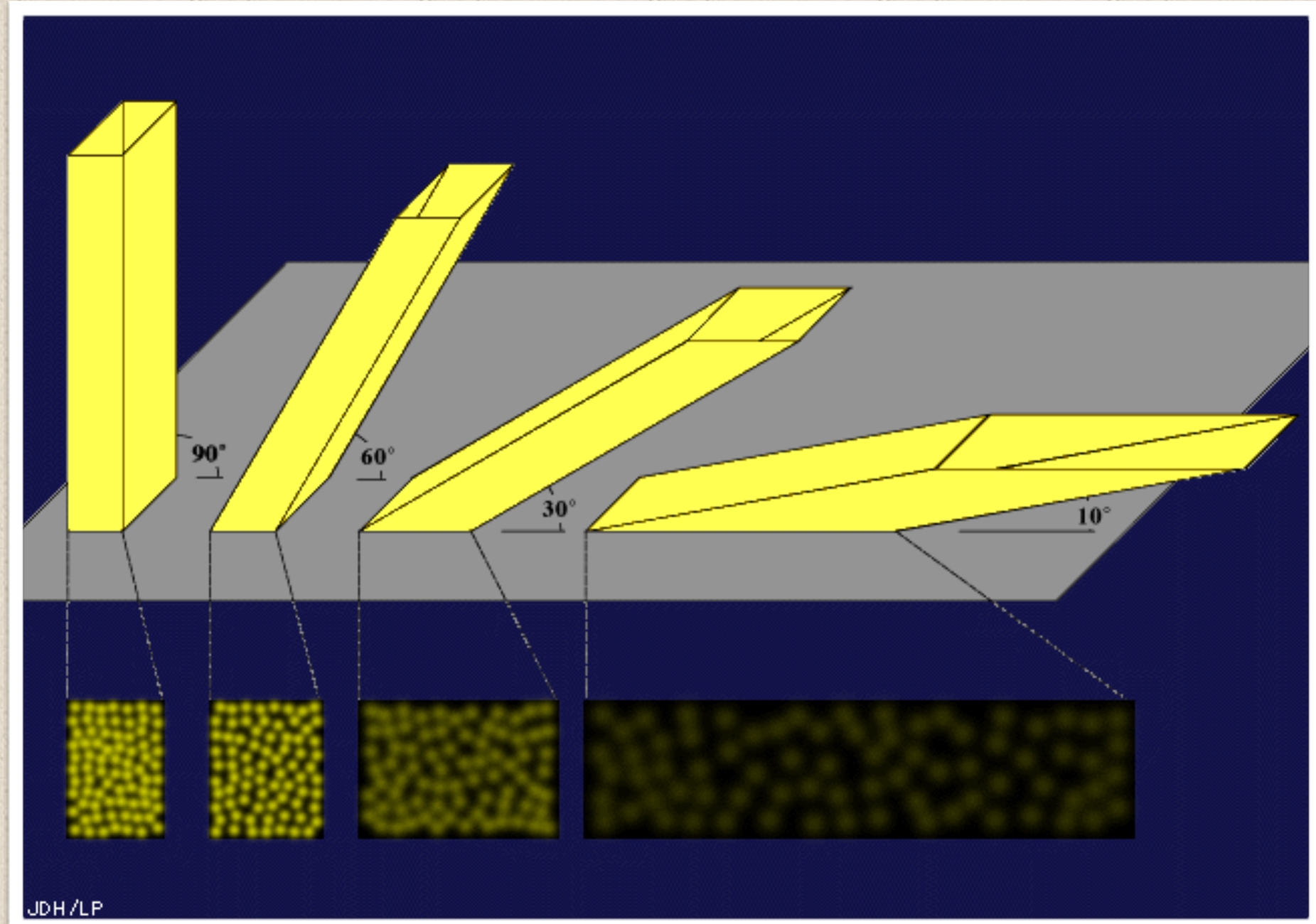
In the figure to the right,

(a) direct light: most concentration of energy

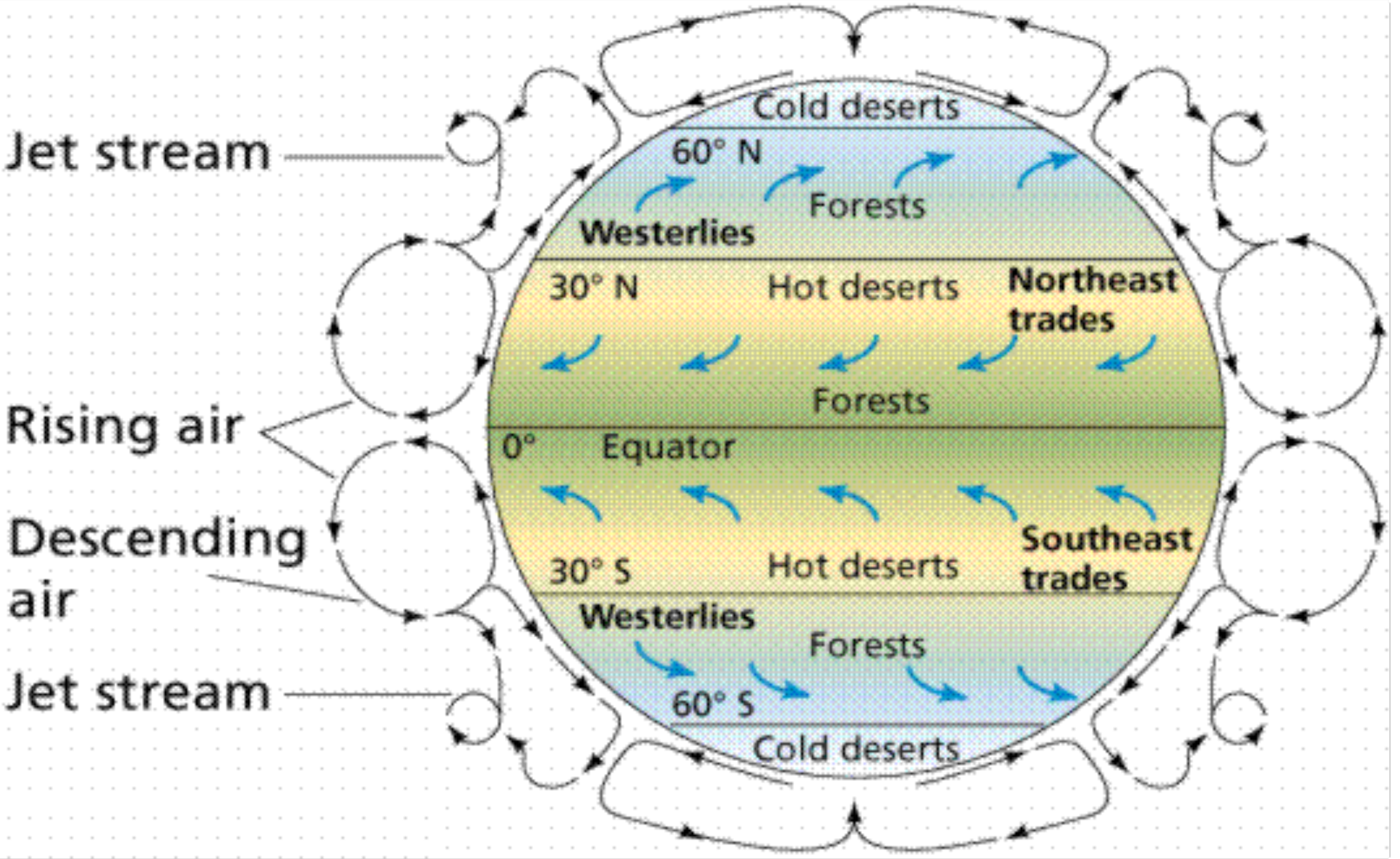
(b) indirect: least concentration of energy

The earth receives the most energy at the equator, where the suns rays are the most concentrated.

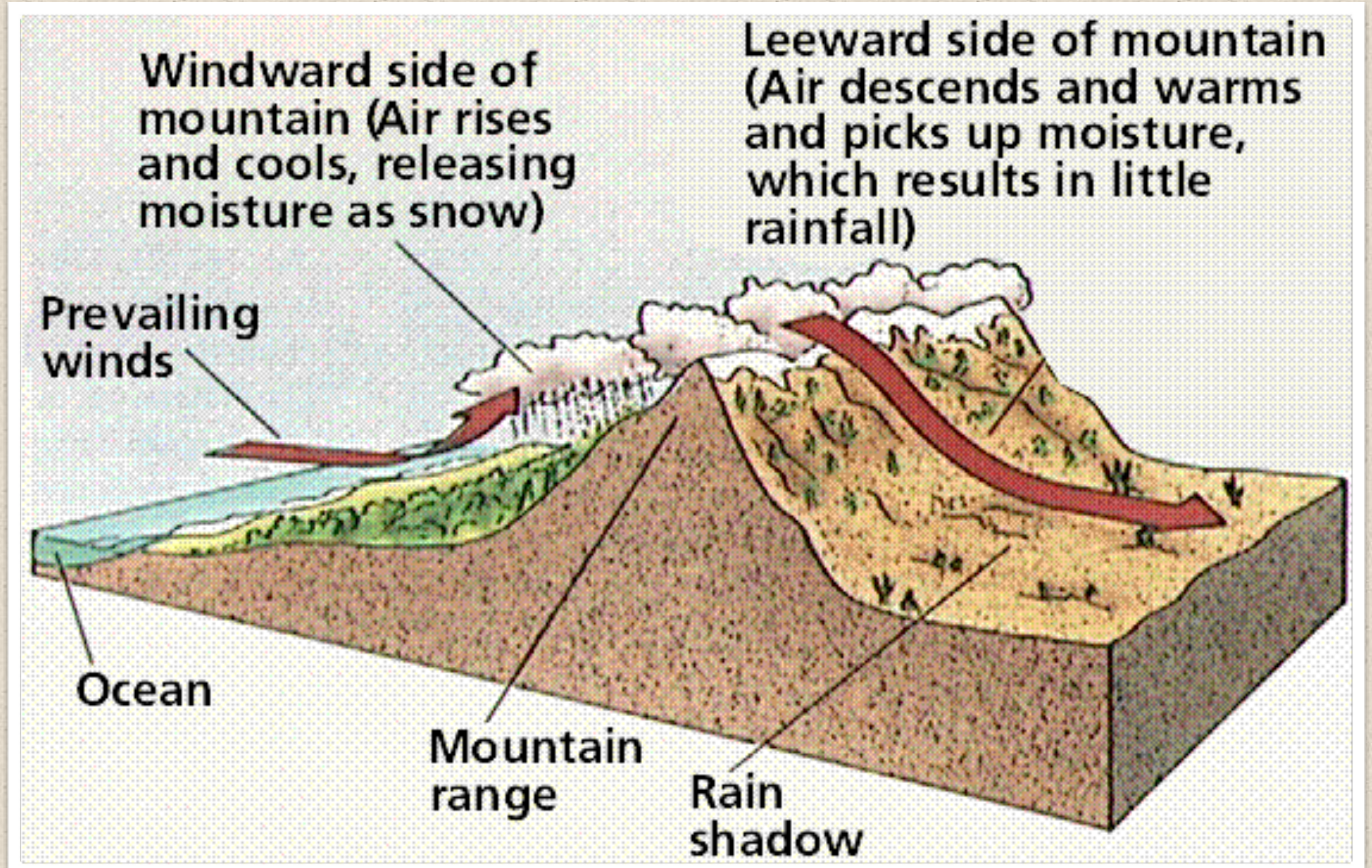
Angle of Incidence (Incoming radiation)



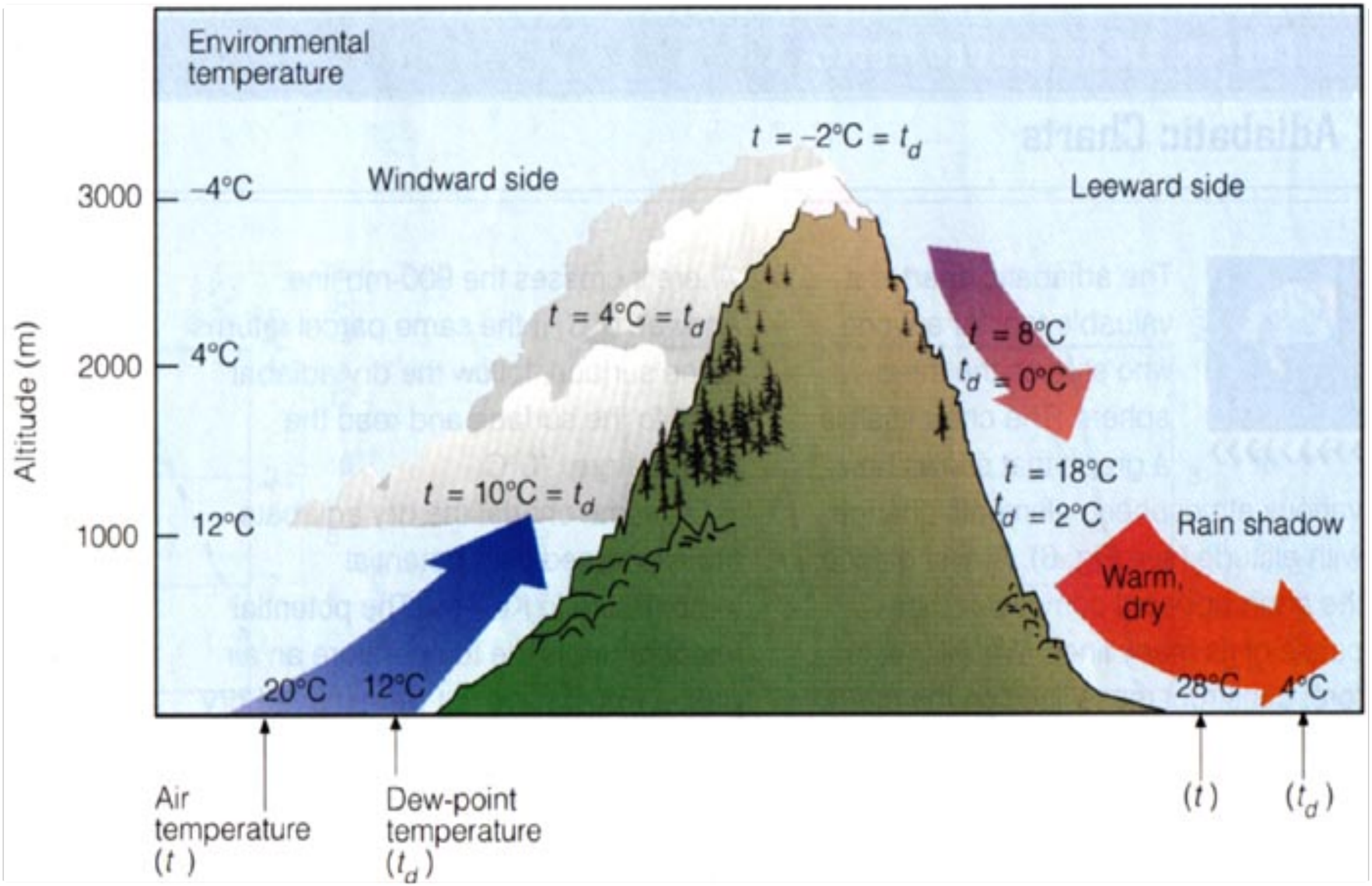
The same amount of energy distributed over differing areas creates the varied intensities the earth receives at varying latitudes.

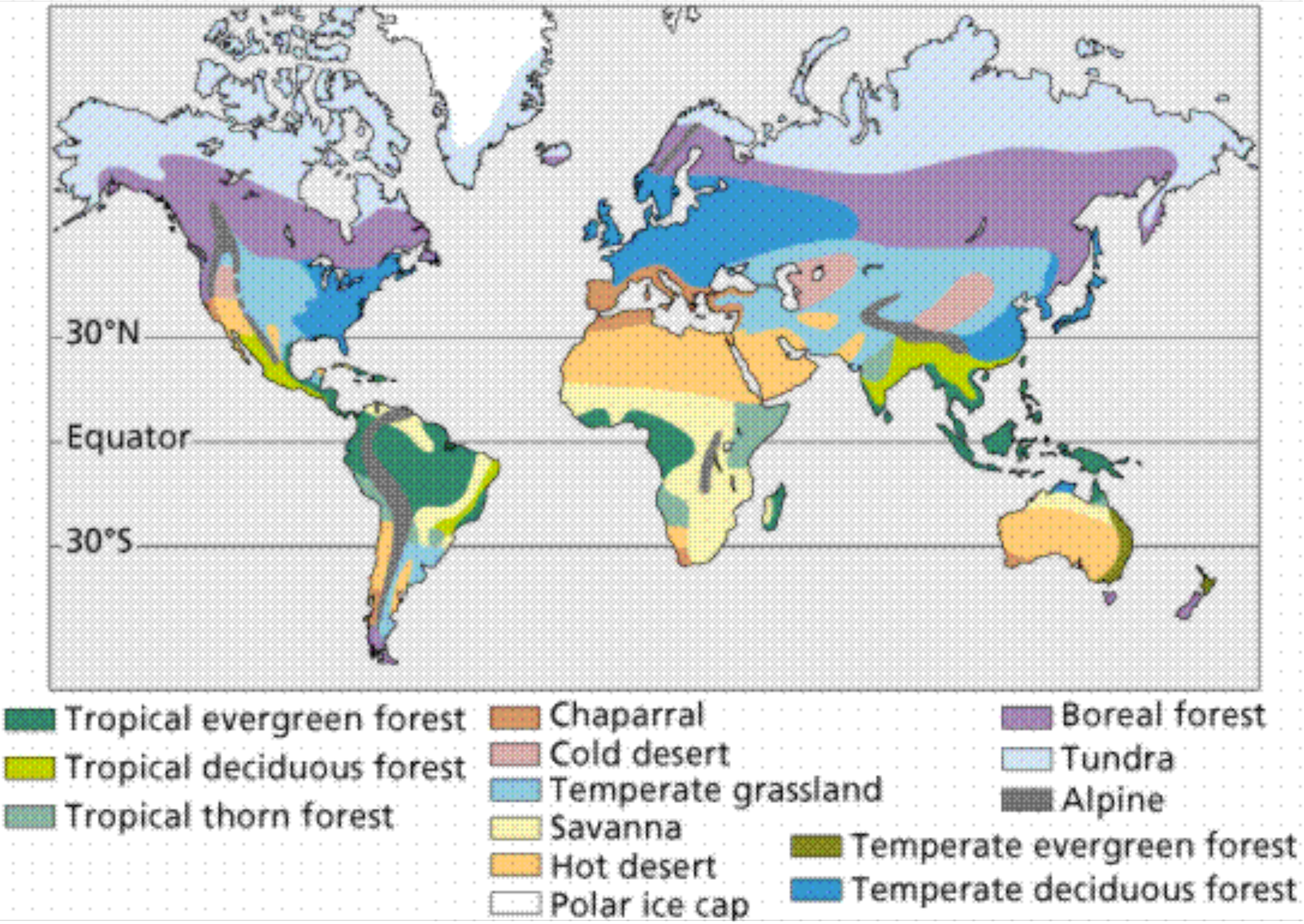


Air circulation patterns and the global distribution of wet and dry areas. Deserts can occur in warm areas due to a blockage of air circulation patterns that form a rain shadow.



Rainshadows and resulting desert-like conditions .


Environmental temperature
Altitude (m)
3000
2000
1000
−4°C
4°C
12°C
Windward side
Leeward side
t = −2°C = t_d
t = 4°C = t_d
t = 10°C = t_d
t = 8°C
t_d = 0°C
t = 18°C
t_d = 2°C
Rain shadow
Warm, dry
20°C
12°C
28°C
4°C
Air temperature (t)
Dew-point temperature (t_d)
(t)
(t_d)


30°N
Equator
30°S
Tropical evergreen forest
Tropical deciduous forest
Tropical thorn forest
Chaparral
Cold desert
Temperate grassland
Savanna
Hot desert
Polar ice cap
Boreal forest
Tundra
Alpine
Temperate evergreen forest
Temperate deciduous forest

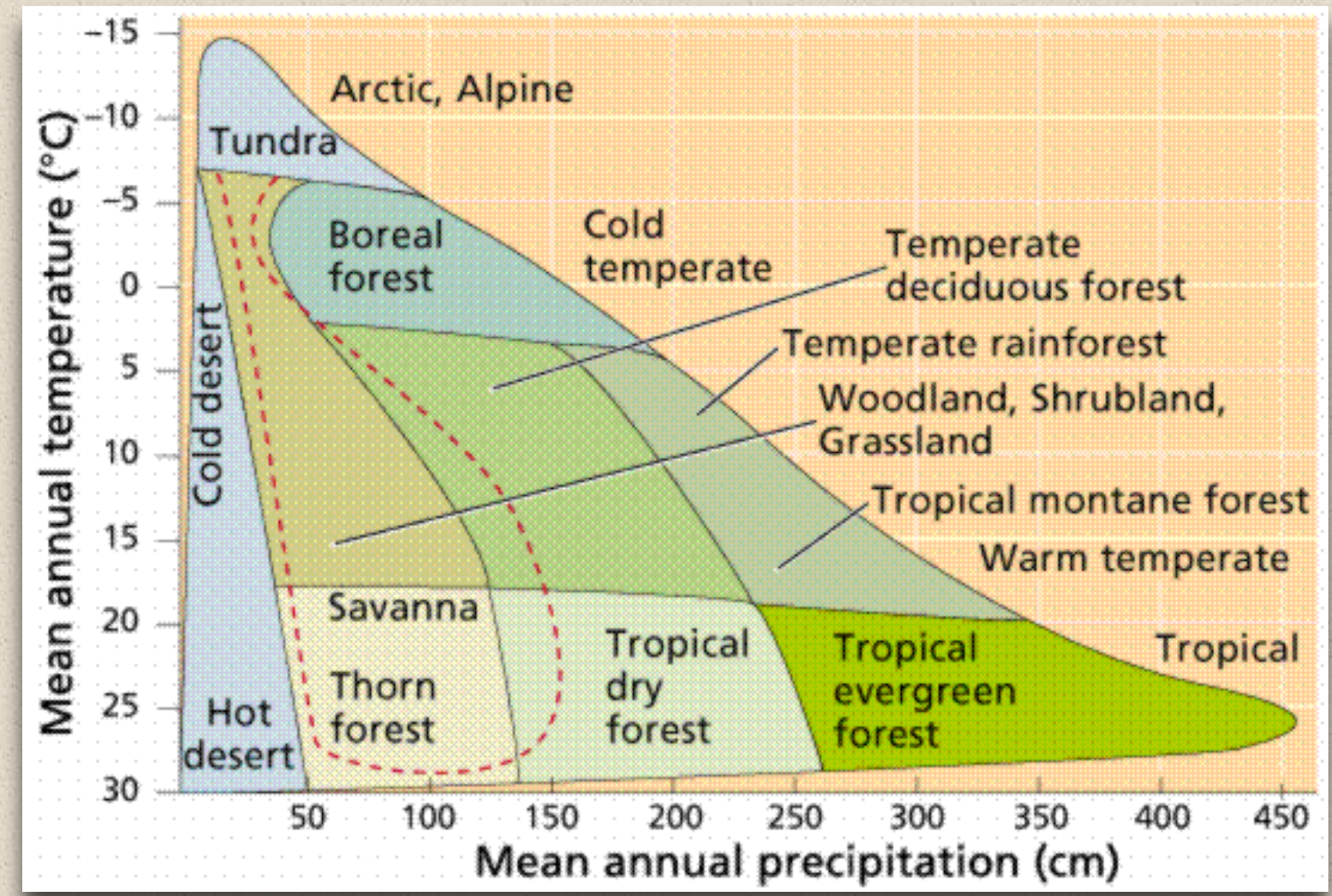
Classification of Communities

There are two major areas where life is found: terrestrial (land) and aquatic (water). These two basic types of community contain eight smaller units known as biomes.

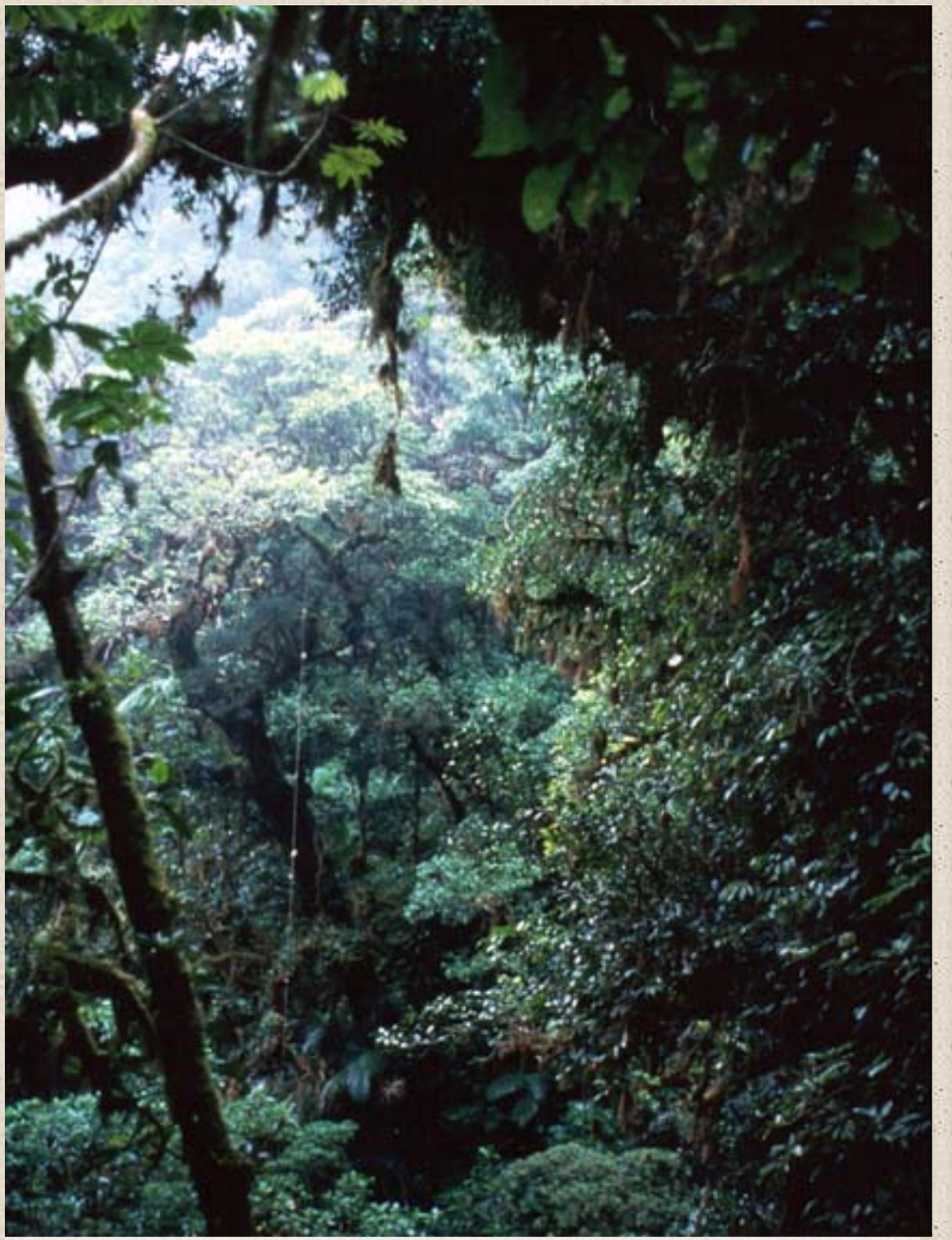
A biome is a large-scale category containing many communities of a similar nature, whose distribution is largely controlled by climate

1. Terrestrial Biomes: tundra, grassland(prairie, savanna), desert, coniferous forest (taiga),deciduous forest (temperate forest), tropical rainforest.
2. Aquatic Biomes: marine, freshwater.

Climate and Terrestrial Biomes



Climate controls biome distribution by an altitudinal gradient and a latitudinal gradient. With increases of either altitude or latitude, cooler and drier conditions occur. Cooler conditions can cause aridity since cooler air can hold less water vapor than can warmer air. Shown above is the effect of temperature on precipitation.



Costa Rican cloud forest.

1. Tropical rain forests:

- Occur in regions near the equator.
- Warm climate(between 20° and 25° C)
- Rainfall: at least 190 cm/ year.

The rain forest is the richest biome, both in diversity and in total biomass. More than half of all terrestrial species live in this biome. While diversity is high, dominance by a particular species is low.

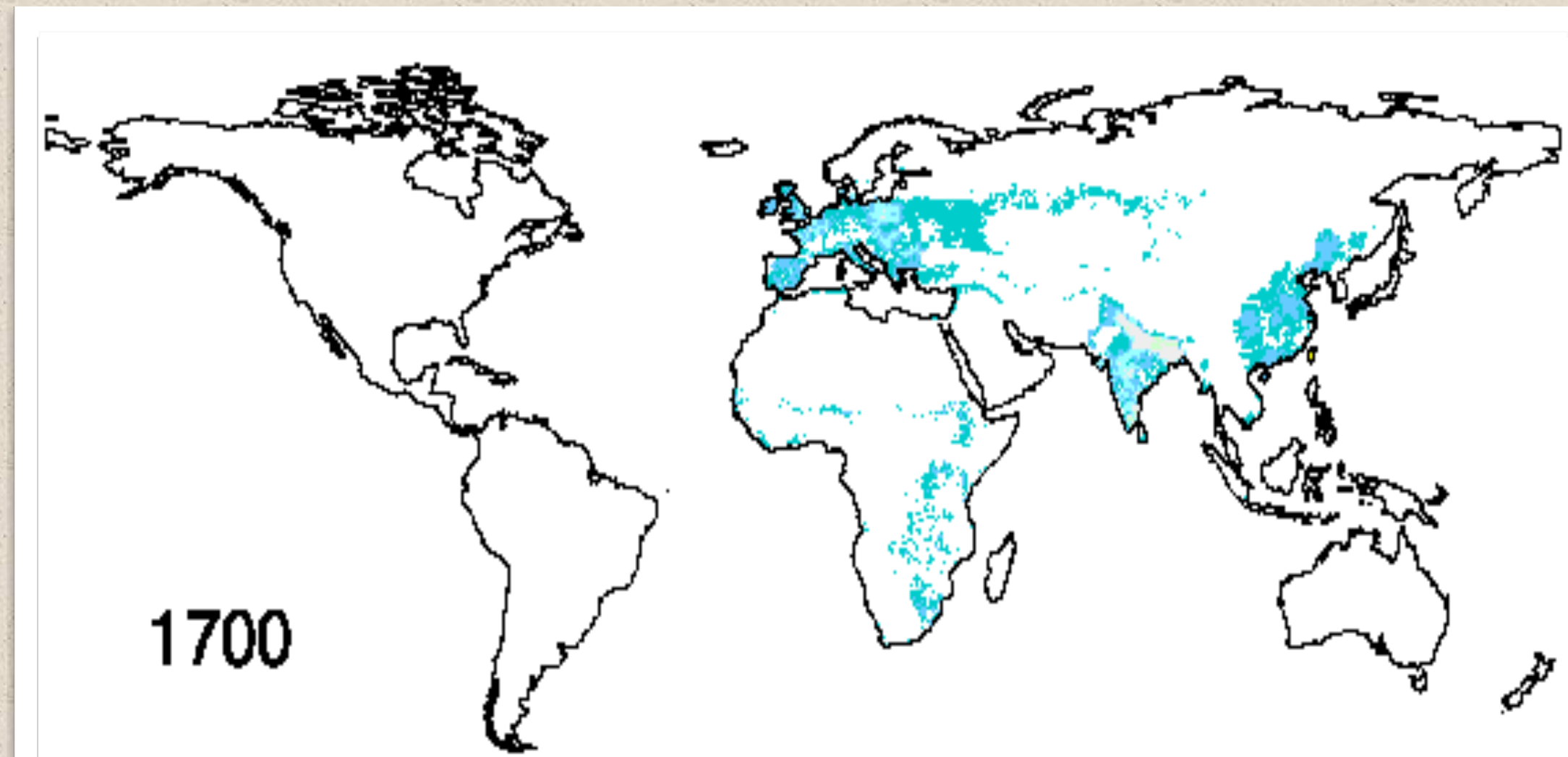
Insects are so abundant in tropical rain forests that the majority have not yet been identified. Termites are critical in the decomposition and nutrient cycling of wood.(carbon cycle)

About 17 million hectares of rain forest are destroyed each year (an area equal in size to Washington state). Estimates indicate the forests will be destroyed (along with a great part of the Earth's diversity) within 100 years. Much of this land is converted to range or farm land. Rainfall and climate patterns could change as a result.

The forests act as a carbon sink and thus changes in forest distribution affect the atmospheric carbon.

With its yearlong growing season, tropical forests have a rapid cycling of nutrients. Soils in tropical rain forests tend to have very little organic matter since most of the organic carbon is tied up in the standing biomass of the plants. These tropical soils, termed laterites, make poor agricultural soils after the forest has been cleared.

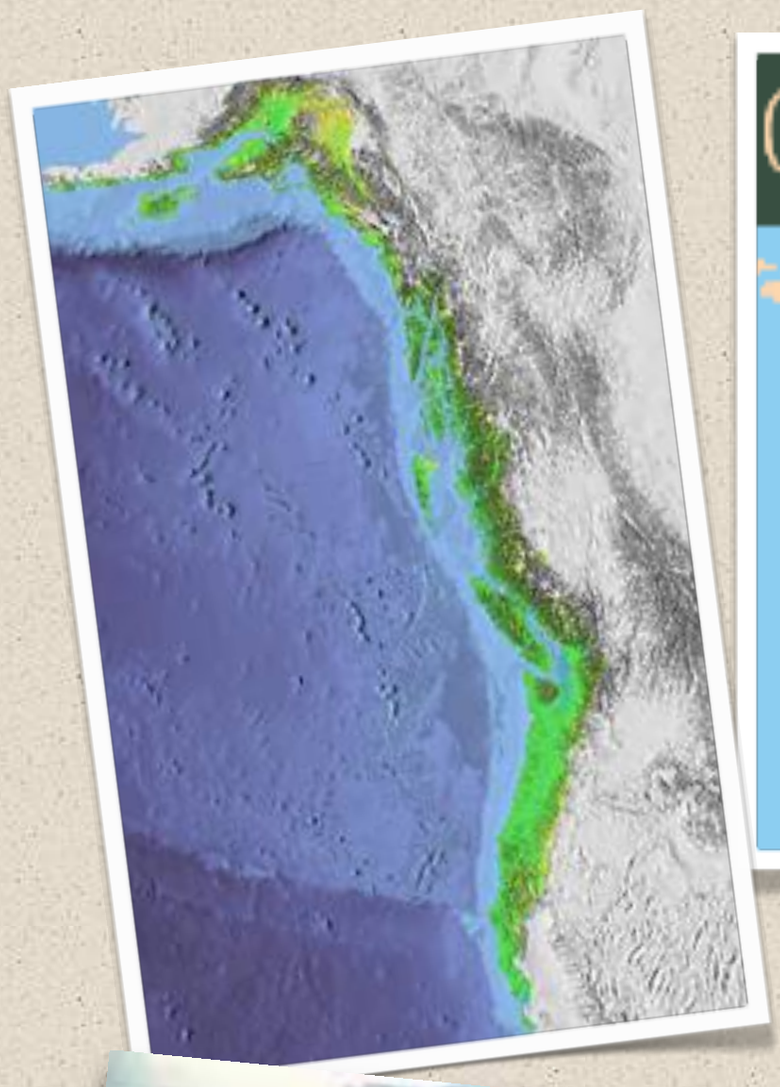
Global Expansion of Agriculture Since 1700

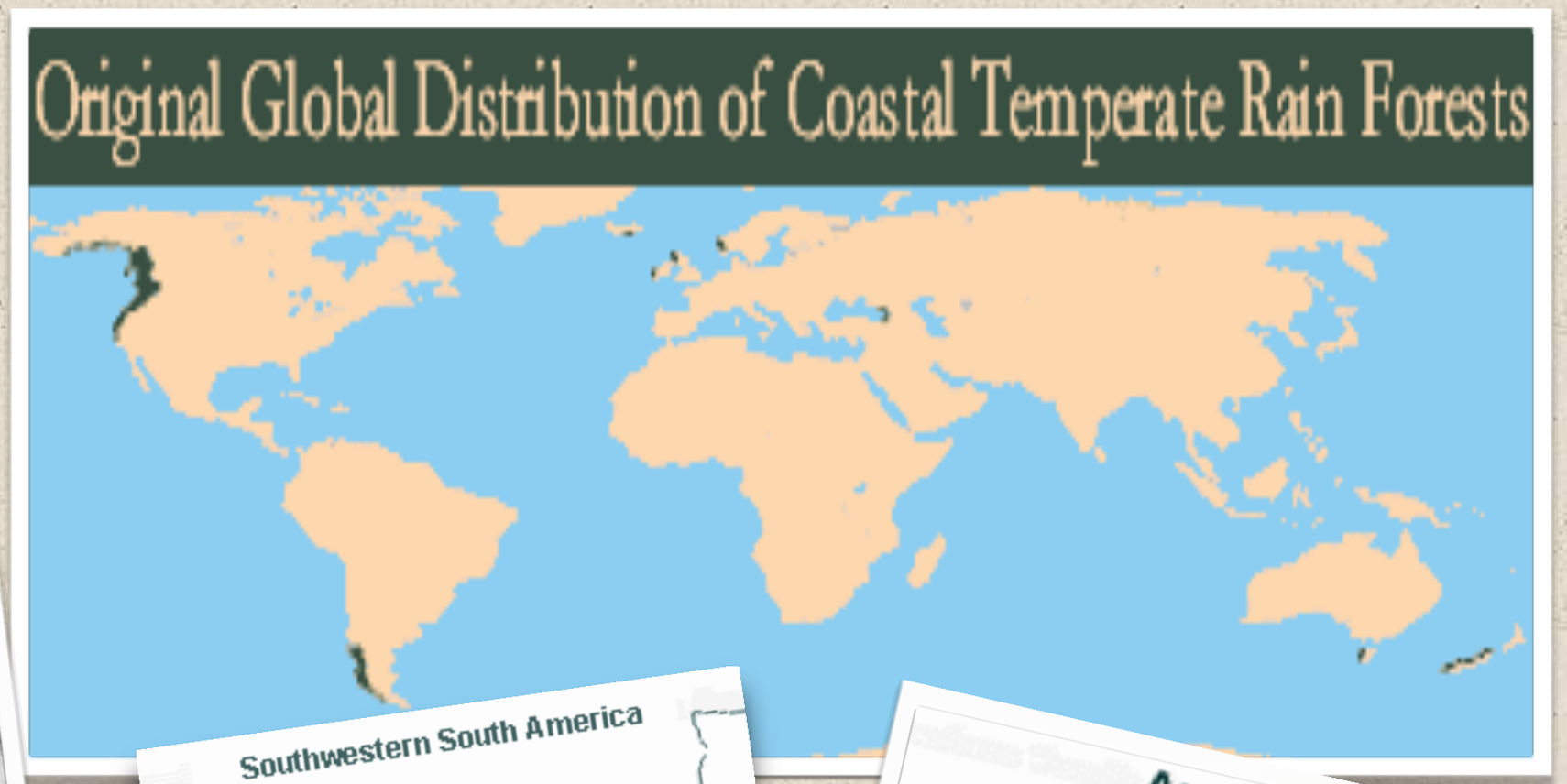


2. The Temperate Rainforests (sub category)

Temperate rainforests experience moderate temperatures (50o F) for at least two to four months each year and have abundant, well-distributed precipitation.

Along the Pacific Coast, extensive forests flourish in the rain and fog. Giant redwood, Douglas fir, sitka spruce, and hemlock form vast forests. Because air temperatures stay cool due to their northerly location, these forests are temperate rainforests, not tropical ones. They are found in relatively few places in the world, such as New Zealand, a few coastal areas of Australia, southern Chile, and in the coastal areas of the Pacific Northwest in the United States.




Original Global Distribution of Coastal Temperate Rain Forests


Southwestern South America
Punta Galera
Bariloche
Puerto Montt
Pacific Ocean
San Pedro
Punta Arenas
Islas Evangelistas
Atlantic Oc


Australia
W.A.
N.T.
O.L.D.
S.A.
N.S.W.
VIC
TAS

Temperate rain forest, Washington. Note the dense understory of ferns and herbaceous plants.

3. Temperate (Deciduous) Forests:

- Rainfall is abundant (30-80 inches/year; 75-150 cm) and
- There is a well-defined growing season of between 140 and 300 days.
- Dominant plants include beech, maple, oak; and other deciduous hardwood trees.
- Trees of a deciduous forest have broad leaves, which they lose in the fall and grow again in the spring.
- Deciduous forests generally have an abundant amount of organic material (fallen leaves and other decaying matter) which provides a rich soil.

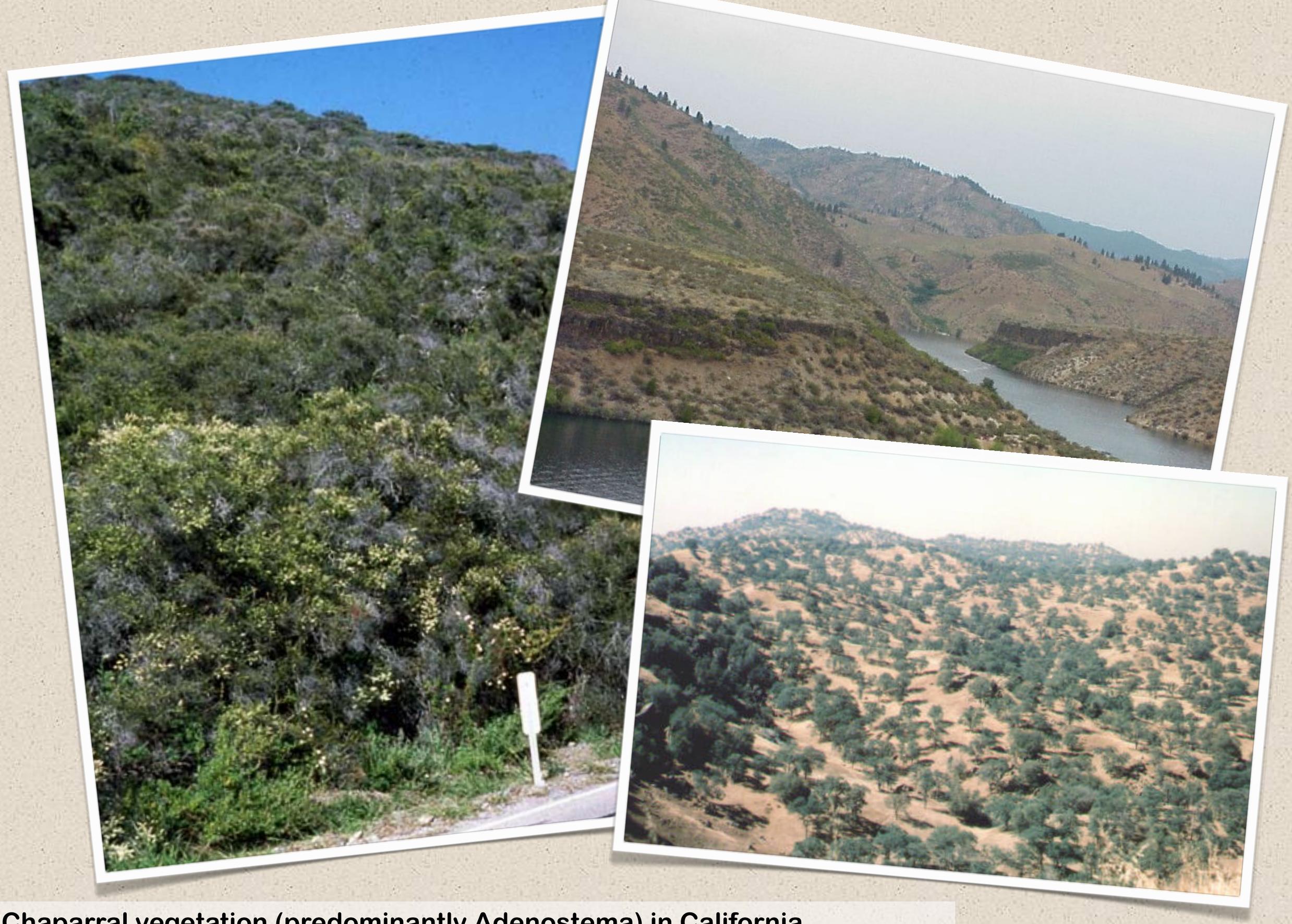
Temperate Forests- Fall color in the eastern deciduous forest. Note the presence of a few evergreens among the hardwoods.

Sufficient sunlight penetrates the canopy to support a well-developed understory composed of shrubs, a layer of herbaceous plants, and then often a ground cover of mosses and ferns. This stratification beneath the canopy provides a numerous habitats for a variety of insects and birds.

The deciduous forest also contains many members of the rodent family, which serve as a food source for bobcats, wolves, and foxes. This area also is a home for deer and black bears. Winters are not as cold as in the coniferous forest, so many amphibian and reptiles are able to survive.

Chaparral (transition between grassland and forest) found in Cameron Park

- Dominated by shrubs
- Shrubs have small, thick evergreen leaves that are often coated with a thick, waxy cuticle
- The shrubs can survive dry summers and frequent fires.
- Shrublands occur in parts of South America, western Australia, central Chile, and around the Mediterranean Sea.
- Dense shrubland in California, where the summers are hot and very dry, is known as chaparral.
- This Mediterranean-type shrubland lacks an understory and ground litter, and is also highly flammable. The seeds of many species require the heat and scarring action of fire to induce germination.



Chaparral vegetation (predominantly Adenostema) in California.

Grasslands

- Grasslands occur in temperate and tropical areas with reduced rainfall (10-30 inches per year)
- Grasslands occur in the Americas, Africa, Asia, and Australia.
- Soils in this region are excellent for agriculture.
- Grasslands are almost entirely devoid of trees, and can support large herds of grazing animals.
- Natural grasslands once covered over 40 percent of the earth's land surface.
- In temperate areas where rainfall is between 10 and 30 inches a year, grassland dominates because it is too wet for desert and too dry for forests.

Short grass prairie.

Most grasslands have now been utilized to grow crops, especially wheat and corn. Grasses are the dominant plants, while grazing and burrowing species are the dominant animals. The extensive root systems of grasses allows them to recover quickly from grazing, flooding, drought, and sometimes fire.

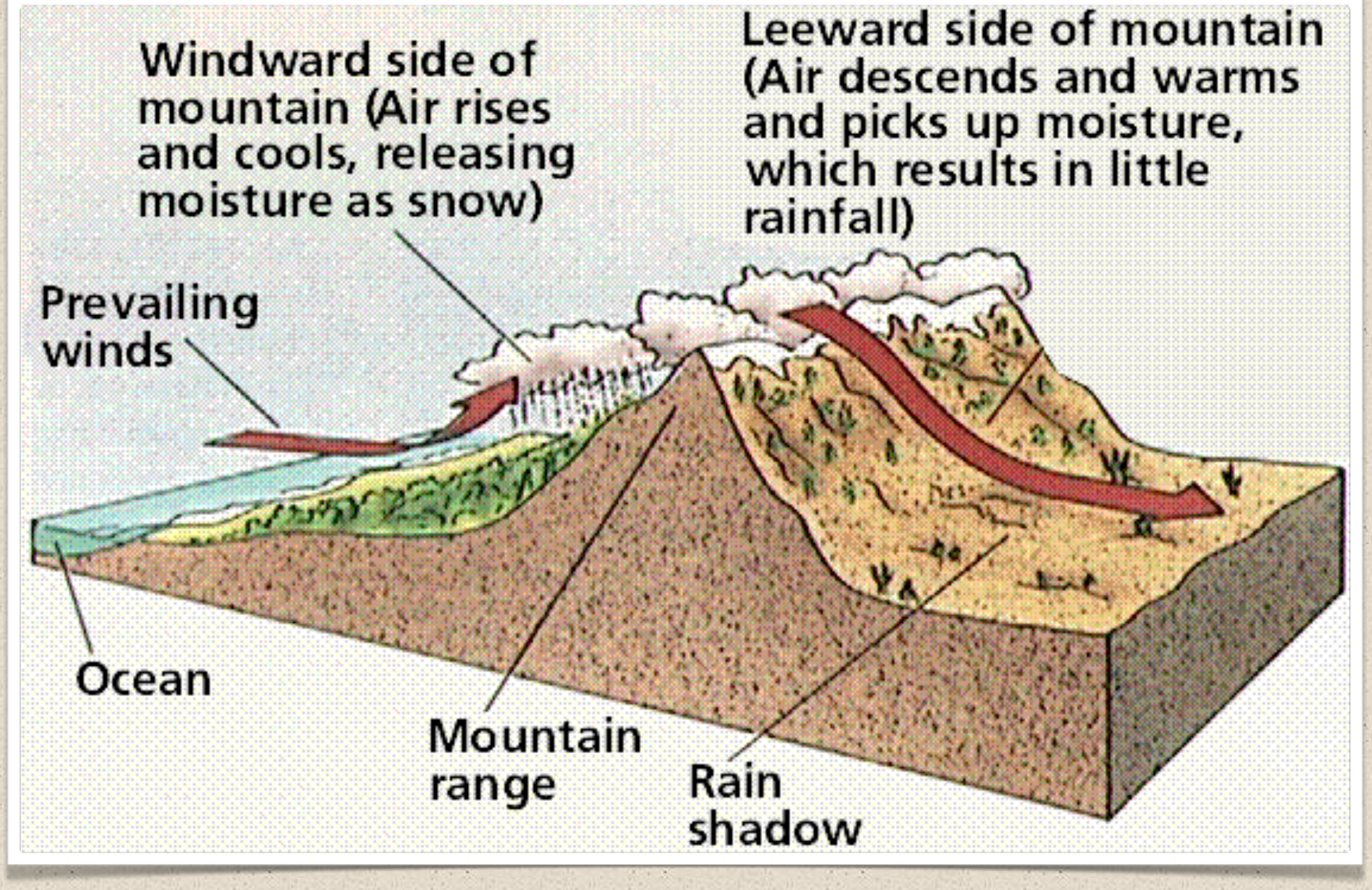
Temperate grasslands include the Russian steppes, the South American pampas, and North American prairies. A tall-grass prairie occurs where moisture is not quite sufficient to support trees. A short-grass-prairie survives on less moisture and occurs between a tall-grass prairie and desert.

Animal life includes mice, prairie dogs, rabbits, and animals that feed on them (hawks and snakes). Prairies once contained large herds of buffalo and pronghorn antelope, but with human activity these once great herds have dwindled.

The savanna is a tropical grassland that contains some trees. The savanna contains the greatest variety and numbers of herbivores (antelopes, zebras, and wildebeests, among others). This environment supports a large population of carnivores (lions, cheetahs, hyenas, and leopards). The growth rate of these small plants is fast and can thus support such large populations. Any plant litter not consumed by grazers is attacked by termites and other decomposers. Once again, human activities are threatening this biome, reducing the range for herbivores and carnivores.

6. Deserts

- Deserts are characterized by dry conditions (usually less than 10in per year; 25cm) and a wide temperature range.
- The dry air leads to wide daily temperature fluctuations from freezing at night to over 120^{o} during the day.
- Most deserts occur at latitudes of 30^{o} N or S where descending air masses are dry.
- Some deserts occur in the rainshadow of tall mountain ranges or in coastal areas near cold offshore currents.
- Plants in this biome have developed a series of adaptations to conserve water and deal with these temperature extremes.



Rainshadows and deserts.

Saguaro and cholla cacti in association with palo verde trees in the Sonoran desert, AZ. Note the lack of a canopy and the scarcity of ground cover.

The Sahara and a few other deserts have almost no vegetation. Most deserts, however, are home to a variety of plants, all adapted to heat and lack of abundant water (succulents and cacti). Animal life includes arthropods (especially insects and spiders), reptiles (lizards and snakes), running birds (the roadrunner of the American southwest and Warner Brothers cartoon fame), rodents (kangaroo rat and pack rat), and a few larger birds and mammals (hawks, owls, and coyotes).

7. Coniferous Forest – (taiga)

- The Coniferous forest receives between 10 and 40 inches of rain per year and has a short growing season.
- Winters are cold and short, while summers tend to be cool.
- Trees in the taiga have thick protective leaves and bark, as well as needlelike (evergreen) leaves.
- forests have a limited understory of plants, and a forest floor covered by low-lying mosses and lichens.
- Conifers, alders, birch and willow are common plants
- Wolves, grizzly bears, moose, and caribou are common animals.
- Dominance of a few species is pronounced, but diversity is low when compared to temperate and tropical biomes.

Images of the Coniferous forest biome.

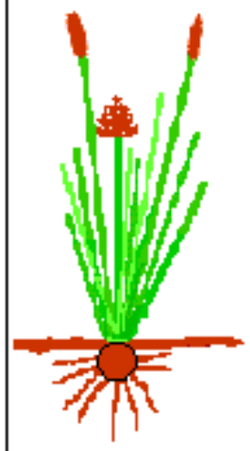
8. Tundra

- The tundra covers about 20% of the Earth's land area.
- This biome receives about 20 cm (8-10 inches) of rainfall annually.
- Winters are long and dark, followed by very short summers.
- Water is frozen most of the time, producing frozen soil, permafrost.
- Vegetation includes no trees, but rather patches of grass and shrubs; grazing musk ox, reindeer, and caribou exist along with wolves, lynx, and rodents.
- The ground is nearly completely covered with sedges and short grasses during the short summer.
- There are also plenty of patches of lichens and mosses.
- Dwarf woody shrubs flower and produce seeds quickly during the short growing season.
- The alpine tundra occurs above the timberline on mountain ranges, and may contain many of the same plants as the arctic tundra.

View of the tundra.

Evolve a Plant: Cone Rush to Desert Biome

Here is an imaginary plant called the cone rush. Show the changes that will help the plant to adapt to a new environment. Give reasons for the changes.

Environment	Organism	Body Features	Reasons for Body Features
Temperate Grasslands **20° to 85° Fahrenheit** **Rainfall 20 inches**		Grows in large dense clumps Height = 18 inches Wind Pollinated Pollen borne on tall reeds Seed forms on lower triangular cone Small bulb below ground	Closely packed plants make wind pollination efficient. Sturdy green spikes function as leaves, resist wind damage. Tall spikes receive more wind: pollen travels far and falls slowly. Seed-forming structure has large area, is lower than pollen spikes. Pollen stores resources during winter and droughts.
New Environment **Arid Desert** **20° to 120° Fahrenheit** **Rainfall 4 inches**	Draw your plant here. Changes in form		Reasons for these changes.