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# Introduction to Ecology



# What is Ecology?

- Ecology is the study of the interactions between organisms and their environments (biotic and abiotic).
  - Ecologists seek to understand:
    - the patterns of abundance and distribution of species
    - the patterns of species diversity across space and time
    - The patterns of nutrients and energy flow within the environment

# Units and approaches

- Organismal (Individual) is the smallest unit of study in Ecology→Organismal Ecology: either Physiological Ecology or Behavioral Ecology
- Population is a group of organisms of the same species living together→Population Ecology
- Community is an assemblage of populations of different species→Community Ecology
- Ecosystem is a community together with their physical and chemical environments→Ecosystem Ecology
- Biosphere is all ecosystems linked together including all the environments and organisms in Earth→Global Ecology

# Ecology and the diversity of life

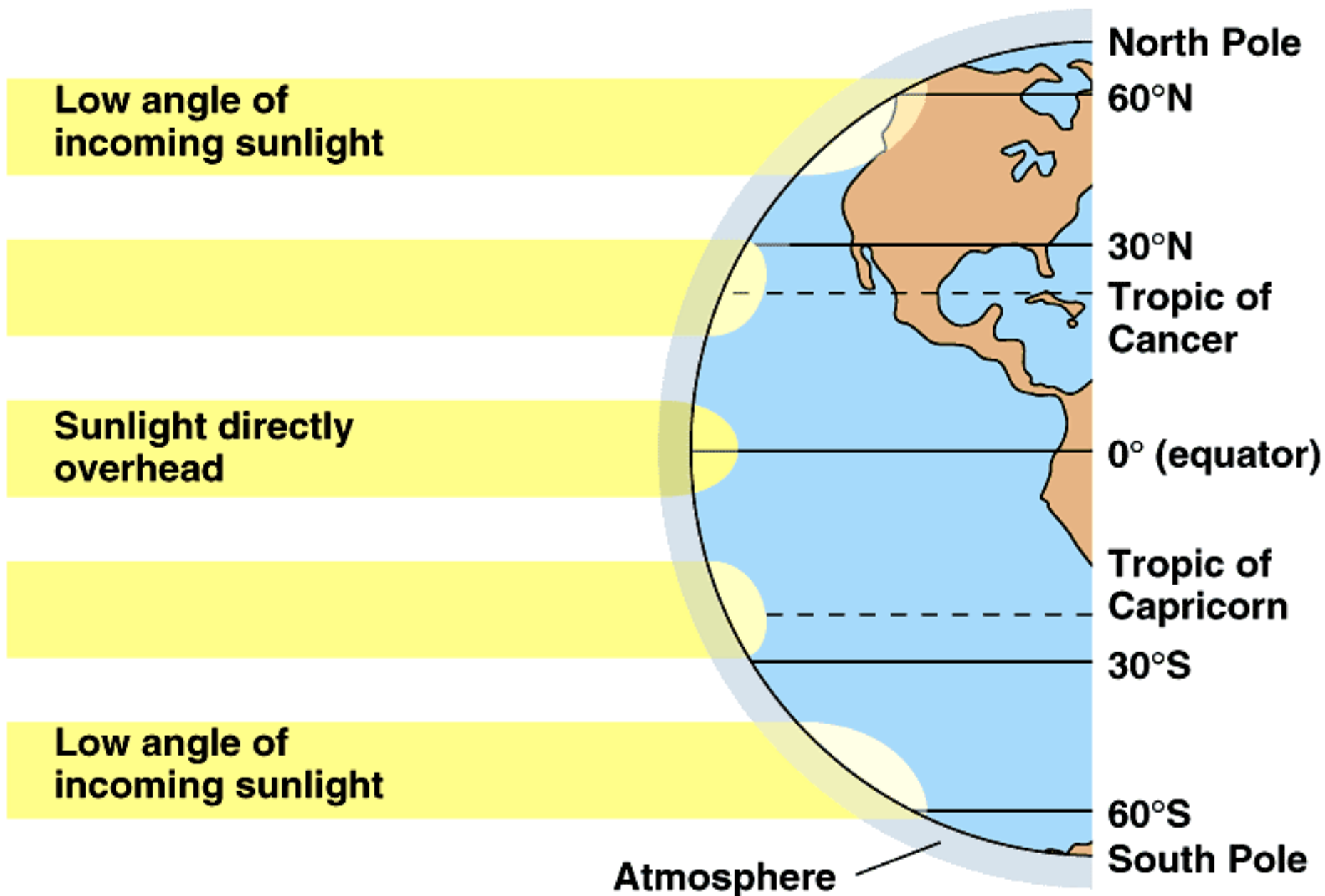
- Ecology and the evolution of diversity
  - Interaction with environment can lead to evolution by natural selection
- Different roles of biodiversity in ecosystems
  - Predators, competitors, mutualists, primary producers, consumers, decomposers

# The abiotic environment

- Temperature→effects on biological processes, inability of organisms to regulate body T
- Water→essential to life, availability varies significantly
- Sunlight→provides energy that drives nearly all ecosystems, variation in availability, photoperiod
- Wind→amplifies effects of T and water
- Soil→physical structure, pH, and mineral composition vary
- Salinity→varies across environments; affects water balance

# Global climate patterns

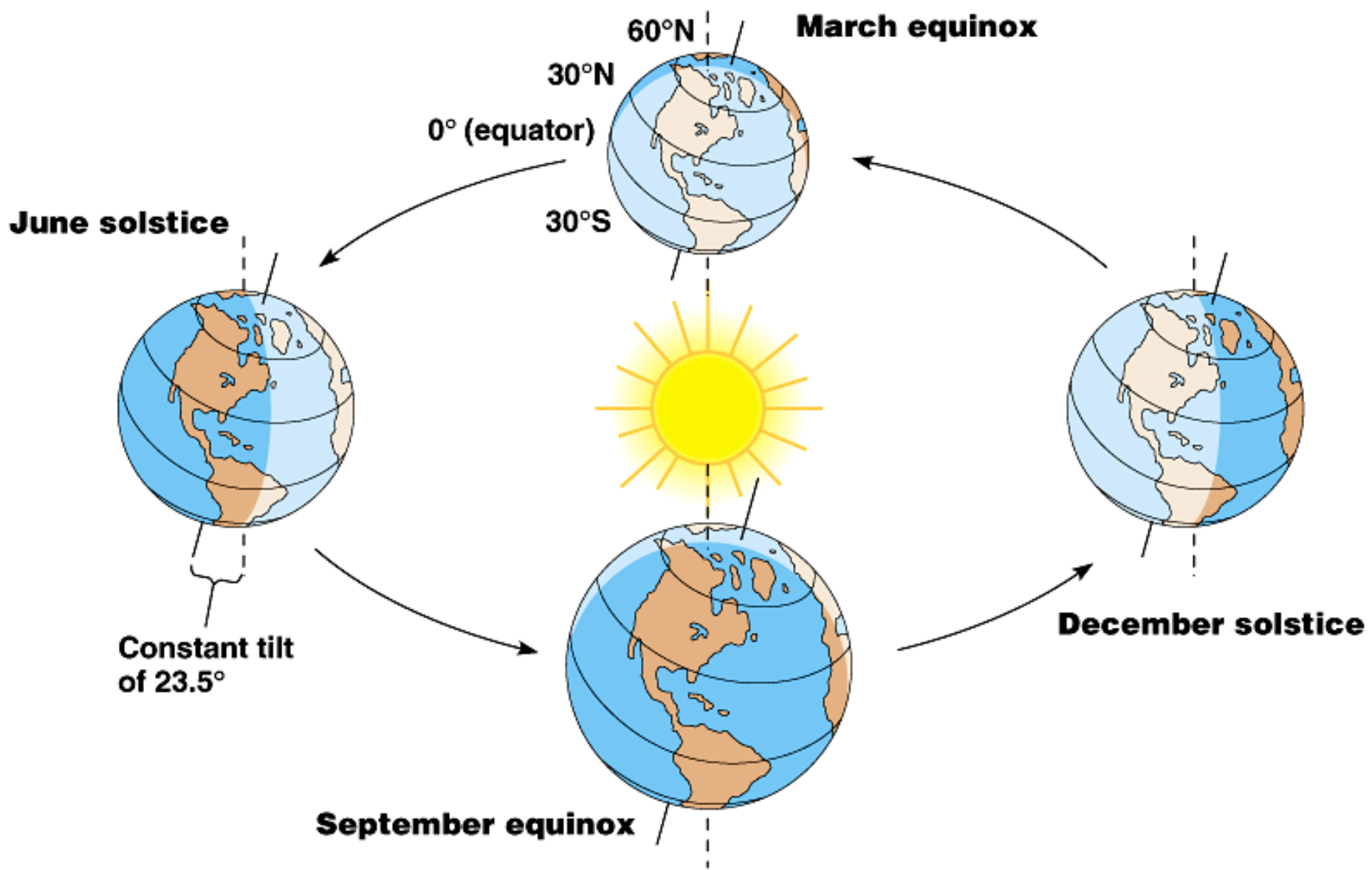
- In average, earth's climate is cold and dry towards poles and hot and wet toward the equator. This pattern is driven by the input of solar energy and the planet's tilt and movement in space
- 1) Input of solar energy
  - Driven by the variation of the angle of the sun relative to the surface of the earth at different latitudes (shape of earth causes this variation)



# Global climate patterns

- 2) Planet's tilt and movement in space
  - Seasonality in intensity of solar radiation occurs because of earth's revolution around the sun and the  $23.5^\circ$  tilt of earth relative to its plane of orbit around the sun

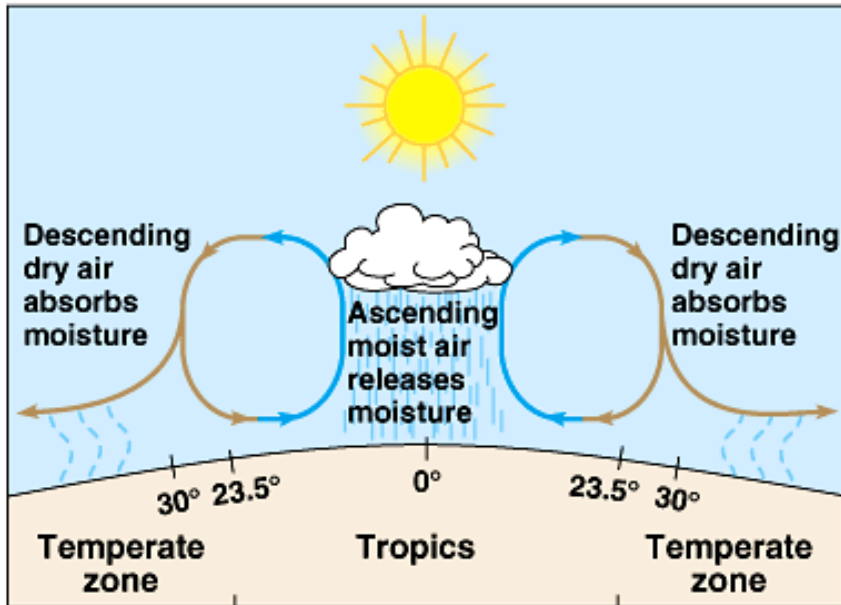
# What causes the seasons?



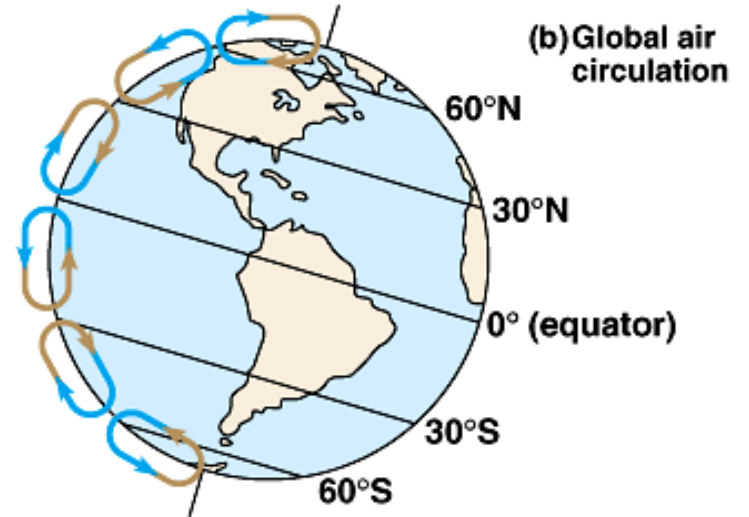
# Global climate patterns

- Overall, the tropics experience the greatest annual input and least seasonal variation in solar radiation
  - This initiates a global circulation of air, creating precipitation and winds

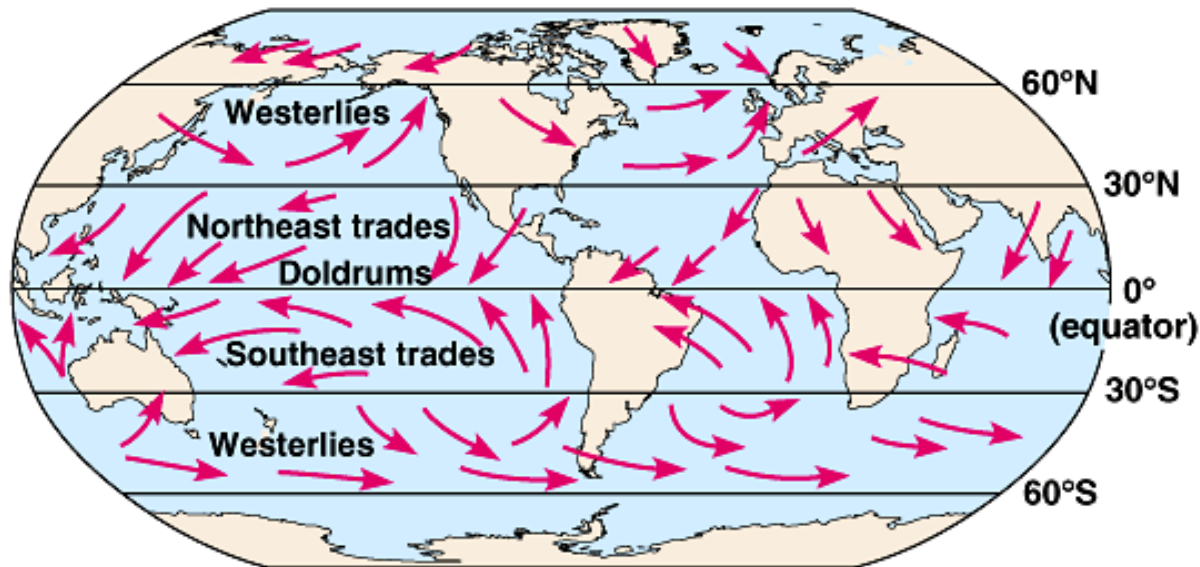
# Global air circulation, precipitation, and winds



(a) Air circulation and precipitation near the equator



(b) Global air circulation



(c) Global wind patterns

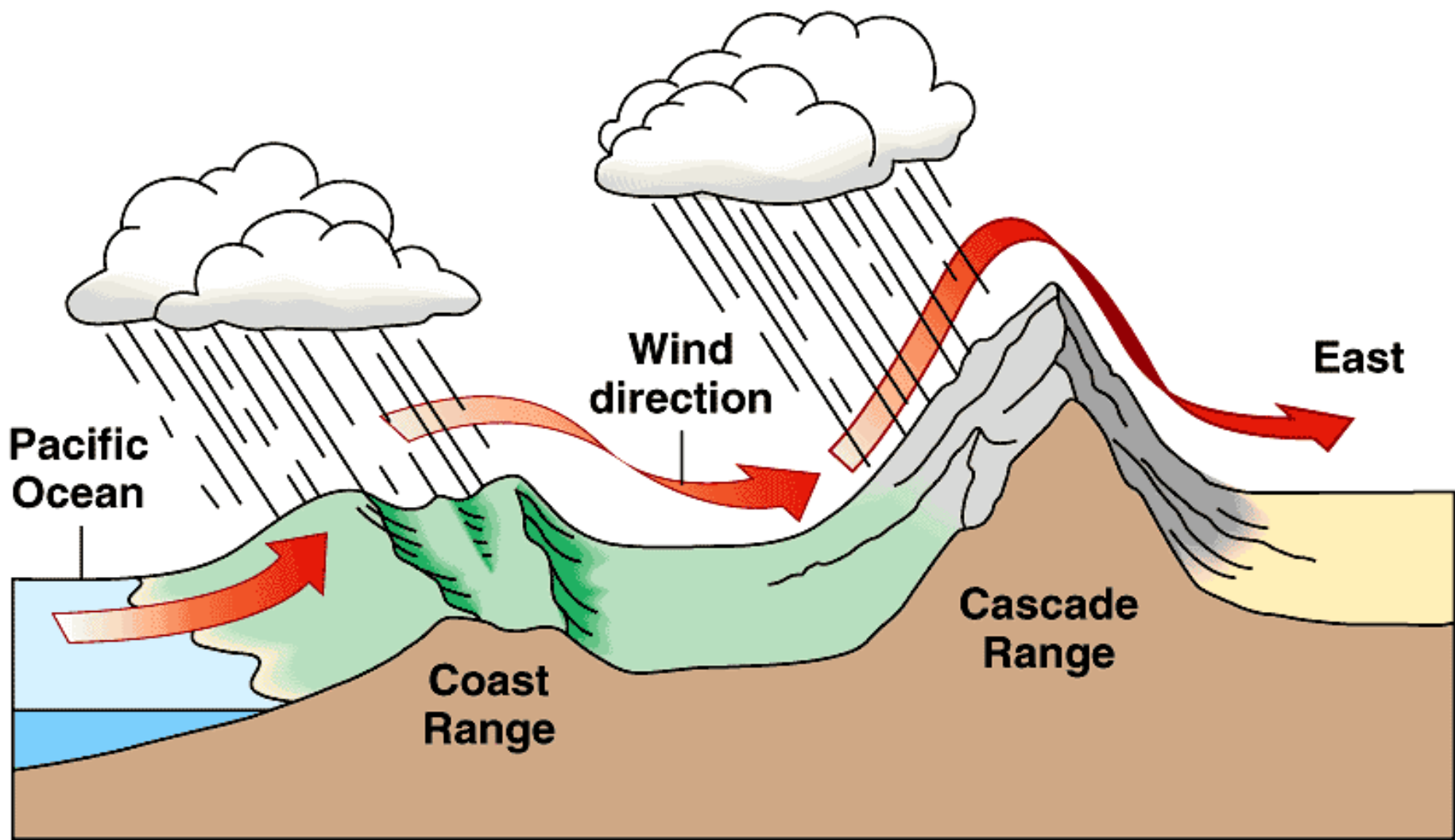
# Physical conditions on land

- They are determined by:
  - Global climate patterns
    - In turn locally modified by bodies of water and topography
  - Soils

# Local effects on climate

- Bodies of water
  - Ocean currents can heat or cool overlaying wind
  - Ocean produces greater evaporation
  - Ocean and lakes can cause local wind circulation
- Topography
  - Mountains create microclimates depending on slope orientation
  - Mountain elevation can cause sharp  $T^{\circ}$  changes
  - Mountains create rain shadows

# How mountains affect rainfall



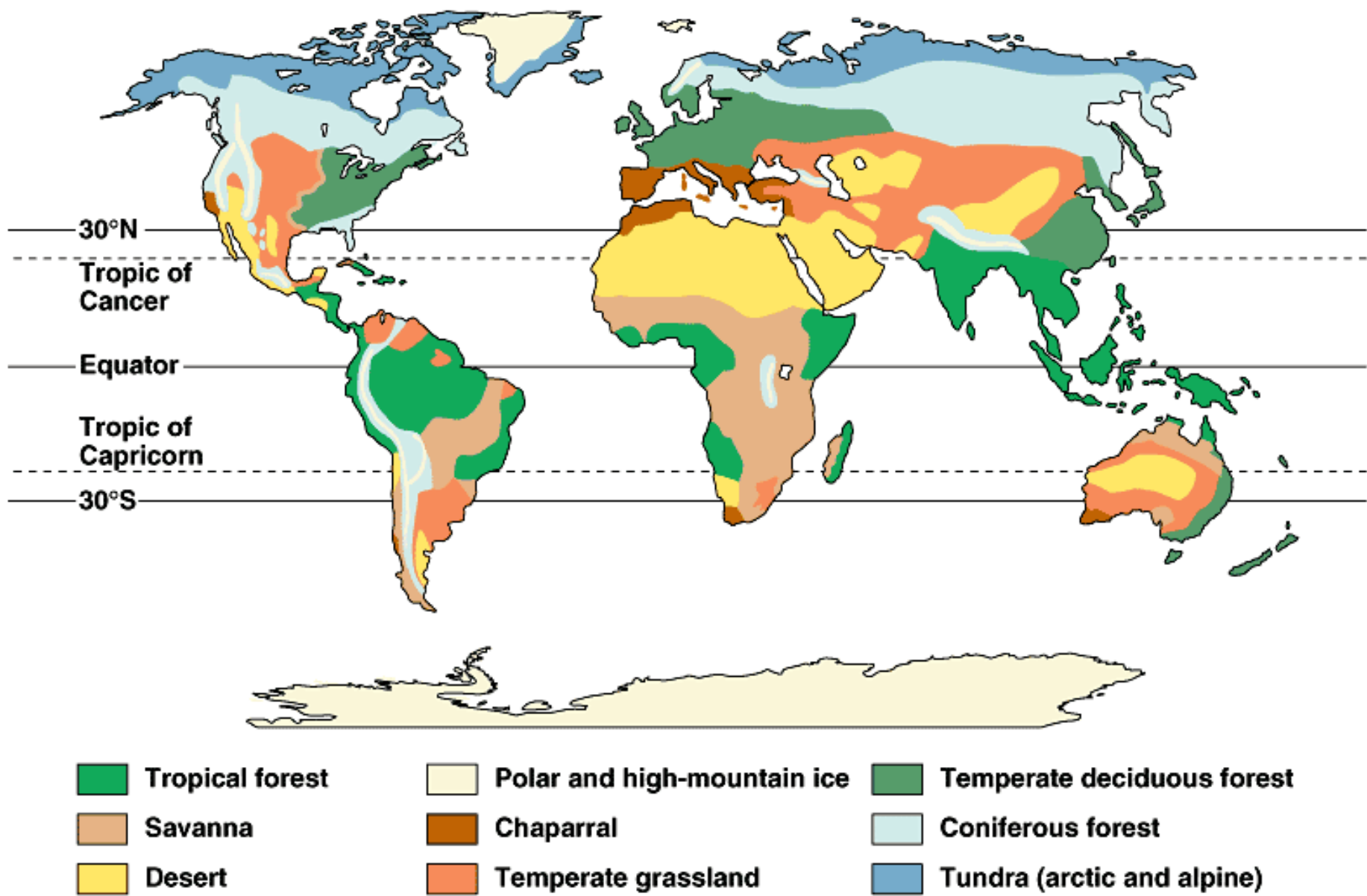
# Soils

- Five factors define soil characteristics: climate, parent material (underlying rock), vegetation, local topography, and age
  - Distribution of plants and burrowing animals is affected by climate and soil

# Terrestrial biological environments: Biomes

- Biomes are categories of biological communities based on their dominant plant forms
  - To a large extent, the distribution of biomes is determined by global climate patterns, the influence of bodies of water and topography on global climate and the distribution of soils

Figure 50.24 The distribution of major terrestrial biomes



Tropical forests. Canopy made up by trees, it is often closed so little light reaches the ground below. Many trees are covered with epiphytes (orchids, bromeliads). Humidity is high



Savanna. Grasses and scattered trees are dominant plants. Fire is an important abiotic component

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Benjamin  
Cummins

Deserts. Sparse rainfall largely defines a desert area. Deserts can be found in very hot or cold environments.  
Usually dominated by deeply rooted shrubs and succulents

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Chaparral. Dense, spiny evergreen shrubs dominate these biomes. Found in coastal areas with mild rainy winters and hot dry summers. Periodic fires occur

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Temperate grassland. There is seasonal drought, occasional fires and soil is deep and rich in nutrients

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Benjamin  
Cummings

Temperate deciduous forest. Dense stands of deciduous trees characterize these biomes. Moisture is high. Trees drop leaves during winter when temperatures are too low for effective photosynthesis and water availability to replace water lost through transpiration is low

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Coniferous forests. Cone bearing trees dominate this biome. Dominated by one or a few tree species.

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Tundra. Permafrost (permanently frozen soil), bitterly cold temperatures, and high winds cause lack of tall plants. Dry conditions prevail.

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# Physical conditions of oceans

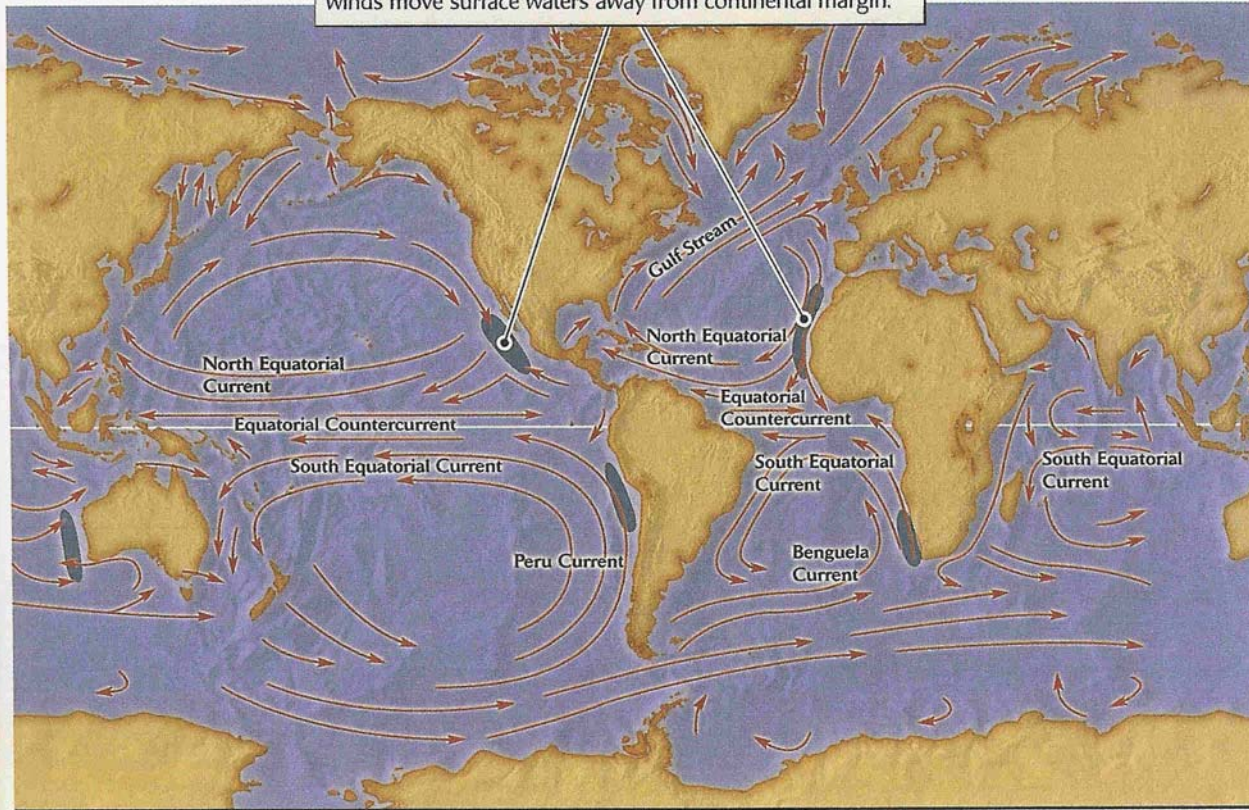
- Influence of global climate patterns on T, salinity, light and oxygen concentration modified by water properties and ocean depth:
  - Sea surface temperature. Annual T° variation is more stable than in land
  - Salinity (amount of salt dissolved in water) varies across latitudes being lowest at the tropics and around 40° N and S and highest about 20-30° N and S (due to influence of precipitation)
  - Oxygen present in much lower concentrations (9 vs. 200 ml/liter) which also vary more than in aerial environments
  - Light availability highest towards the tropics
  - Influence of depth: Availability of light, T and O<sub>2</sub> varies with depth of ocean. Highest towards the surface

## Physical conditions of oceans cont.

- Effects of winds generated by global climate patterns interact with earth's rotation to generate:
  - Ocean currents that redistribute heat and moisture from atmosphere across ocean surface
  - Upwelling: upward movement of water brings cold water and nutrients from deeper ocean layers
    - Coastal and ocean basin topography can modify general current patterns

# Major ocean currents

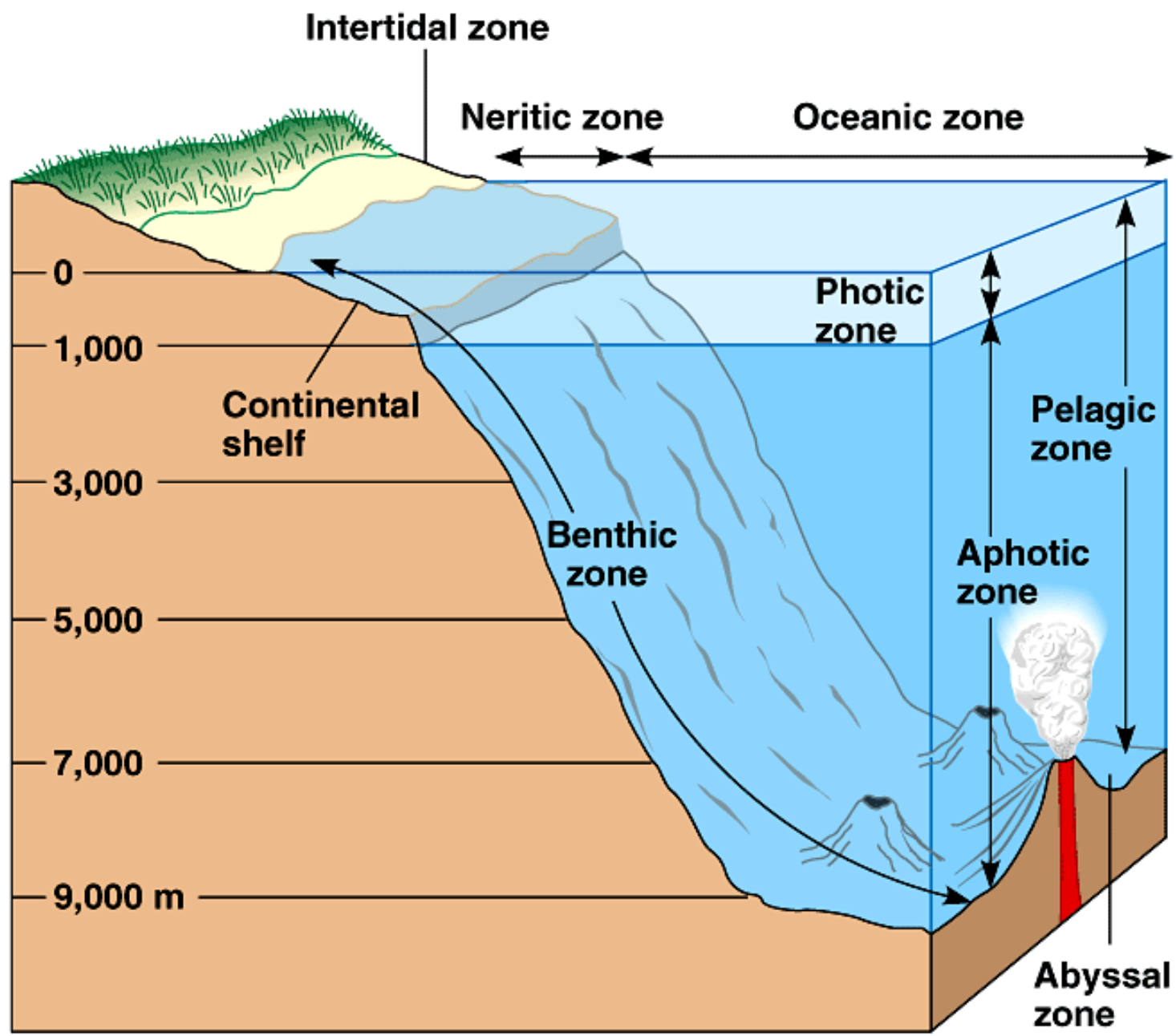
Upwelling zones of high biological productivity occur where winds move surface waters away from continental margin.



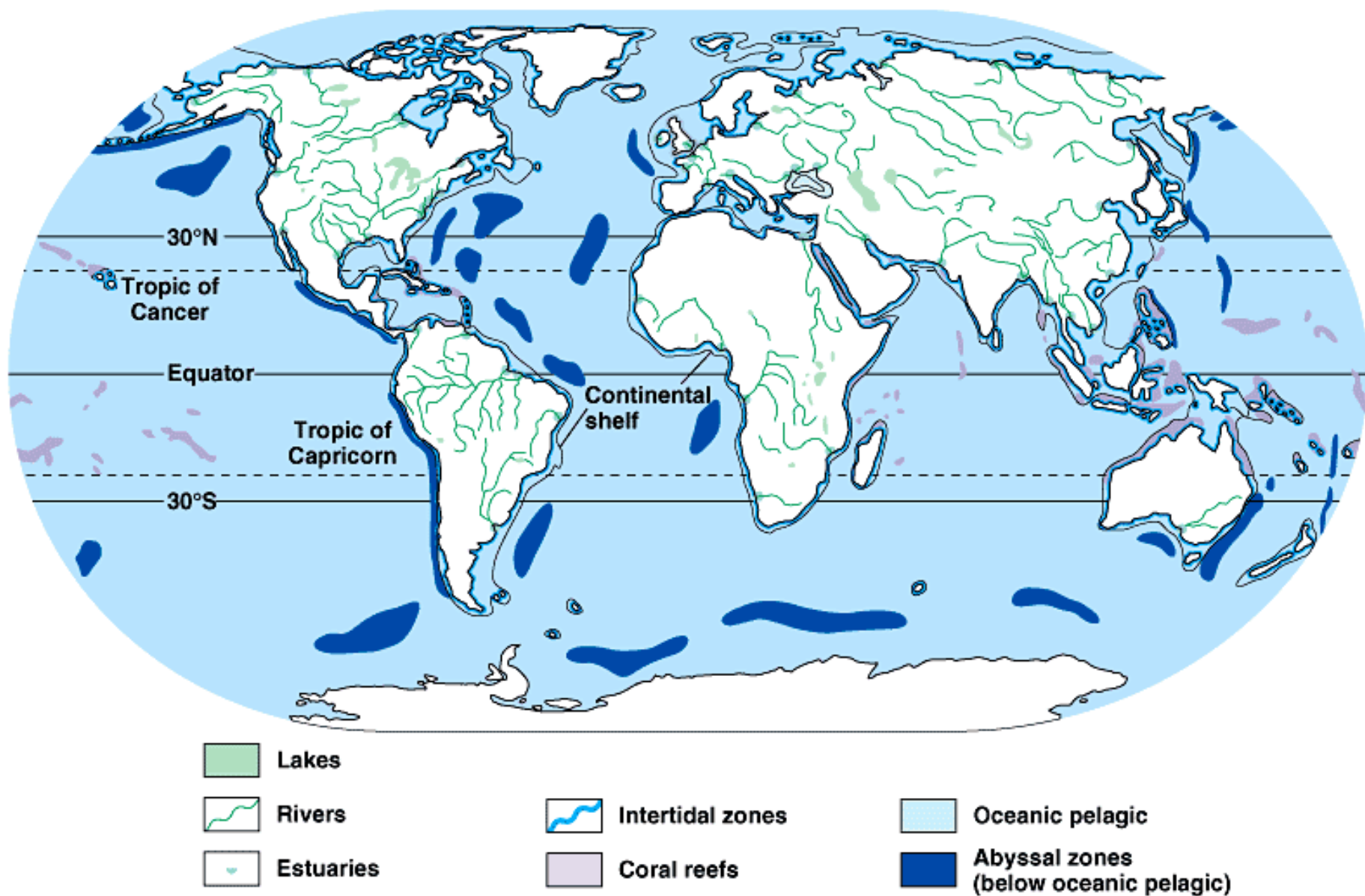
# Marine biological environments

- Marine biological environment can be classified on the basis of three physical criteria:
  - light penetration
  - distance from shore
  - Substrate

# Zonation in the marine environment



# The distribution of major aquatic biomes



Examples of marine biomes: a) Intertidal benthic zone: rocky intertidal, sandy beaches. b) Neritic benthic: coral reefs, kelp forests. c) Oceanic benthic: deep sea benthos. d) Oceanic pelagic.

Coral reefs



Rocky intertidal



Deep sea benthos