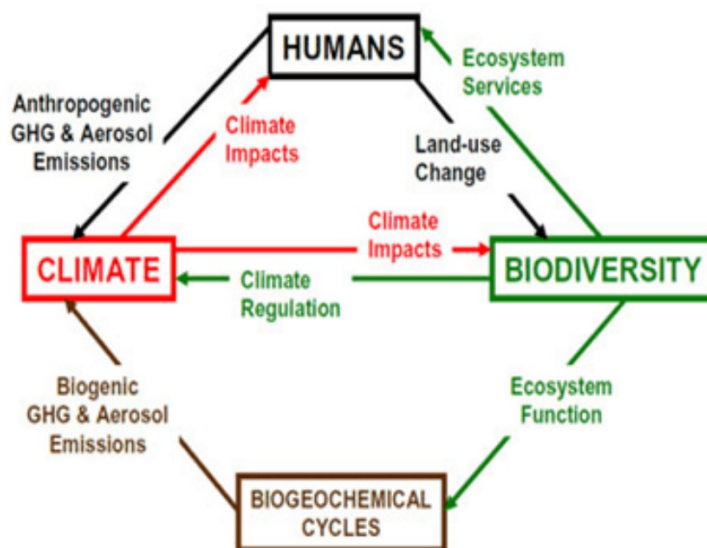


# Chapter 7

## Climate and Biodiversity



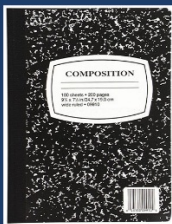
Links between Biodiversity, Climate Change and Human Well-being

*To do science is to search for repeated patterns, not simply to accumulate facts, and to do the science of geographical ecology is to search for patterns of plant and animal life that can be put on a map.*

*- Robert H. MacArthur*

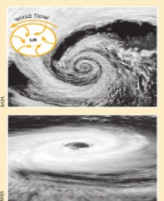
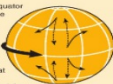
# Variation and Oscillation

*Directions: Read the information and answer the questions in your composition book.*



## The Coriolis Effect

Air flowing towards, or away from, the equator follows a curved path that veers to the right in the northern hemisphere and to the left in the southern hemisphere (right). This phenomenon, known as the **Coriolis effect**, is caused by the anticyclonic rotation of the Earth about its axis, so as air moves across the Earth's surface, the surface itself is moving but at a different speed. The magnitude of the Coriolis effect depends on the latitude and the speed of the moving air. It is greatest at the poles and is responsible for the direction of the rotation of large hurricanes.



Air flows from high pressure to low pressure (see inset). In the northern hemisphere, the Coriolis effect deflects this moving air to the right, causing cyclonic (low pressure) systems to rotate counter-clockwise as seen here in a low pressure system over Iceland. Cyclonic weather is usually dull, with grey cloud and persistent rain.

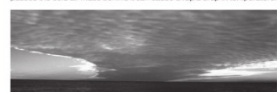
In the southern hemisphere, cyclonic systems spiral in a clockwise direction, seen in this photograph of cyclone Catarina, a rare South Atlantic tropical cyclone which hit Brazil in March 2004. As air rushes into the low pressure area, it is deflected to the left, causing a clockwise spiral.

## Frontal Weather

A **weather front** marks the boundary between two air-masses at different densities. A front is about 100-200 km wide and slopes where warm and cold air masses collide. A front appears on a weather map as a line with triangles (cold front) or semicircles (warm front) attached.

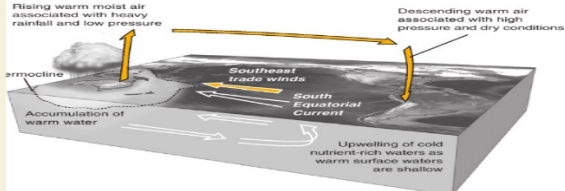


In a **cold front**, cold air undercuts warm air, forcing it steadily upwards along the line of the front and triggering the formation of towering cumulus clouds and rain. Cold fronts are often associated with low-pressure systems and unsettled weather conditions. As the front passes the cold air mass behind it can cause a rapid drop in temperature.

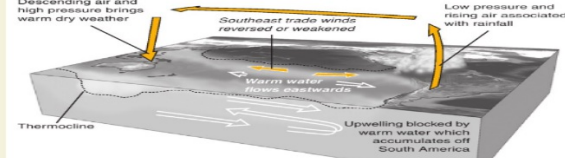


In a **warm front**, warm air rises over cold air more gradually, producing flattened, stratiform clouds. Warm fronts produce low intensity rainfall that may last for some time and precede warm weather. Because it moves more quickly, a cold front will eventually overtake a warm front, creating an occlusion.

## Normal climatic conditions



## El Niño Effect



1. Explain the role of the Coriolis effect in the prevailing winds in different regions of the globe.
2. Draw schematic diagrams to show:
  - a. The movement of a cold front into an area of warm air.
  - b. The movement of air in a Southern Hemisphere cyclone and a Northern Hemisphere hurricane.
3. Describe the events that cause El Niño conditions and its effects on ocean circulation.
4. Describe the effect on an El Niño on one:
  - a. climate of the western coast of South America
  - b. climate of Indonesia and Australia

# Core Case Study: Different Climates Support Different Life Forms

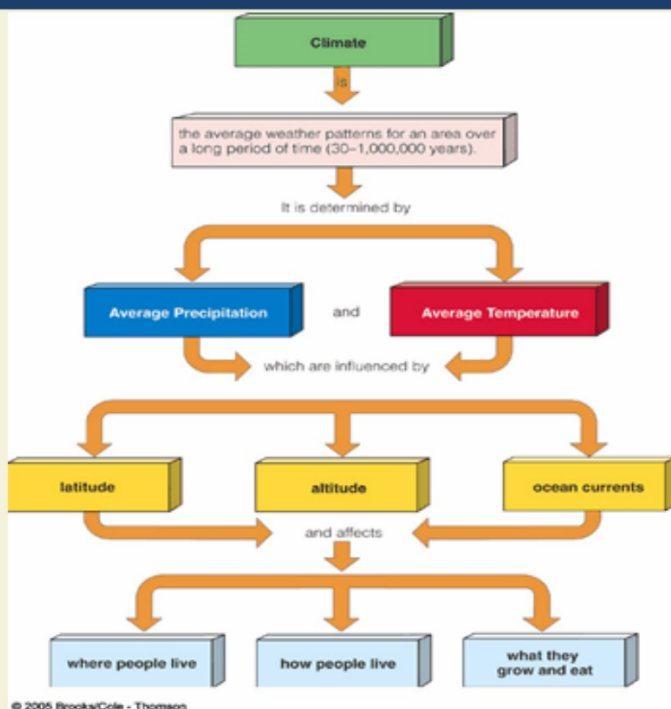
Climate -- long-term temperature and precipitation patterns – determines which plants and animals can live where

- Tropical: equator, intense sunlight
- Polar: poles, little sunlight

Temperate: in-between tropical and polar



## 7-1 What Factors Influence Climate?



**Concept 7-1** Key factors that determine an area's climate are incoming solar energy, the earth's rotation, global patterns of air and water movement, gases in the atmosphere, and the earth's surface features.



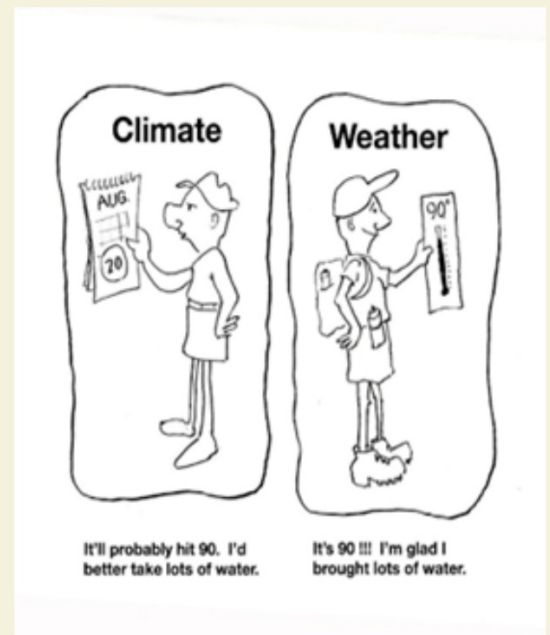
# WEATHER VS. CLIMATE

## Weather

- Temperature, precipitation, wind speed, cloud cover
- Hours to days

## Climate

- Area's general pattern of atmospheric conditions over decades and longer



## VIDEO: Introduction to Climate



## Natural Capital: Generalized Map of the Earth's Current Climate Zones

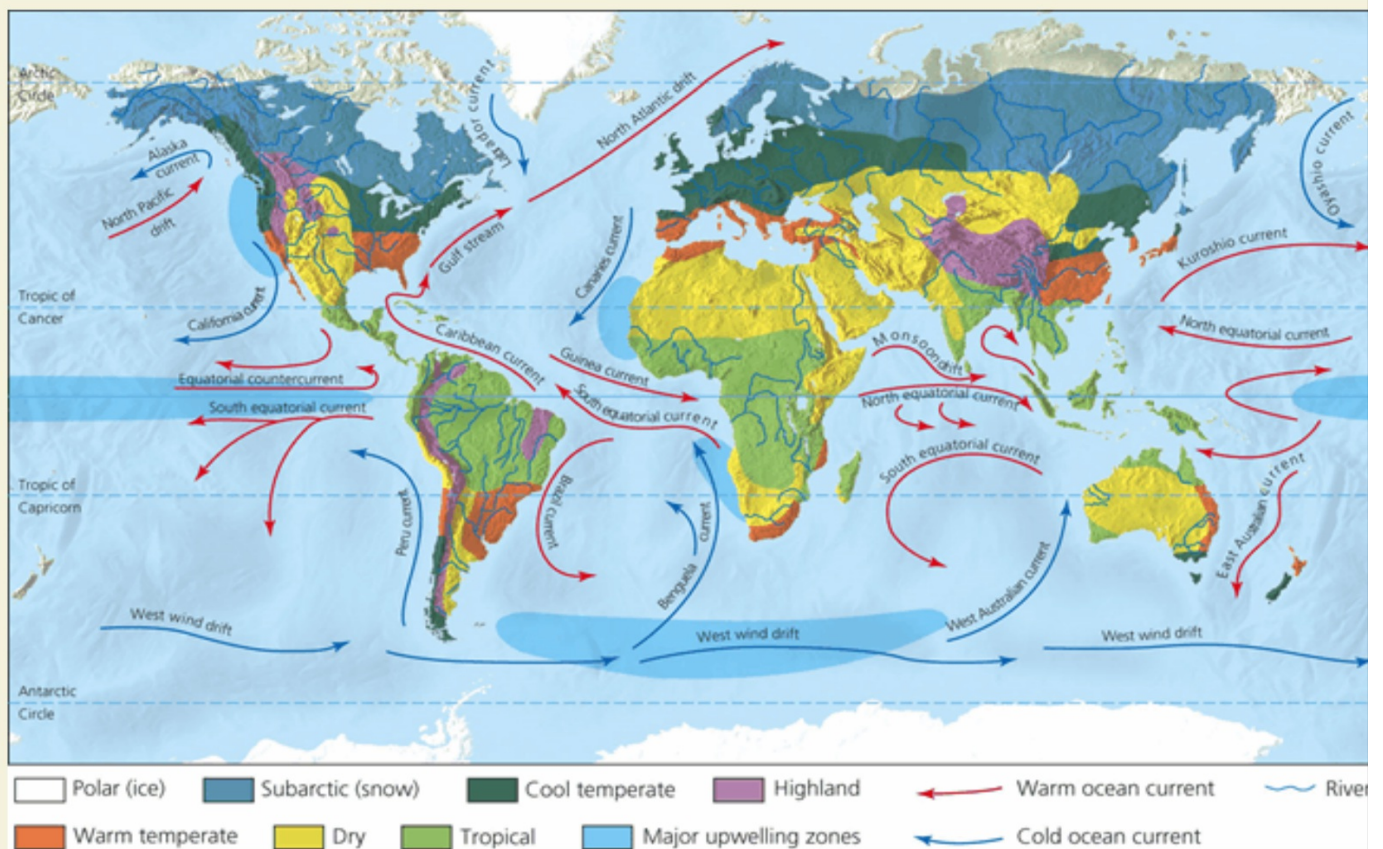


Fig. 7-2, p. 149

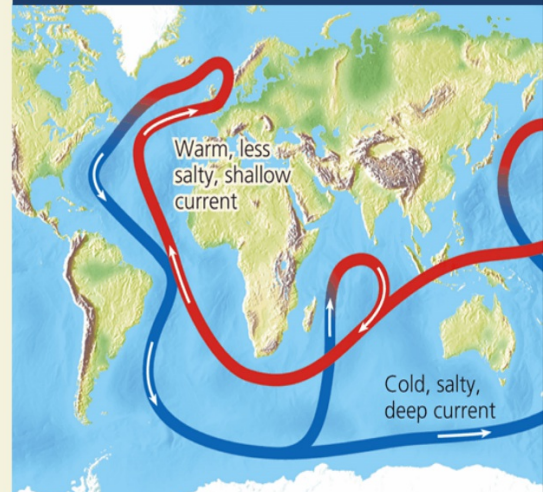
# The Earth Has Many Different Climates

Air circulation in lower atmosphere due to  
Uneven heating of the earth's surface by sun  
Rotation of the earth on its axis  
Properties of air, water, and land

## Ocean currents

- Prevailing winds
- Earth's rotation
- Redistribution of heat from the sun
- Surface currents and deep currents

Connected Deep and Shallow Ocean Currents





## Global Air Circulation

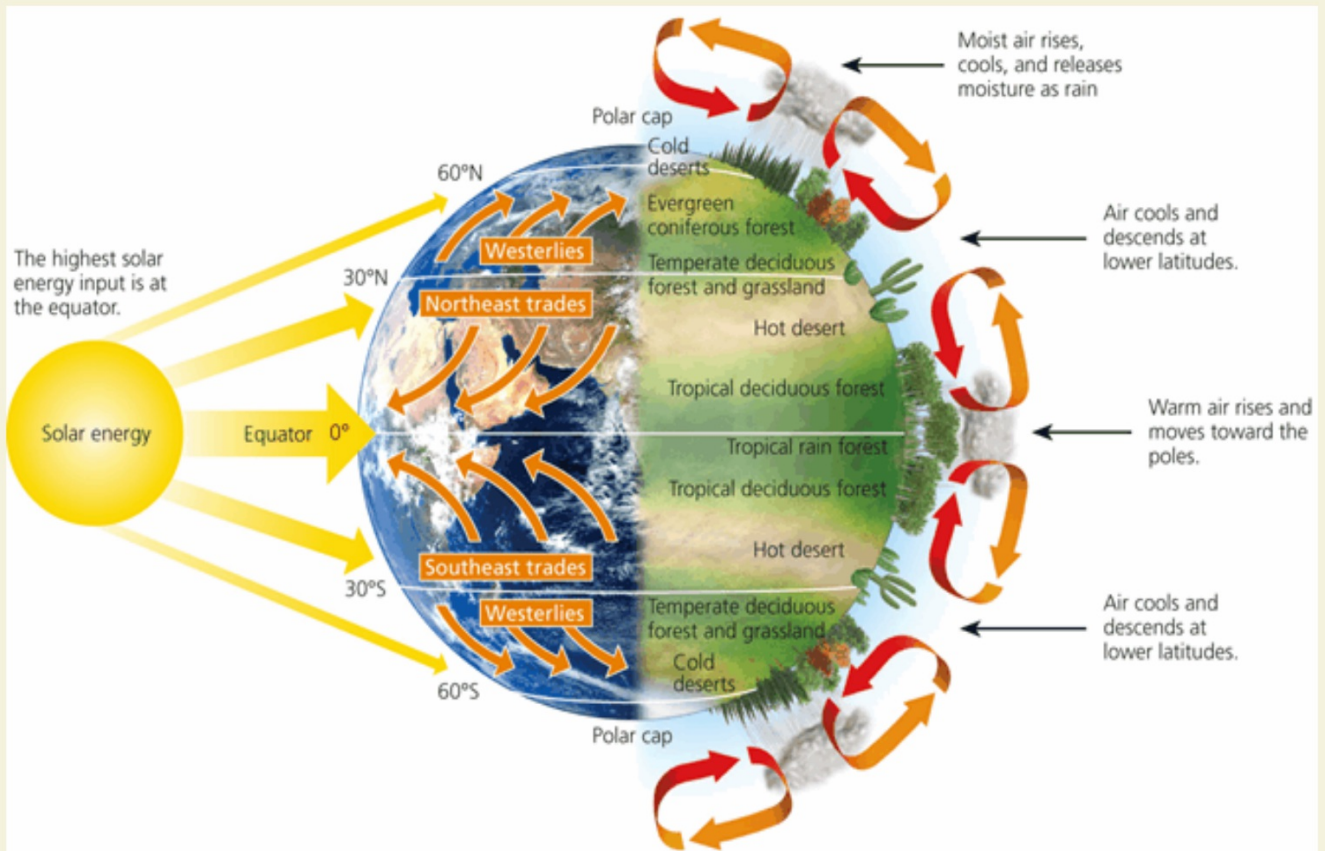


Fig. 7-3, p. 149

## Energy Transfer by Convection in the Atmosphere

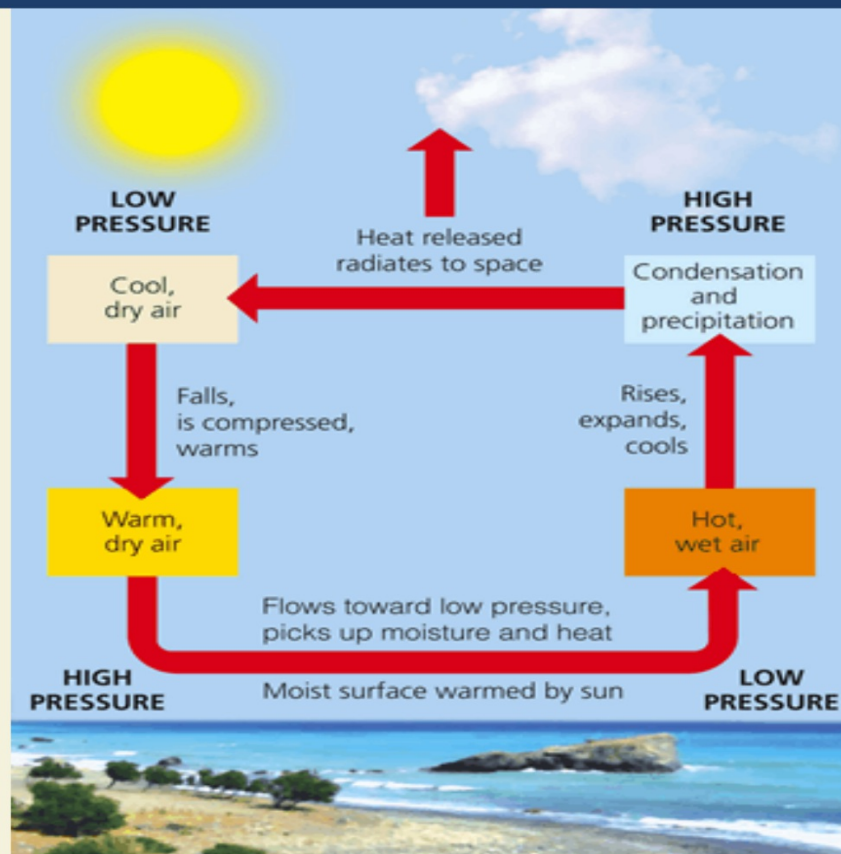


Fig. 7-4, p. 150

# El Nino – Southern Oscillation

## El Niño-Southern Oscillation



- Every few years
- Prevailing winds in tropical Pacific Ocean change direction' Affects much of earth's weather for 1-2 years

***Link between air circulation, ocean currents, and biomes***

## Normal and El Niño Conditions

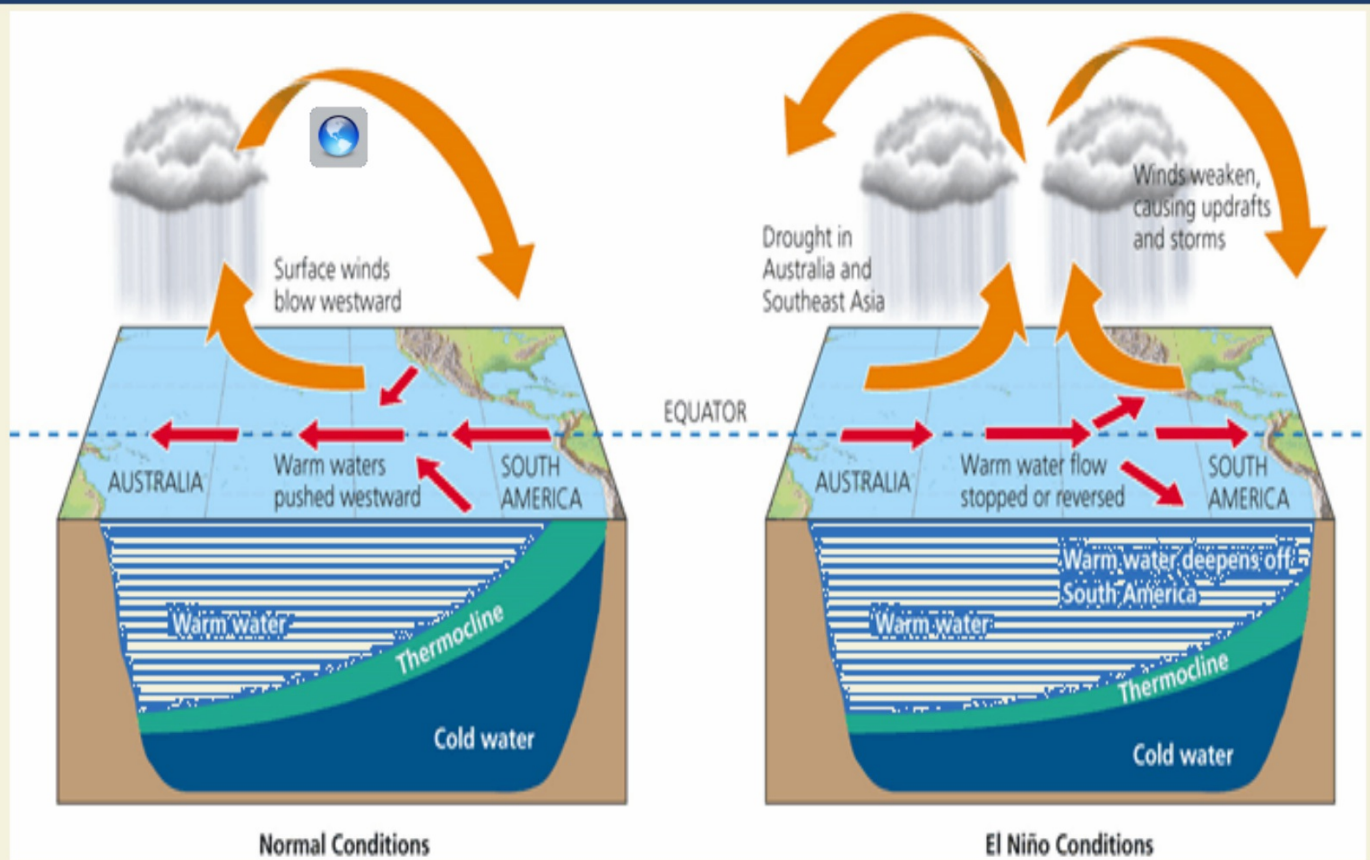


Figure 4, Supplement 7



## Impact of El Niño-Southern Oscillation

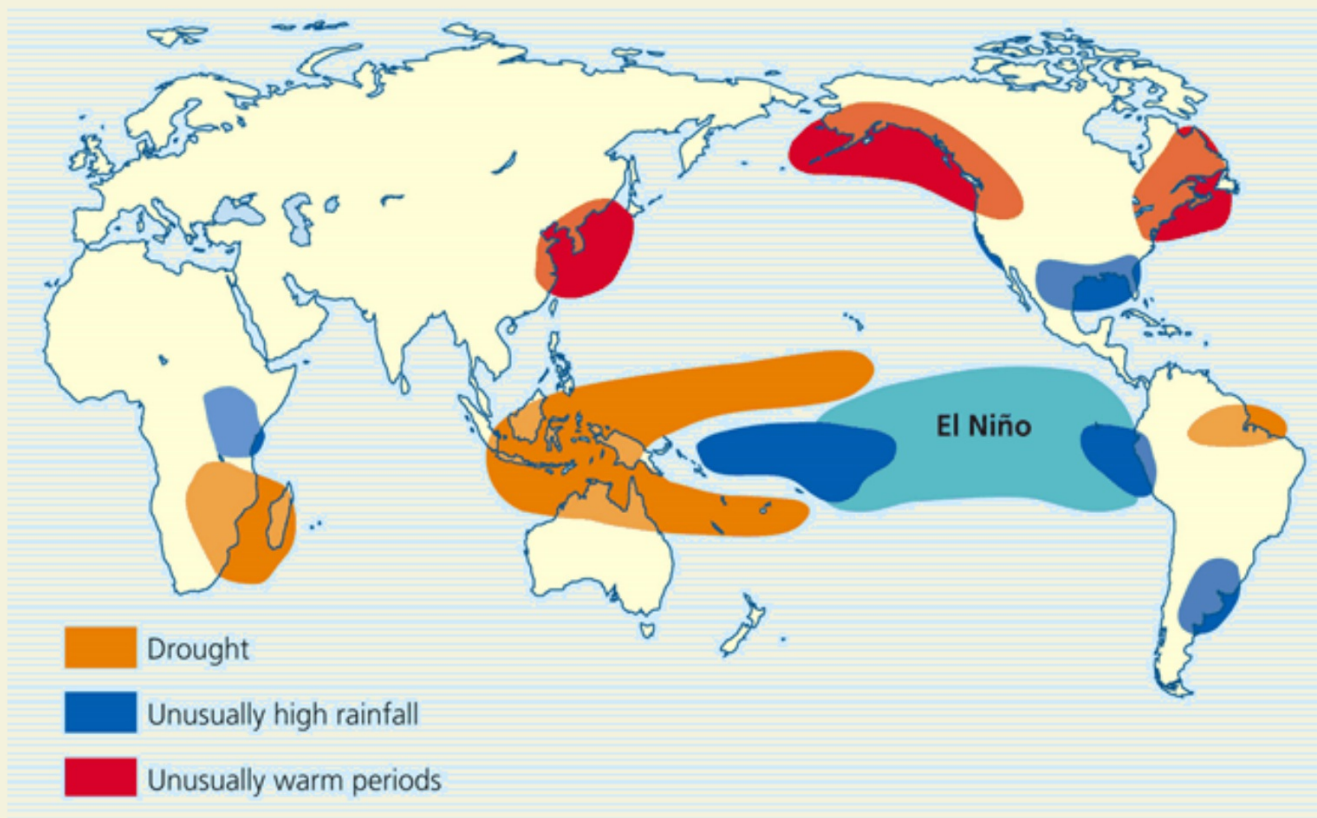


Figure 5, Supplement 7

# Greenhouse Gases Warm the Lower Atmosphere

## Greenhouse gases

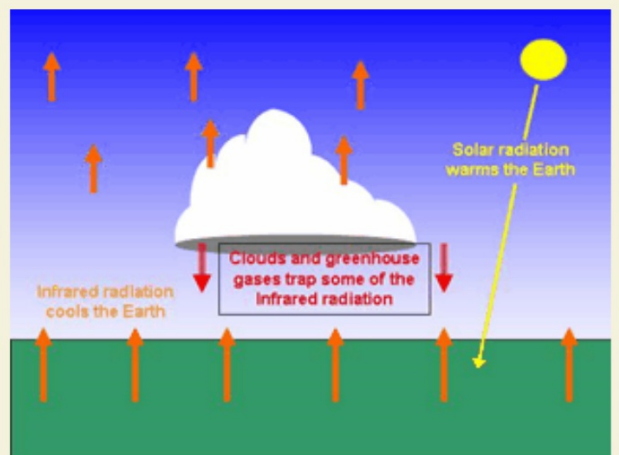


- $\text{H}_2\text{O}$
- $\text{CO}_2$
- $\text{CH}_4$
- $\text{N}_2\text{O}$

## Natural greenhouse effect



- Gases keep earth habitable
- Human-enhanced global warming



## Flow of Energy to and from the Earth

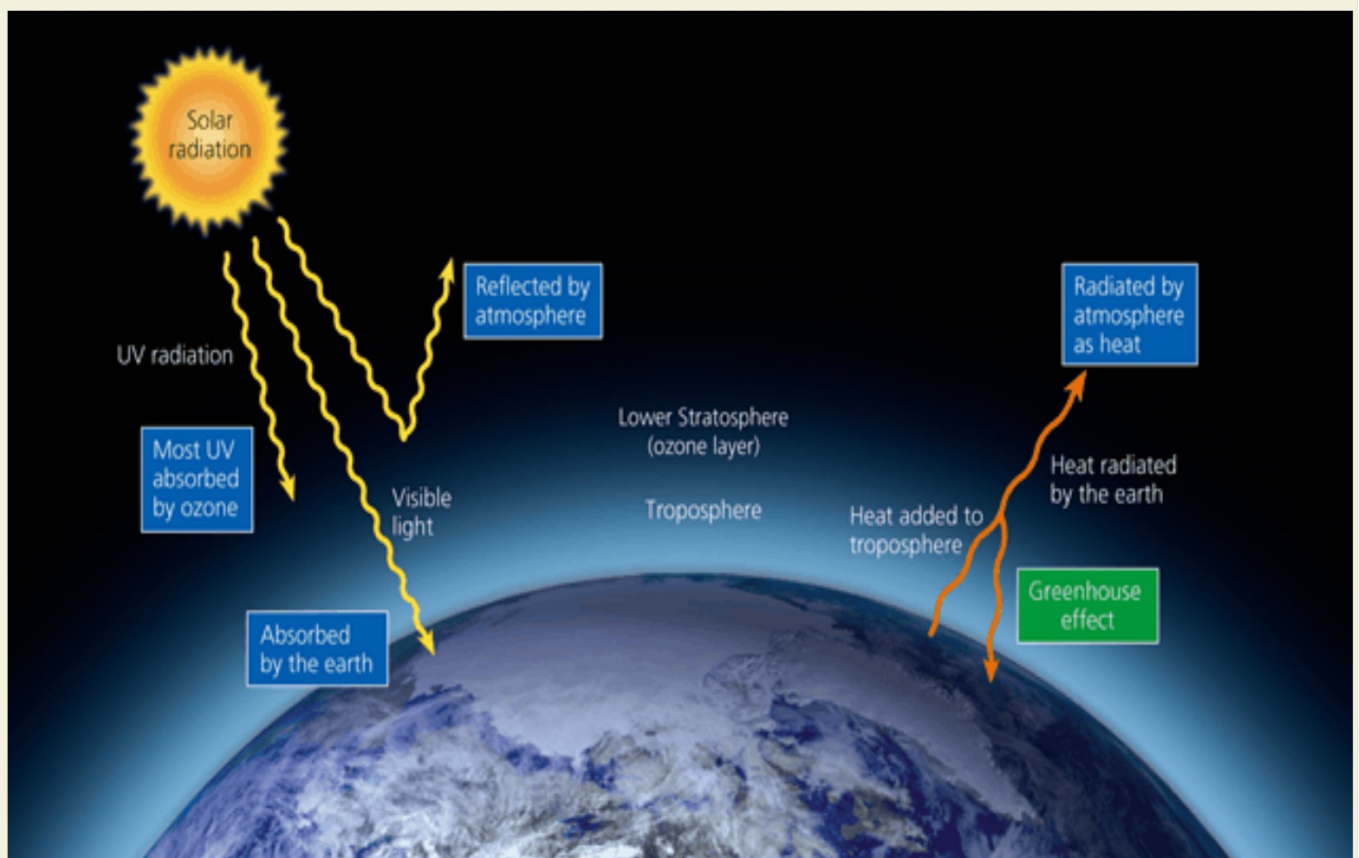


Fig. 3-4, p. 57

# Earth's Surface Features Affect Local Climates

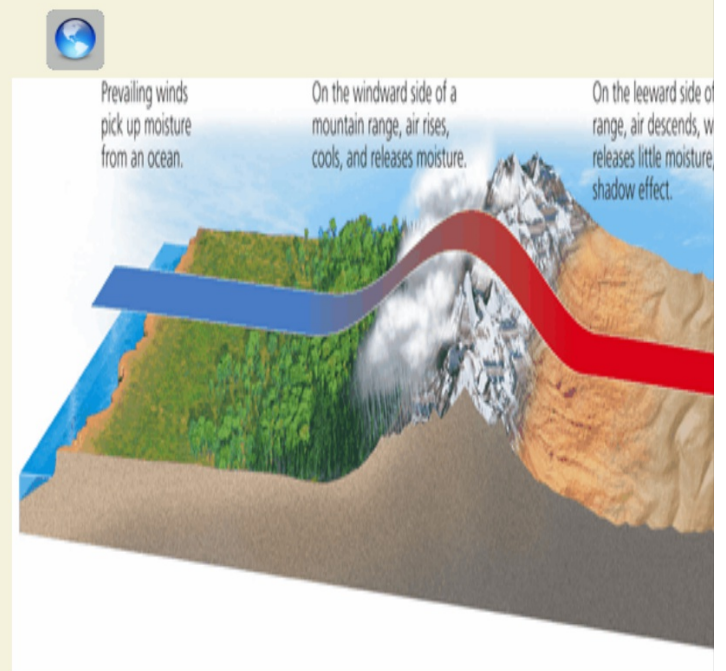
- Differential heat absorption by land and water

- Land and sea breezes

- **Rain shadow effect**

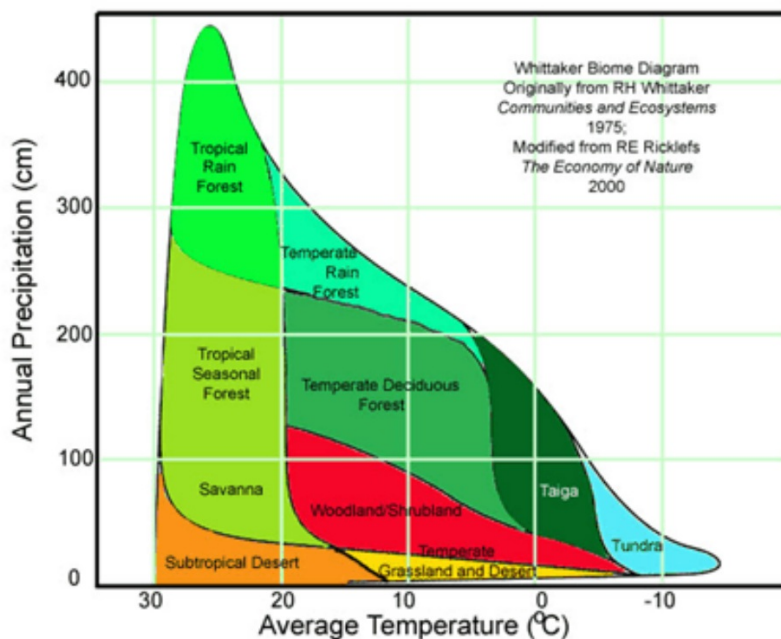
- Most precipitation falls on the windward side of mountain ranges
  - Deserts leeward

*Cities create microclimates*





## 7-2 How Does Climate Affect the Nature and Locations of Biomes?



### Concept 7-2

*Differences in average annual precipitation and temperature lead to the formation of tropical, temperate, and cold deserts, grasslands, and forests, and largely determine their locations.*

# Climate Helps Determine Where Organisms Can Live

**Biomes:** large land regions with certain types of climate and dominant plant life

- Not uniform
- Mosaic of patches

## ABIOTIC FACTORS:

- Latitude and elevation
- Annual precipitation
- Temperature



## The Earth's Major Biomes

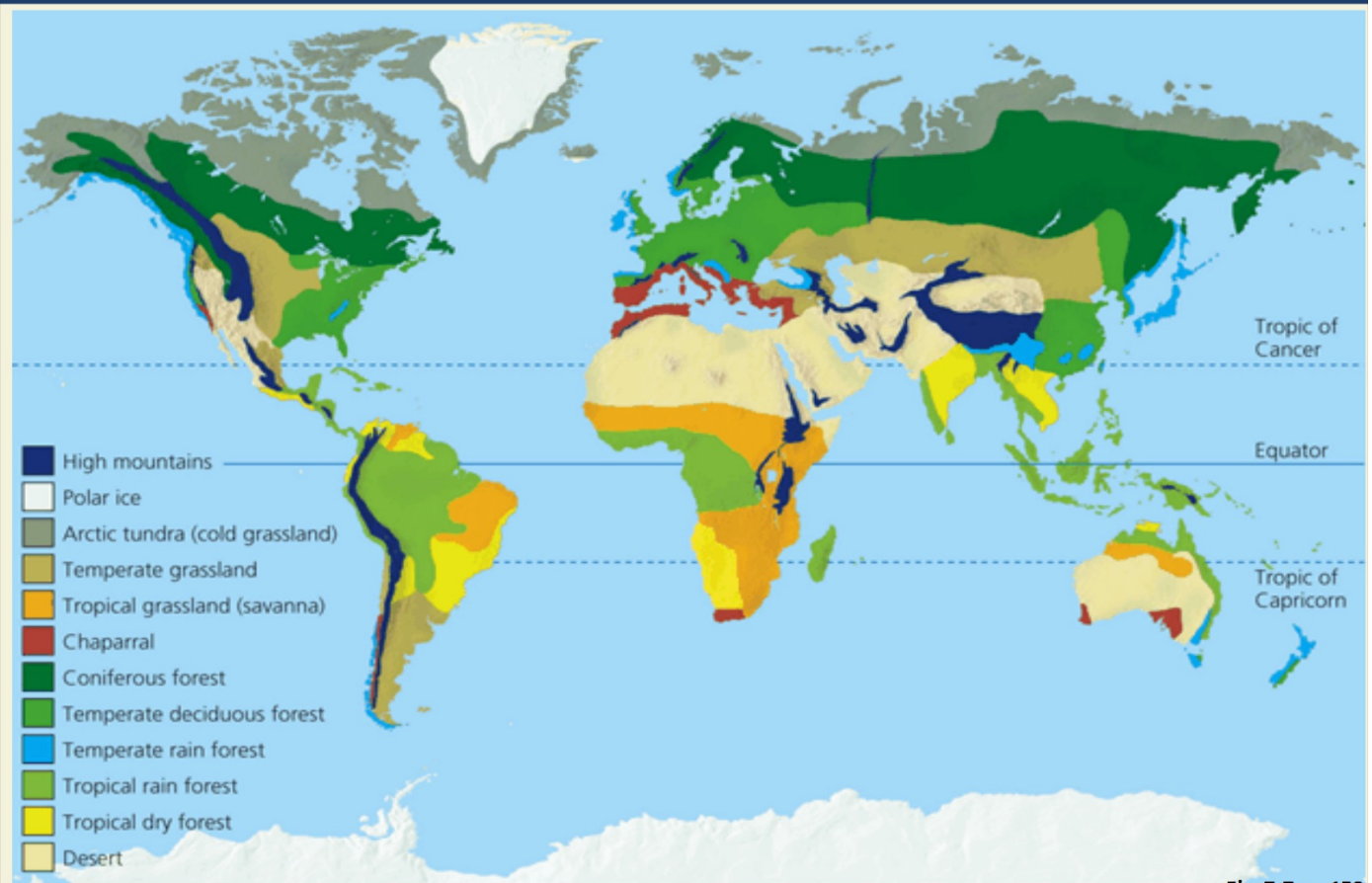


Fig. 7-7, p. 153

## VIDEO: World's Biomes



Earth is a world of many beautiful places!





## Natural Capital: Average Precipitation and Average Temperature as Limiting Factors

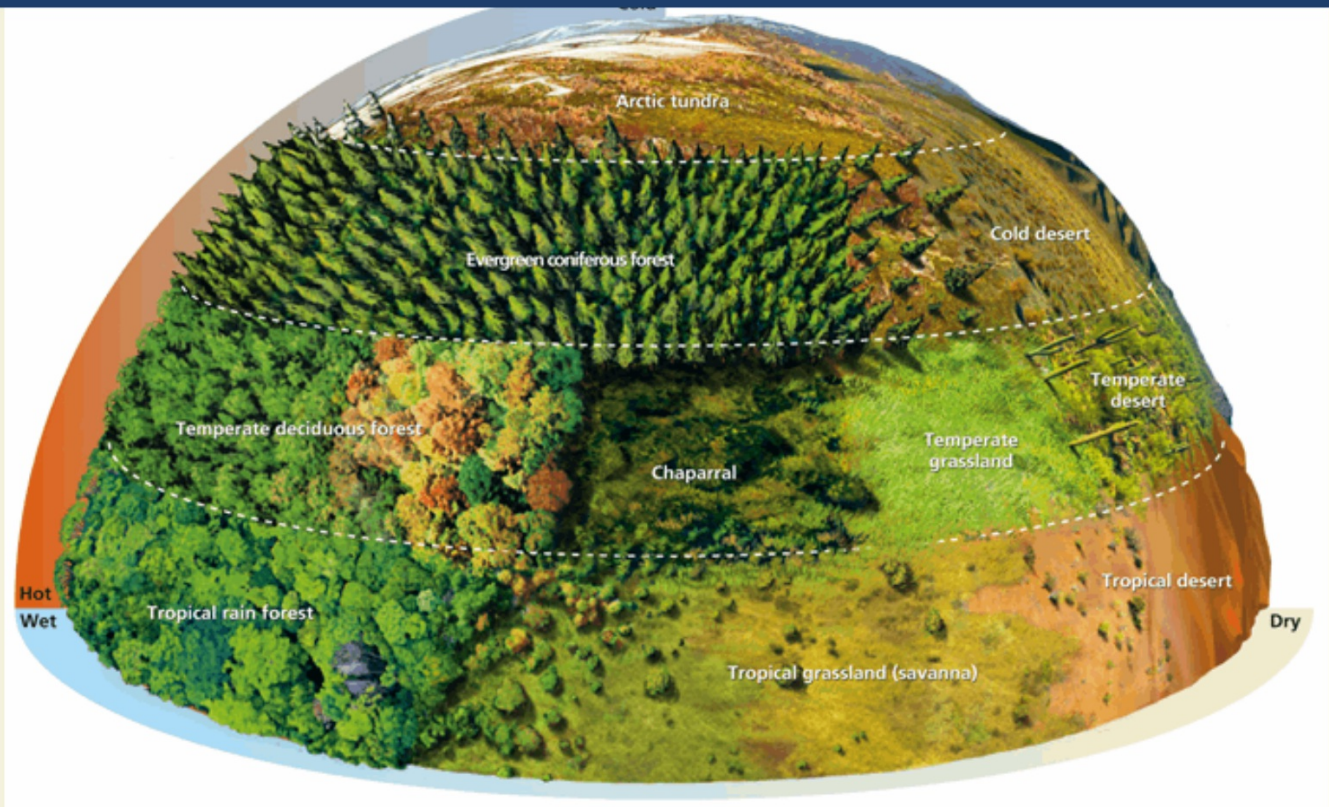


Fig. 7-9, p. 154

## Global Plant Biodiversity

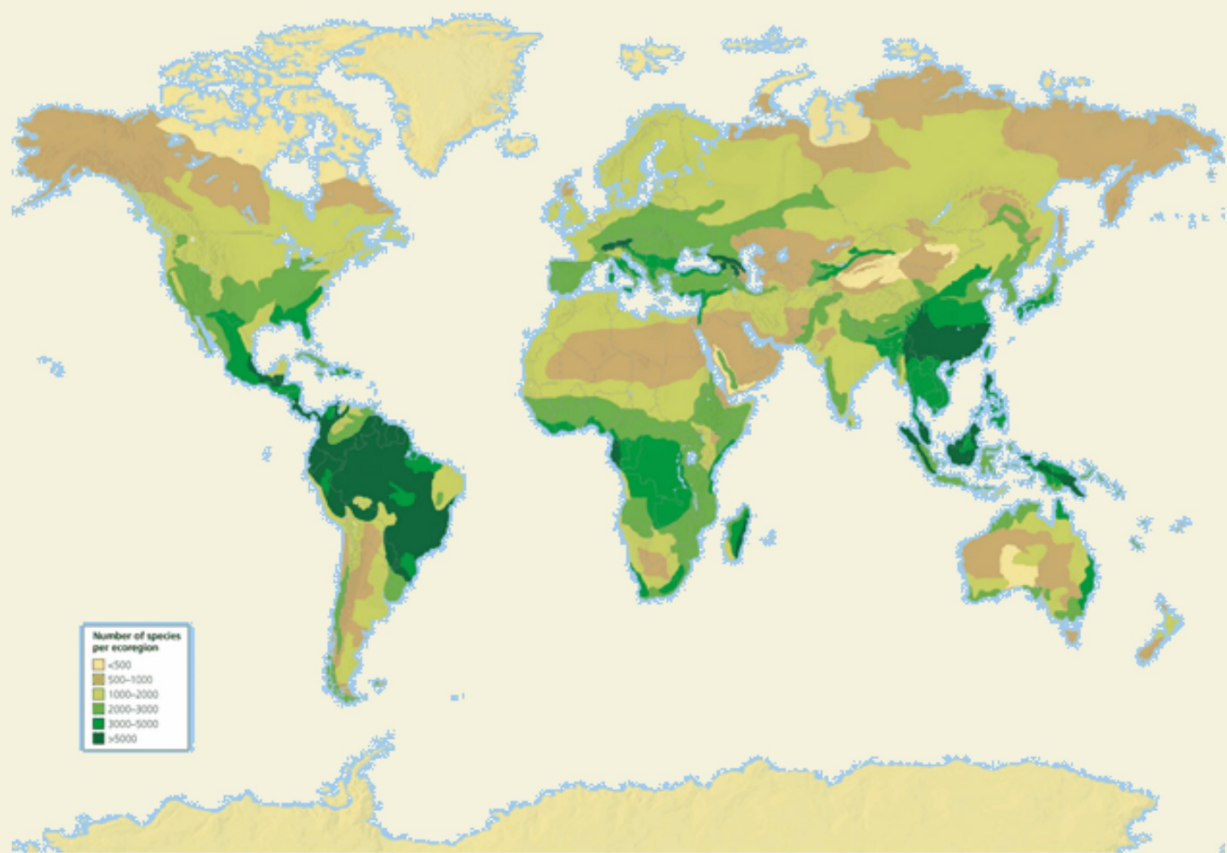


Figure 6, Supplement 8

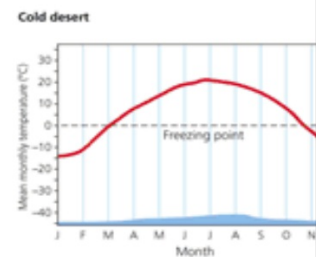
# Three Major Types of Deserts

## Tropical deserts

## Temperate deserts

## Cold deserts

- Fragile ecosystem
  - Slow plant growth
  - Low species diversity
  - Slow nutrient recycling
  - Lack of water





## Temperate Desert Ecosystem in North America

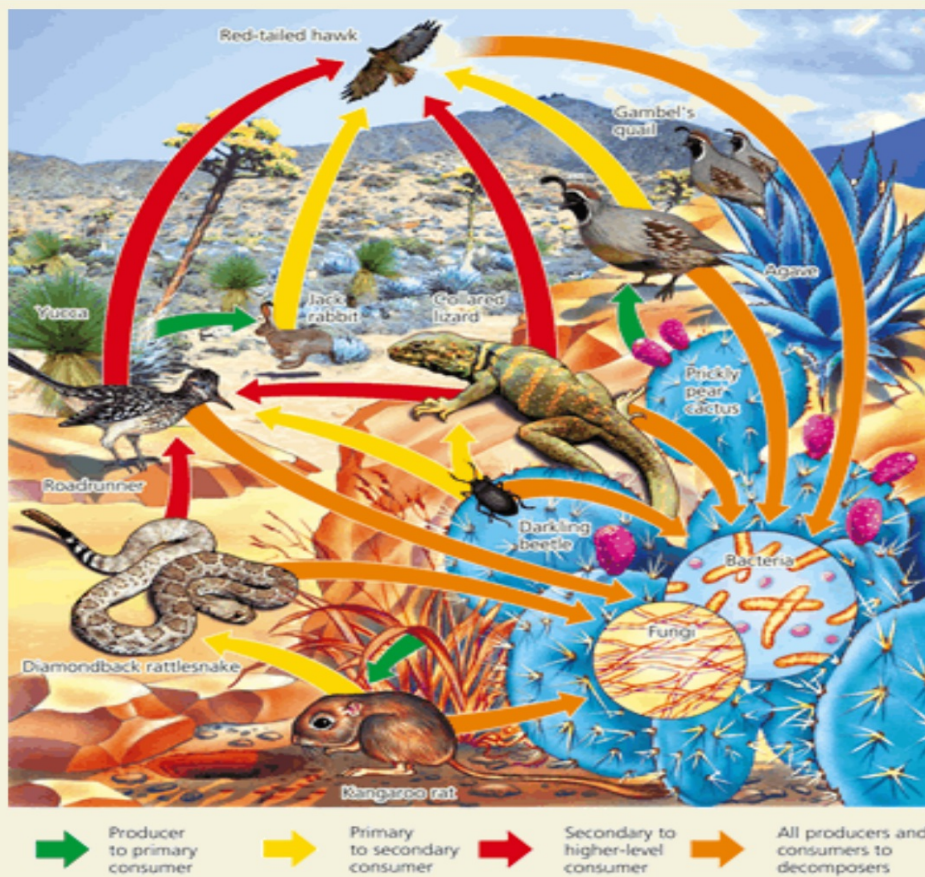
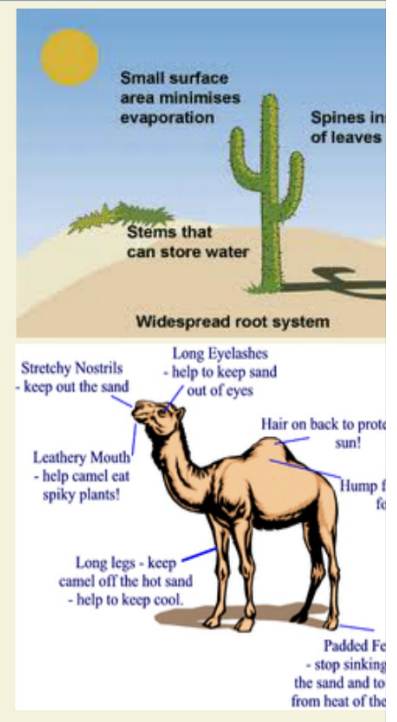


Figure 1, Supplement 6

# Science Focus: Staying Alive in the Desert

- Beat the heat/every drop of water counts
- Plant adaptations
  - Succulents
  - Deep tap roots
- Animal strategies and adaptations
  - Physiology and anatomy
  - Behavior





## Wildflowers Bloom after Rain in Arizona



Fig. 7-A, p. 156

# Three Major Types of Grasslands

## Tropical

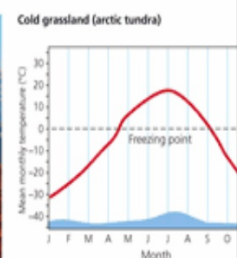
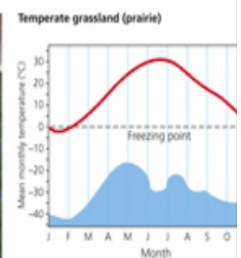
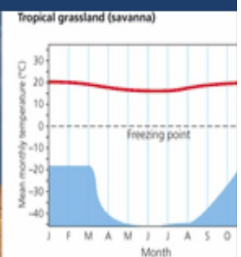
- Savanna
- Grazing & browsing animal

## Temperate

- Cold winters and hot and dry summers
- Tall-grass or short-grass prairies
- Often converted to farmland

## Cold (arctic tundra) - fragile biome

- Plants close to ground to conserve heat
- Most growth in short summer
- Animals have thick fur
- **Permafrost** : Underground soil that stays frozen



## Temperate Tall-Grass Prairie Ecosystem in North America

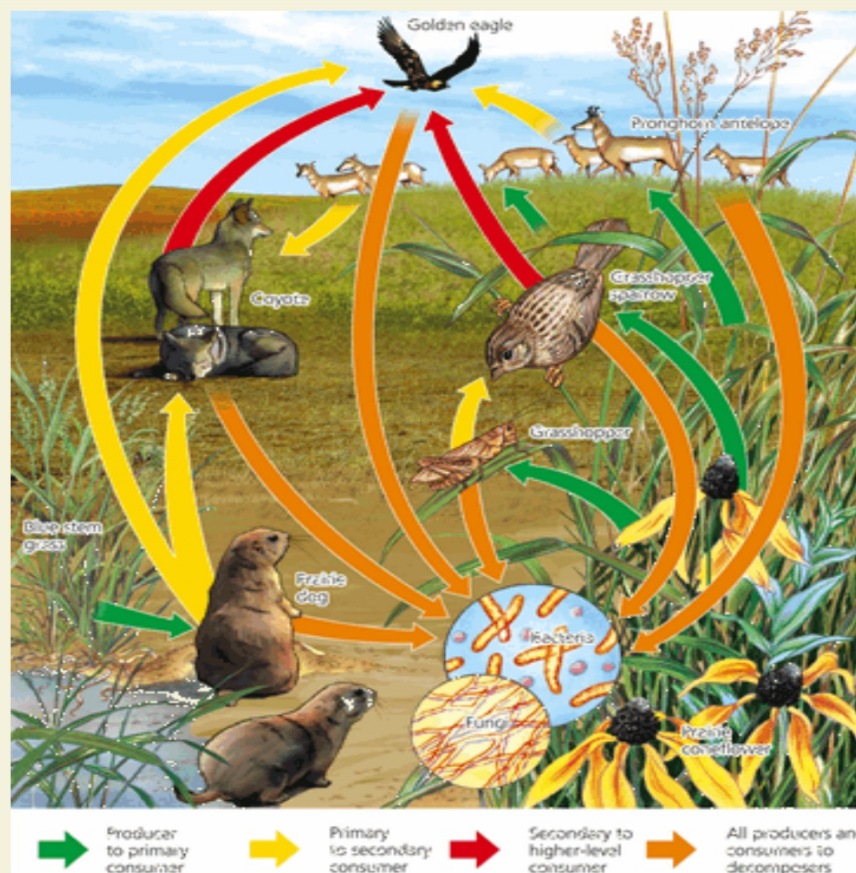


Figure 2, Supplement 6

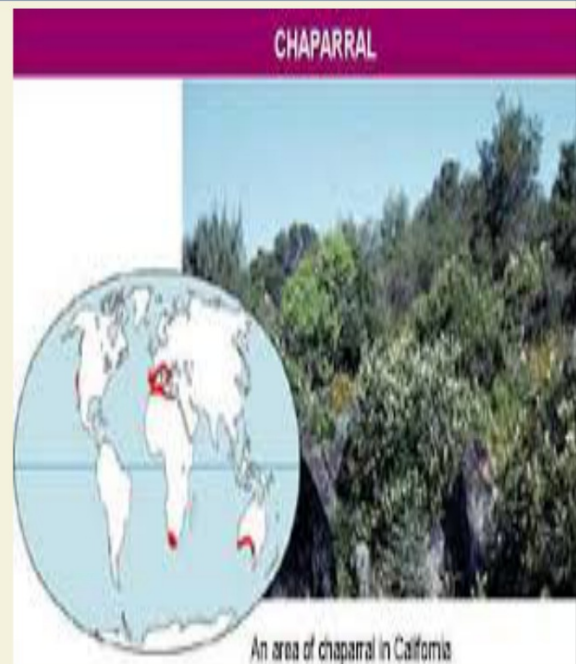


## Monoculture Crop Replacing Biologically Diverse Temperate Grassland



# Temperate Shrubland: Nice Climate, Risky Place to Live

- **Chaparral**
- Near the sea: nice climate
- Prone to fires in the dry season

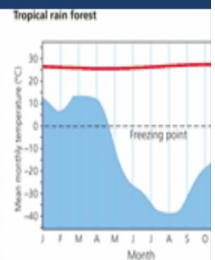




# Three Major Types of Forests

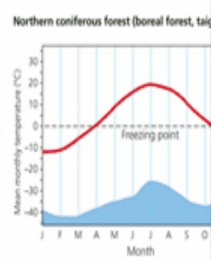
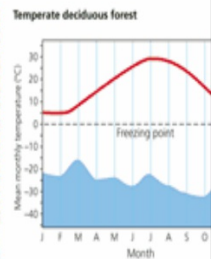
## Tropical

- Temperature and moisture
- Stratification of specialized plant and animal niches
- Little wind: significance
- Rapid recycling of scarce soil nutrients
- Impact of human activities



## Temperate

- Temperature and moisture
- Broad-leaf trees
- Slow rate of decomposition: significance
- Impact of human activities



## Cold (Northern coniferous and boreal)

- Temperature and moisture
- Few species of cone-bearing trees
- Slow decomposition: significance

# Tropical Rain Forest Ecosystem



→ Producer to primary consumer  
 → Primary to secondary consumer  
 → Secondary to higher-level consumer  
 → All producers and consumers to decomposers

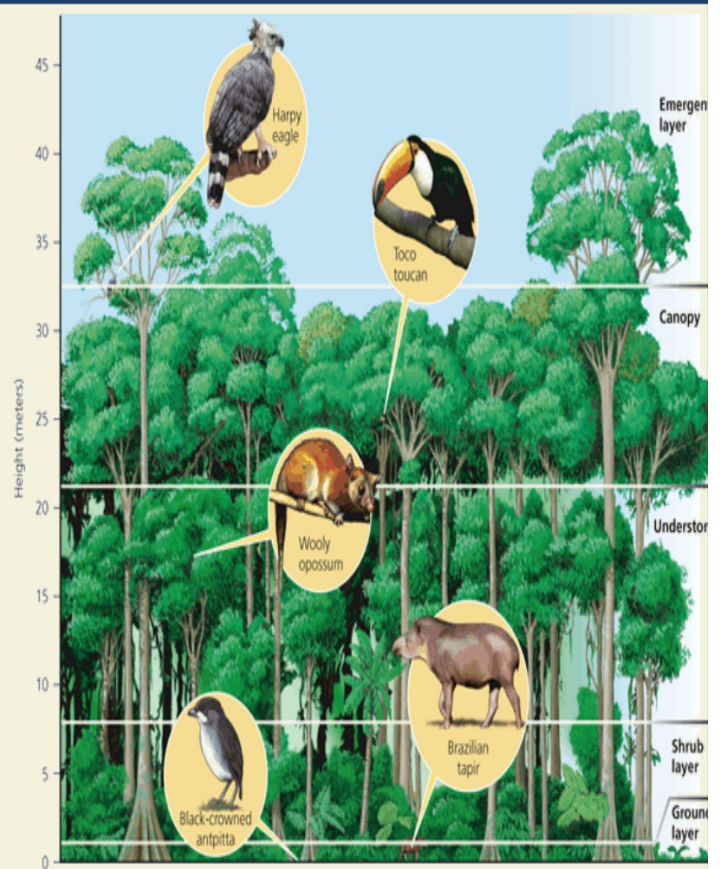


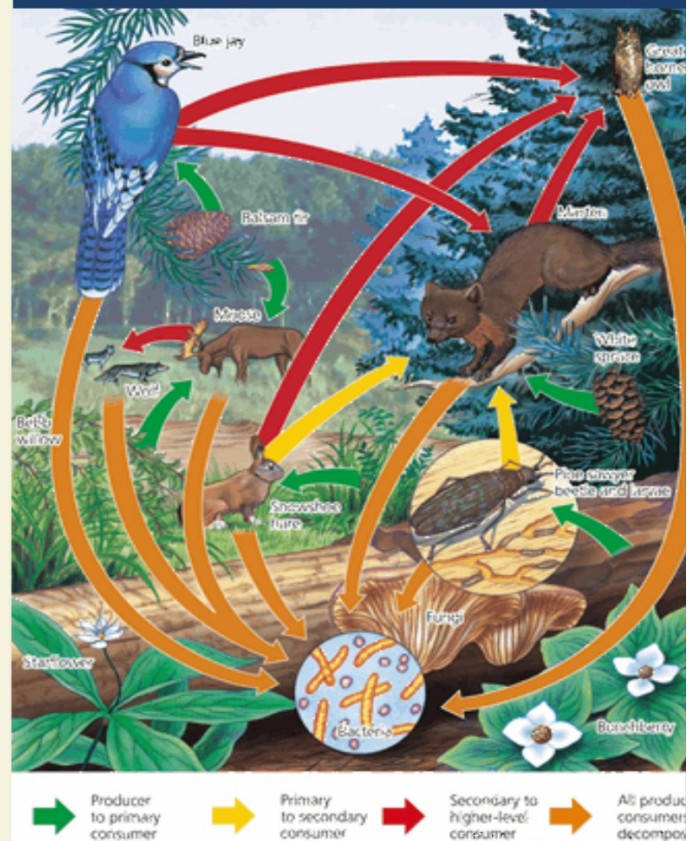
Fig. 7-14, p. 161



## Temperate Deciduous Forest Ecosystem in North America



## Evergreen Coniferous Forest Ecosystem in North America



## Temperate Rain Forest in Washington State



Fig. 7-16, p. 163



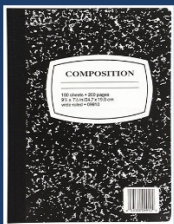
# Mountains Play Important Ecological Roles

- Majority of the world's forests
- Islands of biodiversity
- Habitats for endemic species
- Help regulate the earth's climate
- Major storehouses of water
  - Role in hydrologic cycle



Mount Rainier National  
Park in Washington State

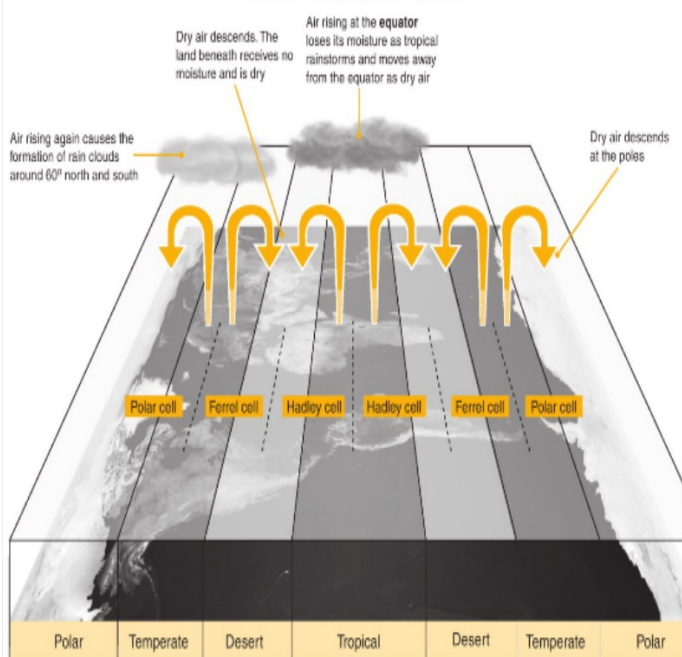




# Biomes

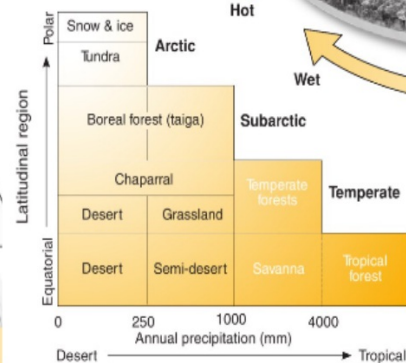
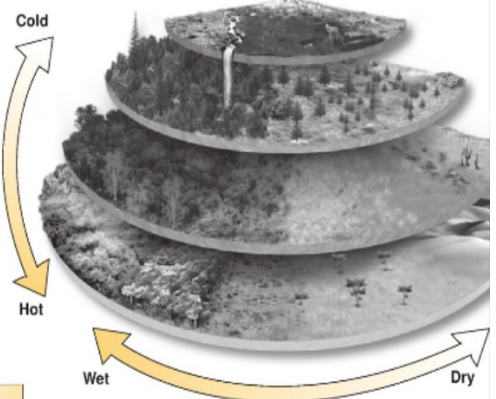
*Directions: Read the information and answer the questions in your composition book.*

## Earth's Climate and Biomes



Latitude directly affects solar input and temperature. As the Earth curves towards the poles, solar energy is spread out over an ever increasing area. This energy must also travel through a greater amount of the atmosphere, expending more energy than at low latitudes.

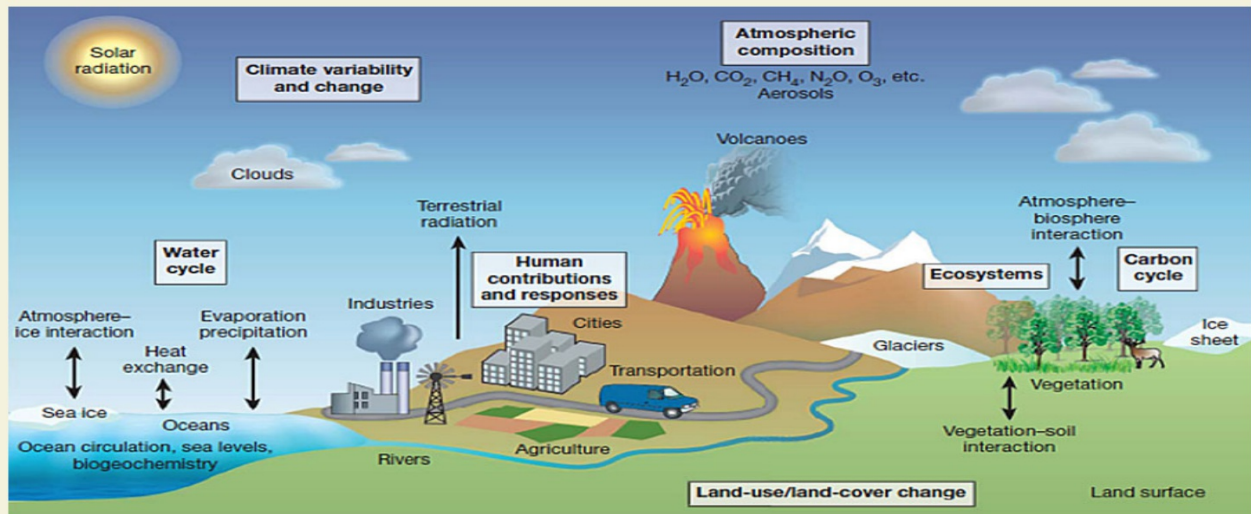
Within a single latitudinal region, the level of precipitation (rainfall) governs the type of plant community found. Note that the effect of altitude is similar to that of latitude (ice will occur at high altitudes even at low-latitudes).



Temperature and precipitation are the predictors of biome distribution. Temperature decreases from the equator to the poles. Temperature and precipitation act together as limiting factors to determine the type of grassland, or forest biome in a region.

## 7-3 How Have We Affected the World's Terrestrial Ecosystems?

**Concept 7-3** *In many areas, human activities are impairing ecological and economic services provided by the earth's deserts, grasslands, forests, and mountains.*



# Humans Have Disturbed Most of the Earth's Lands

## NATURAL CAPITAL DEGRADATION

### Major Human Impacts on Terrestrial Ecosystems

#### Deserts



Soil salinization from irrigation  
Depletion of groundwater  
Land disturbance and pollution from mineral extraction

#### Grasslands



Conversion to cropland  
Release of CO<sub>2</sub> to atmosphere from burning grassland  
Overgrazing by livestock  
Oil production and off-road vehicles in arctic tundra

#### Forests



Clearing for agriculture, livestock grazing, timber, and urban development  
Conversion of diverse forests to tree plantations  
Damage from off-road vehicles  
Pollution of forest streams

#### Mountains



Agriculture  
Timber extraction  
Mineral extraction  
Hydroelectric dams and reservoirs  
Increasing tourism  
Urban air pollution  
Increased ultraviolet radiation from ozone depletion  
Soil damage from off-road vehicles

# Three Big Ideas

1. Differences in climate, based mostly on long-term differences in average temperature and precipitation, largely determine the types and locations of the earth's deserts, grasslands, and forests.
2. The earth's terrestrial systems provide important ecological and economic services.
3. Human activities are degrading and disrupting many of the ecological and economic services provided by the earth's terrestrial ecosystems.