

MILLER/SPOOLMAN
LIVING IN THE ENVIRONMENT

17TH



Chapter 7
Climate and Biodiversity

Core Case Study: Different Climates Support Different Life Forms

- Climate -- long-term temperature and precipitation patterns – determines which plants and animals can live where
- 3 Major Climate Zones:
 - Tropical: equator, intense sunlight
 - Polar: poles, little sunlight
 - Temperate: in-between tropical and polar

Three Major Climate Zones



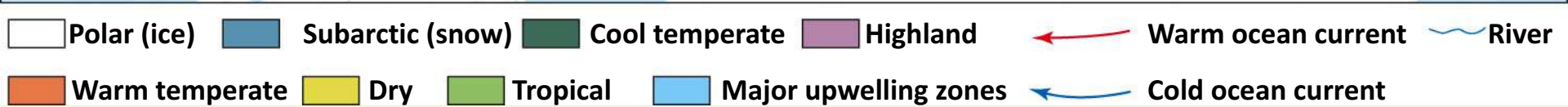
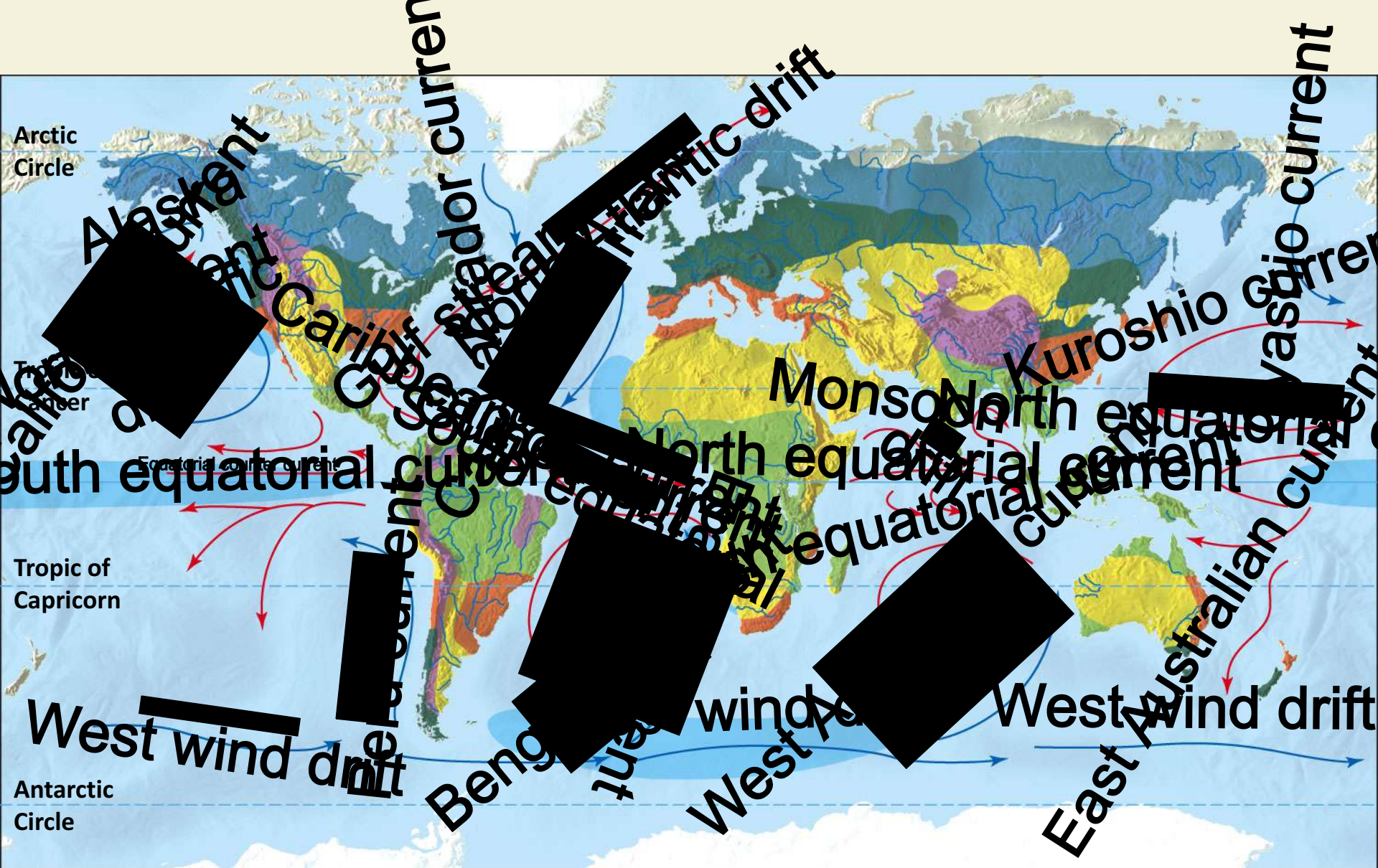
Fig. 7-1, p. 147

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.*

The Earth Has Many Different Climates (1)

- **Weather**
 - Temperature, precipitation, wind speed, cloud cover
 - Hours to days
- **Climate**
 - Area's general pattern of atmospheric conditions over decades and longer



The Earth Has Many Different Climates (2)

- Air circulation in lower atmosphere due to
 1. Uneven heating of the earth's surface by sun
 2. Rotation of the earth on its axis
 3. Properties of air, water, and land
- **Ocean currents – 4 main factors**
 - Prevailing winds
 - Earth's rotation
 - Redistribution of heat from the sun
 - Surface currents and deep currents

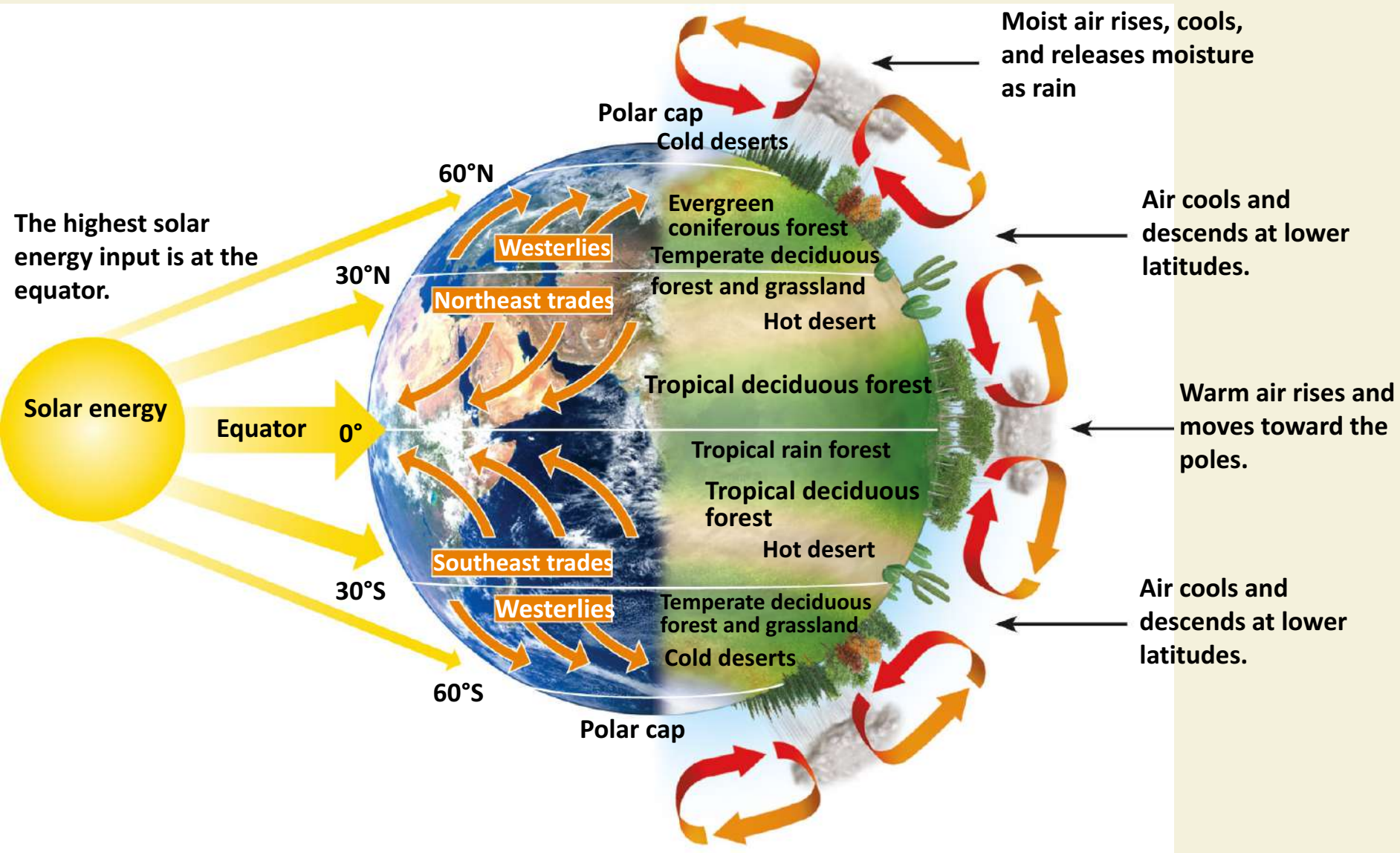


Fig. 7-3, p. 149

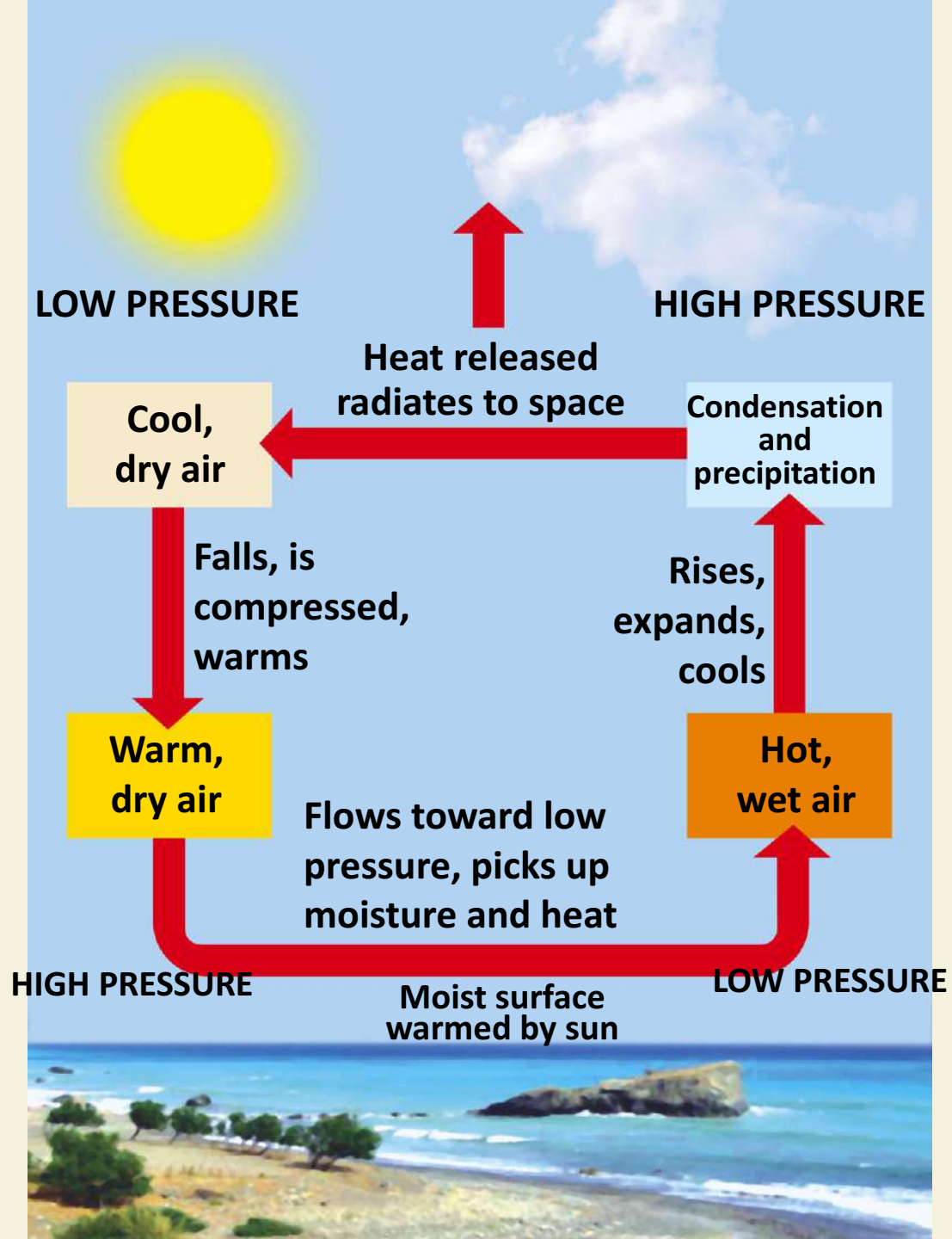


Fig. 7-4, p. 150

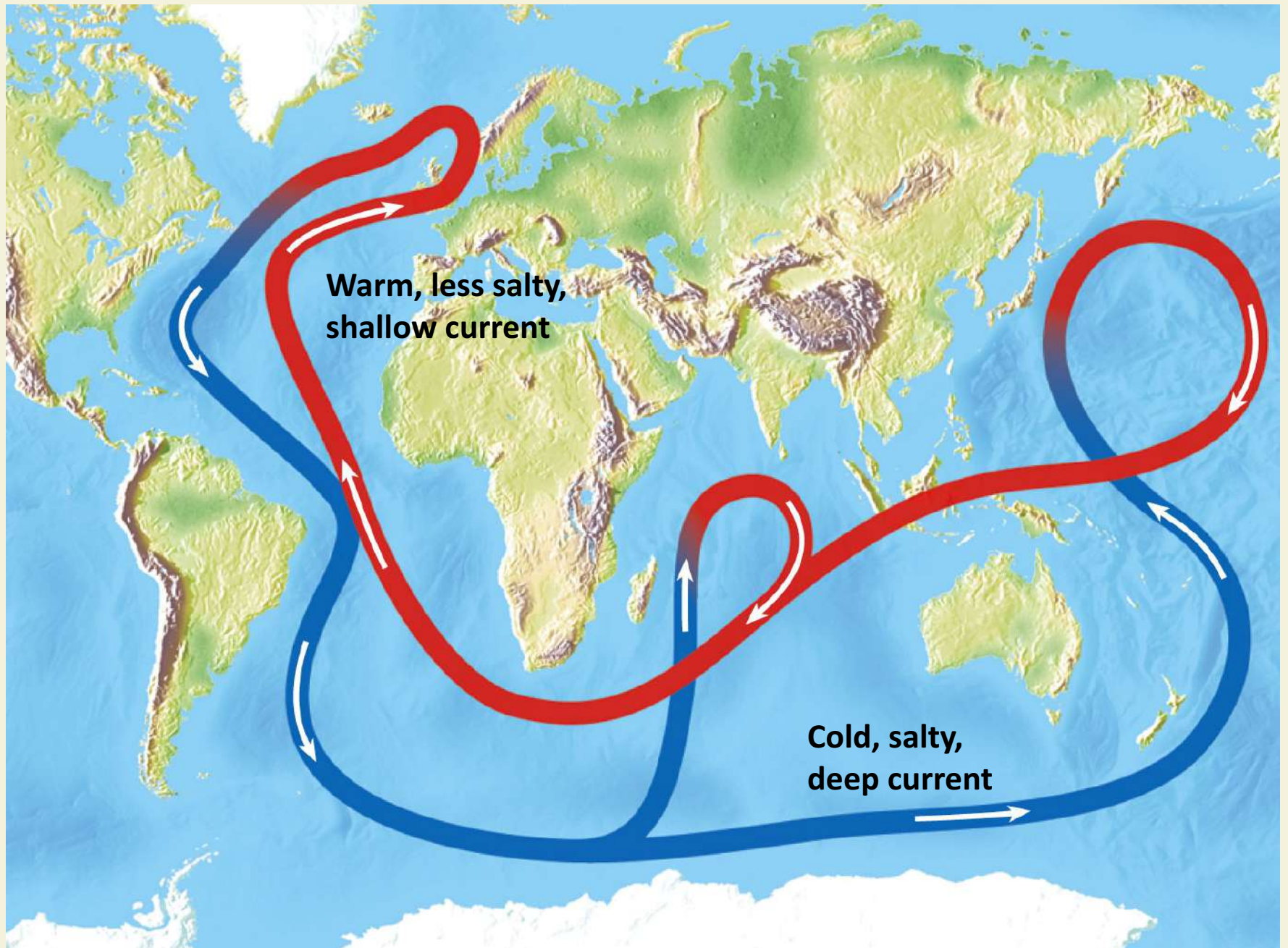


Fig. 7-5, p. 150

The Earth Has Many Different Climates (3)

- 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

Normal and El Niño Conditions

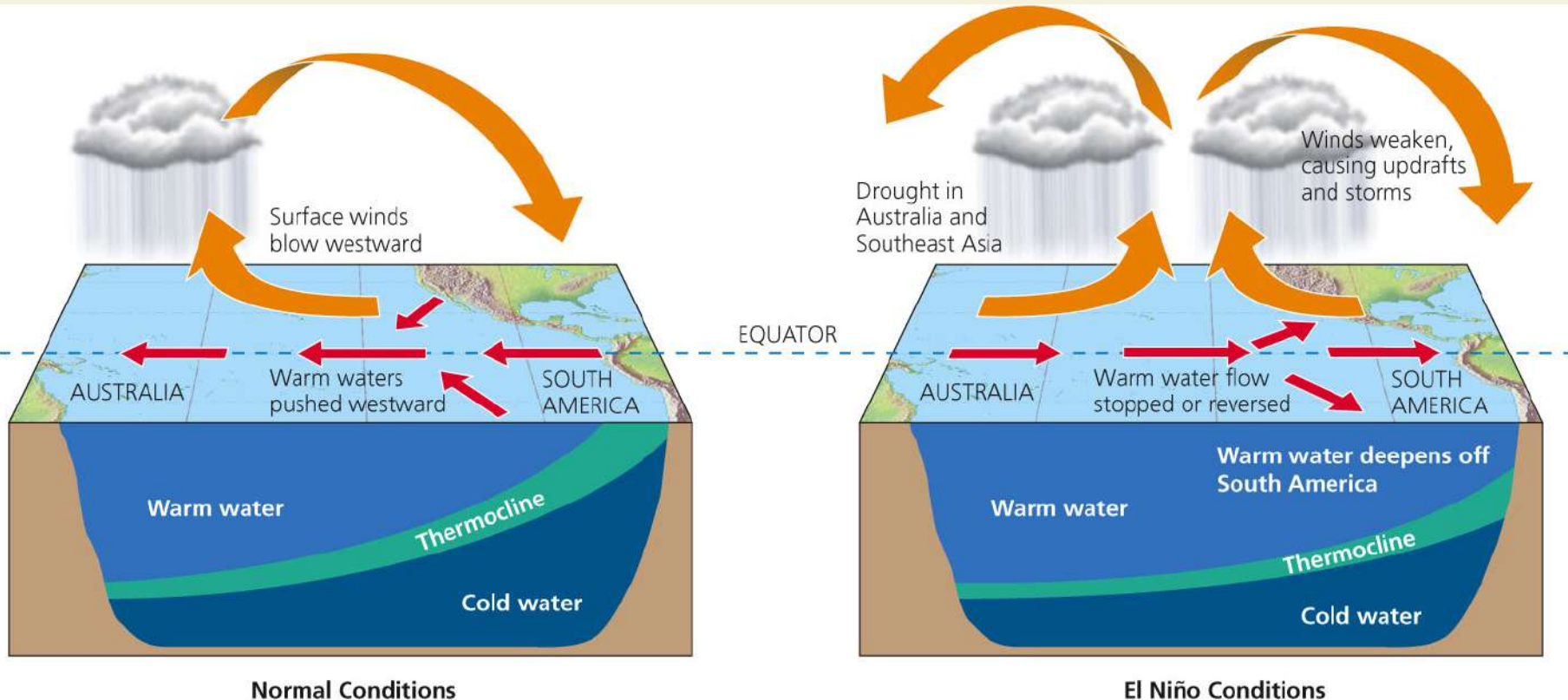


Figure 4, Supplement 7

Impact of El Niño-Southern Oscillation

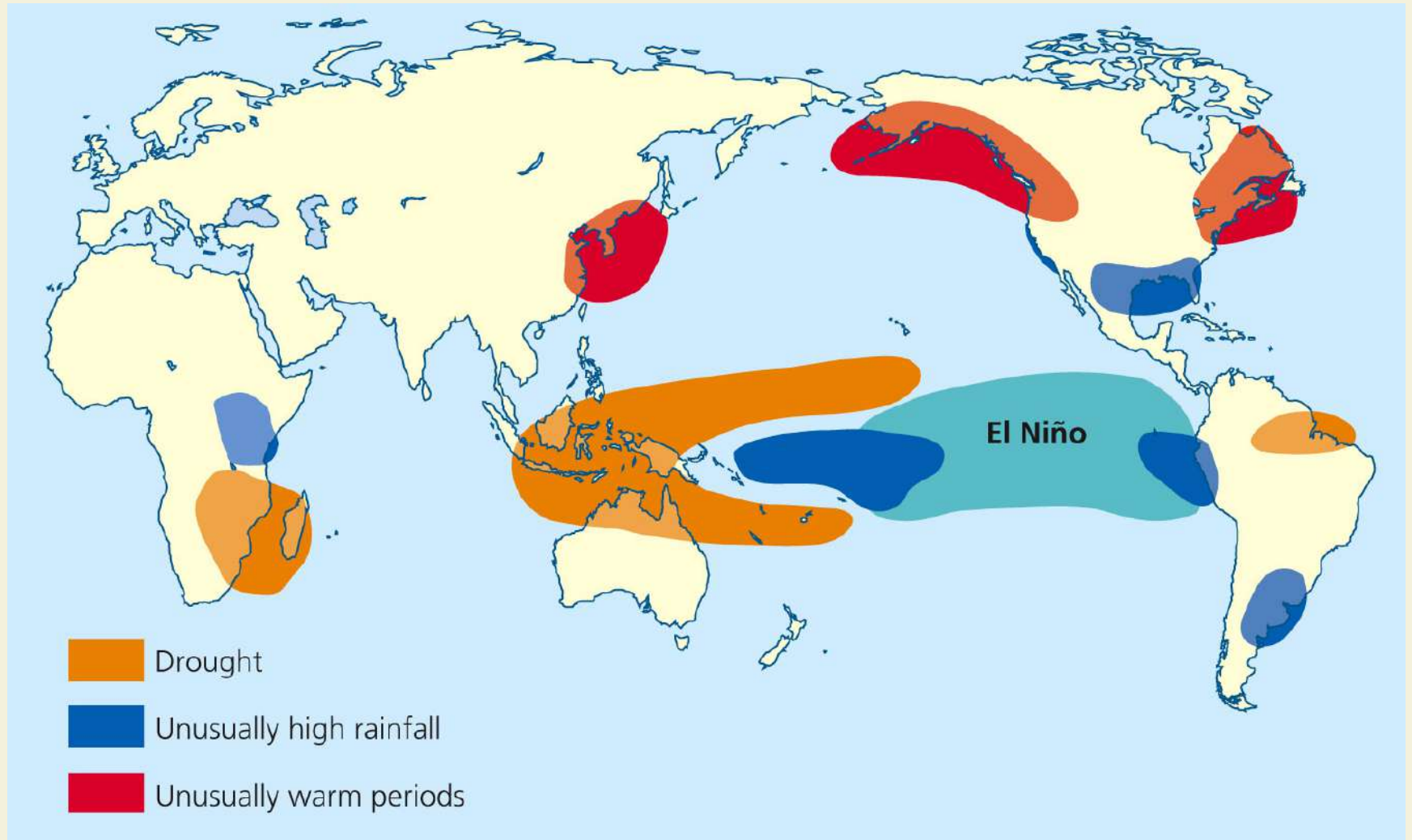
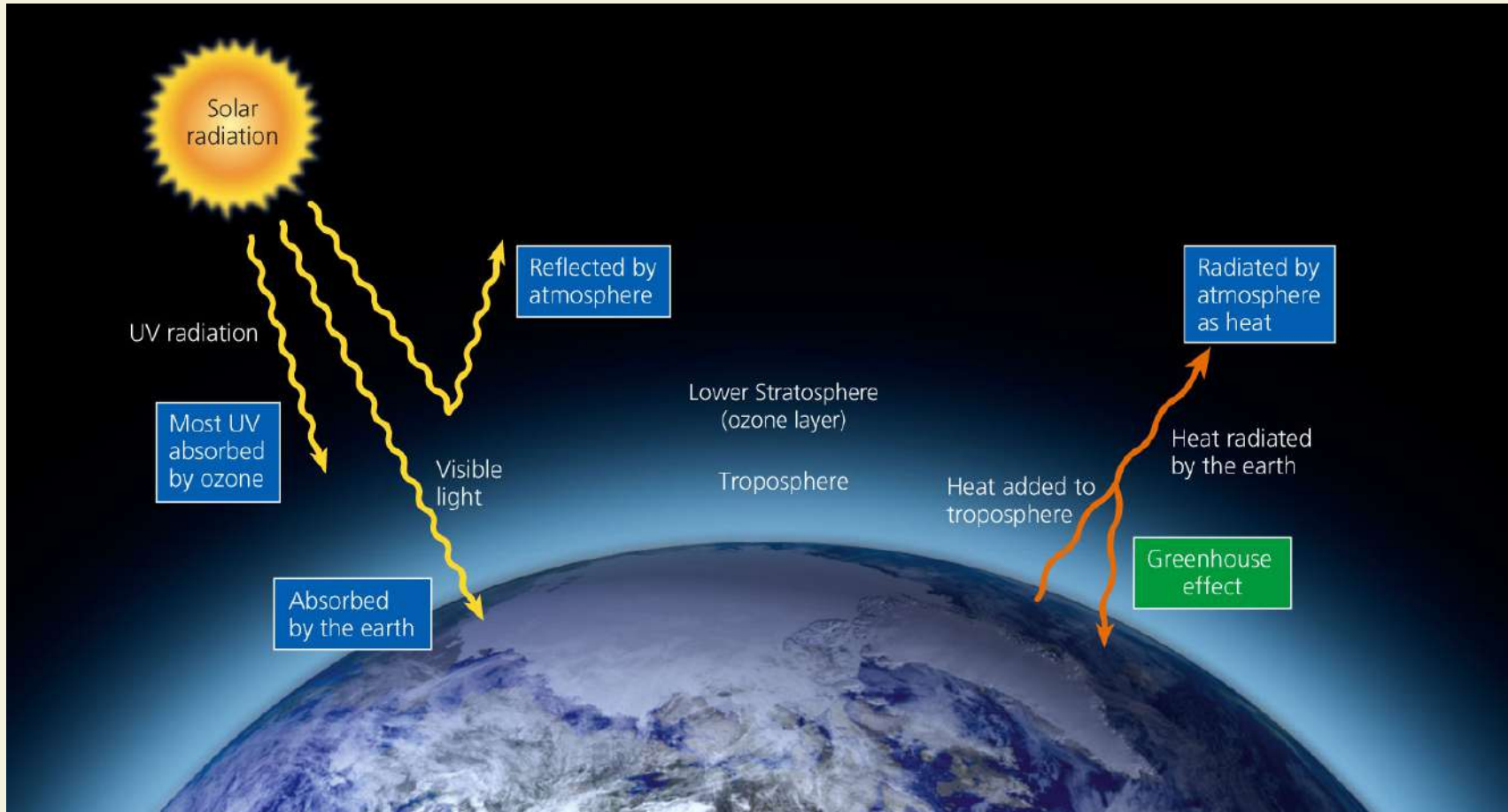


Figure 5, Supplement 7

Greenhouse Gases Warm the Lower Atmosphere

- **Greenhouse gases**
 - Absorb and release heat that warm the planet
 - Examples
 - H_2O
 - CO_2
 - CH_4
 - N_2O
- **Natural greenhouse effect**
 - Some gases radiate out of the atmosphere, some are trapped by greenhouse gases.
 - These gases keep earth habitable

Flow of Energy to and from the Earth



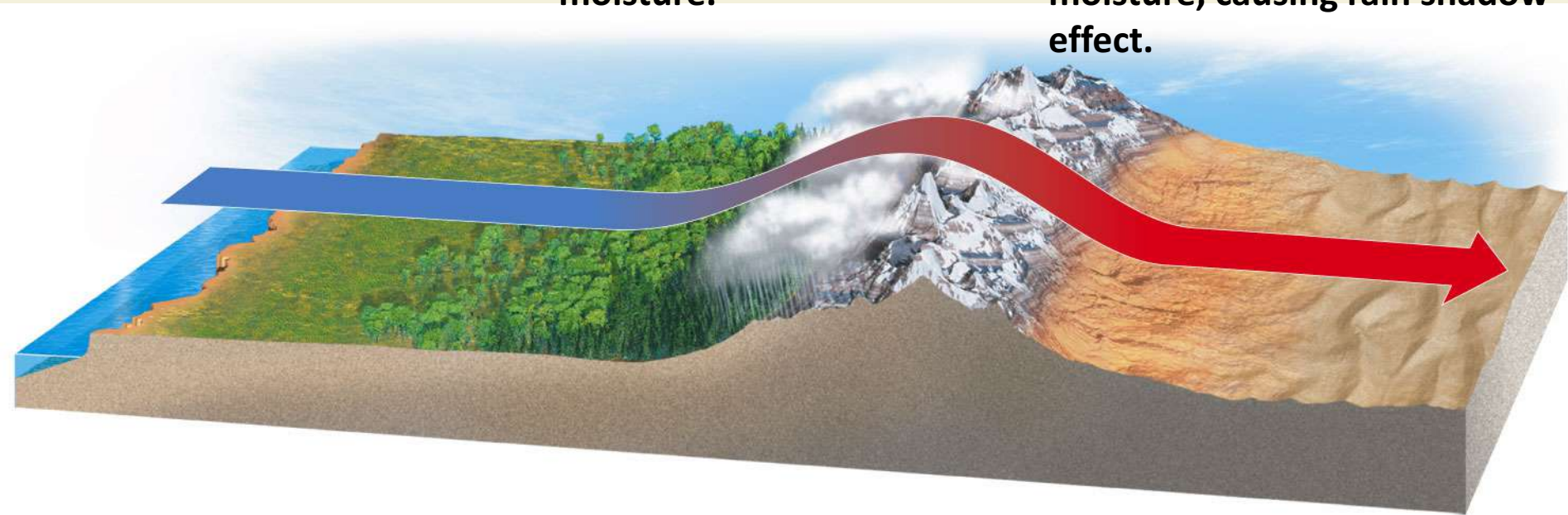
Earth's Surface Features Affect Local Climates

- Heat is absorbed and released more slowly by water than by land.
- This creates land and sea breezes
- **Rain shadow effect – created by many decades of arid or semi-arid conditions on the leeward side of high mountains.**
 - Most precipitation falls on the windward side of mountain ranges
 - Deserts leeward
- Cities create microclimates

Prevailing winds pick up moisture from an ocean.

On the windward side of a mountain range, air rises, cools, and releases moisture.

On the leeward side of the mountain range, air descends, warms, and releases little moisture, causing rain shadow effect.



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
- Influenced by:
 - Latitude and elevation
 - Annual precipitation
 - Temperature

The Earth's Major Biomes

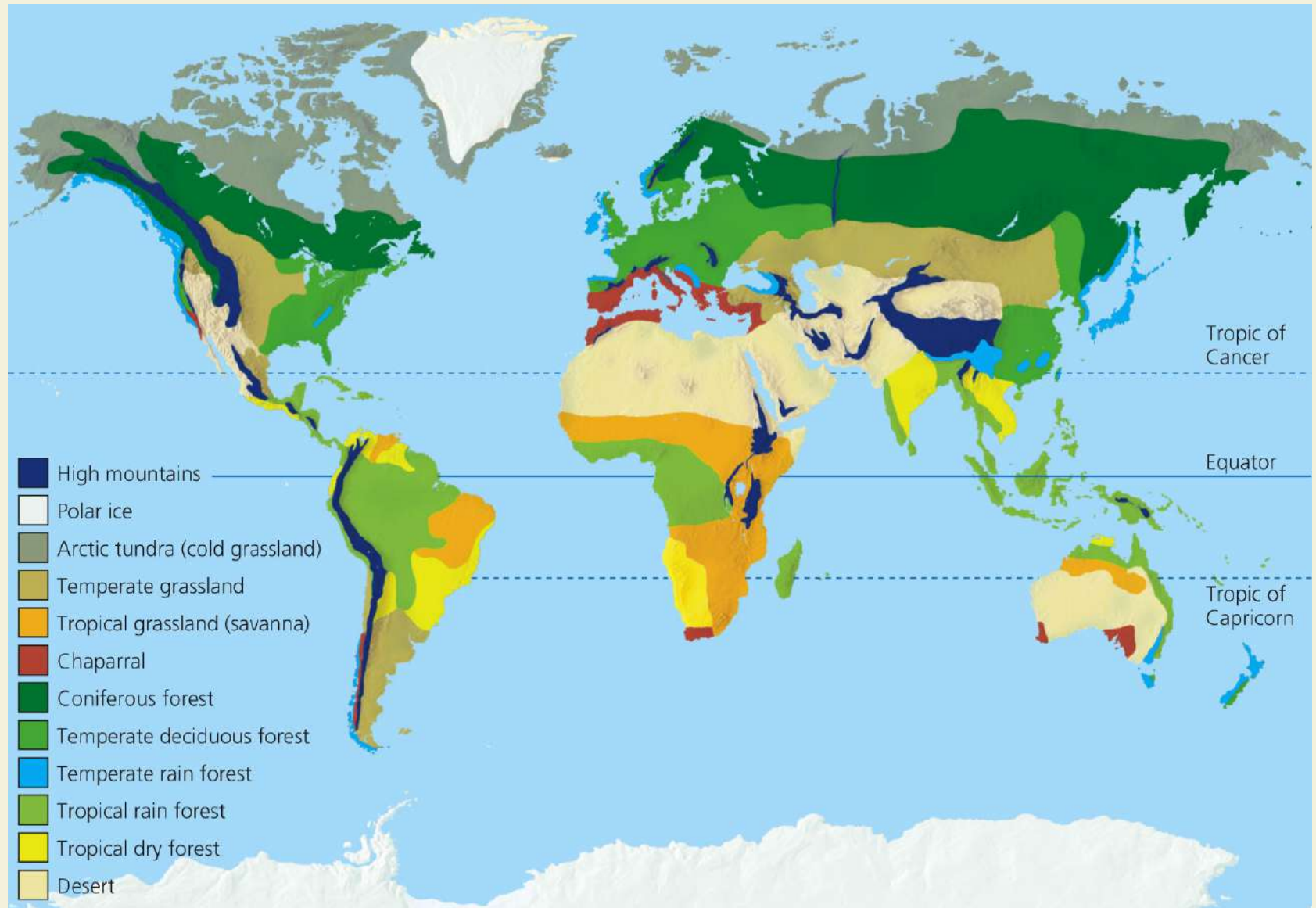


Fig. 7-7, p. 153

North America Biomes

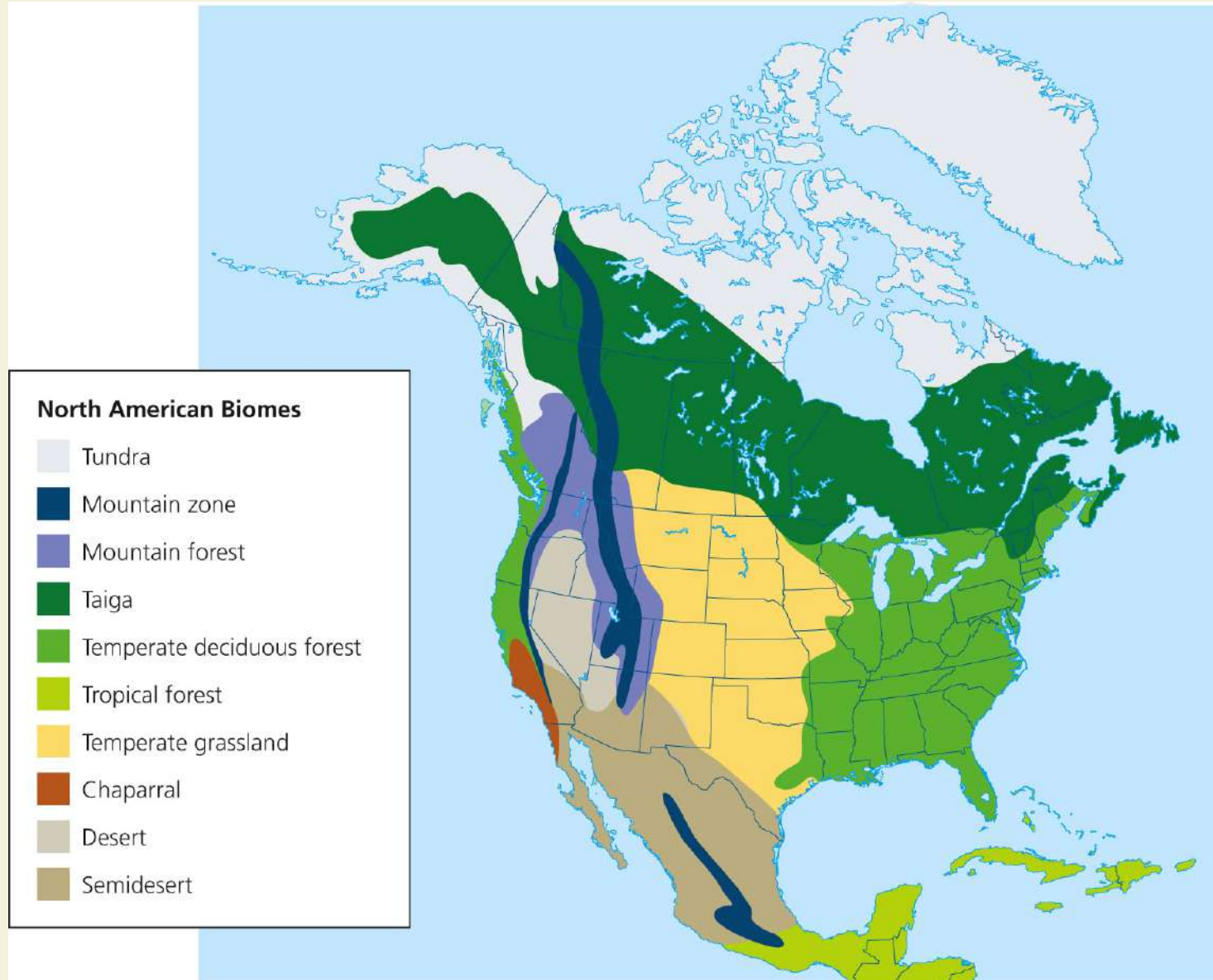


Figure 3, Supplement 8

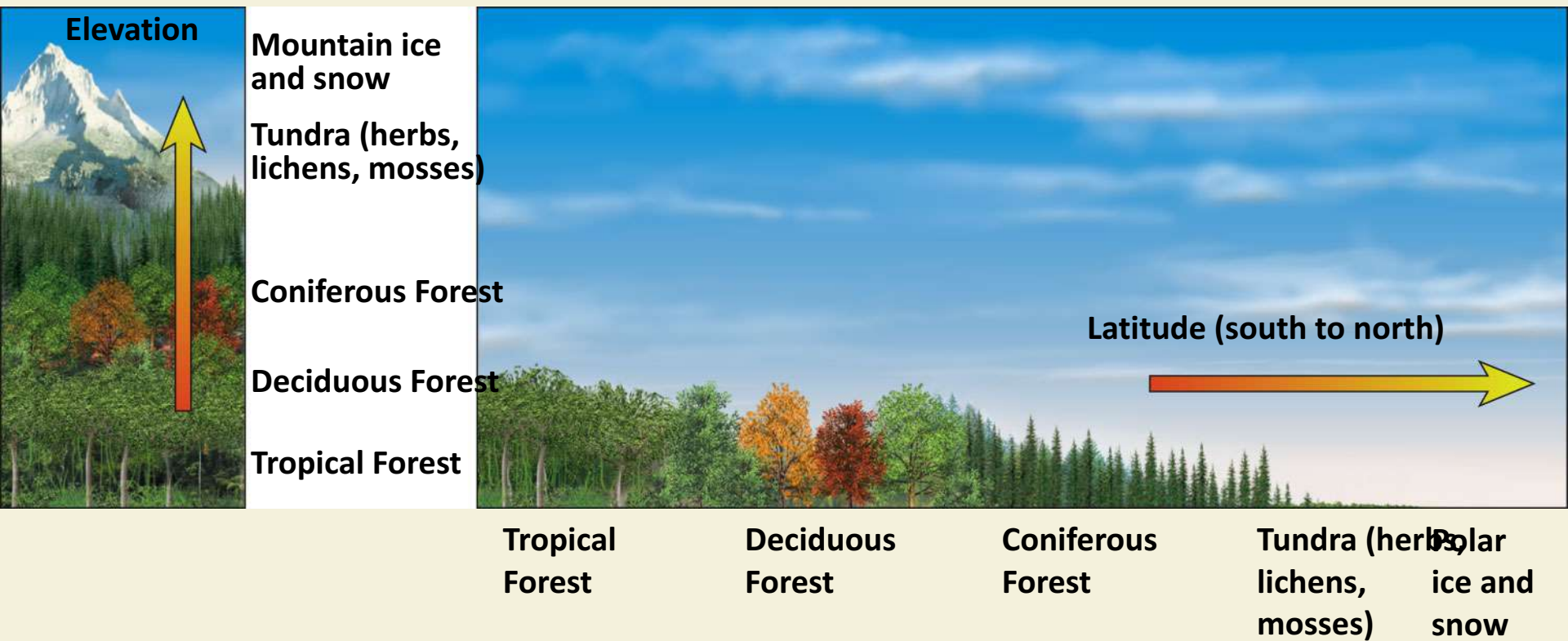


Fig. 7-8, p. 153

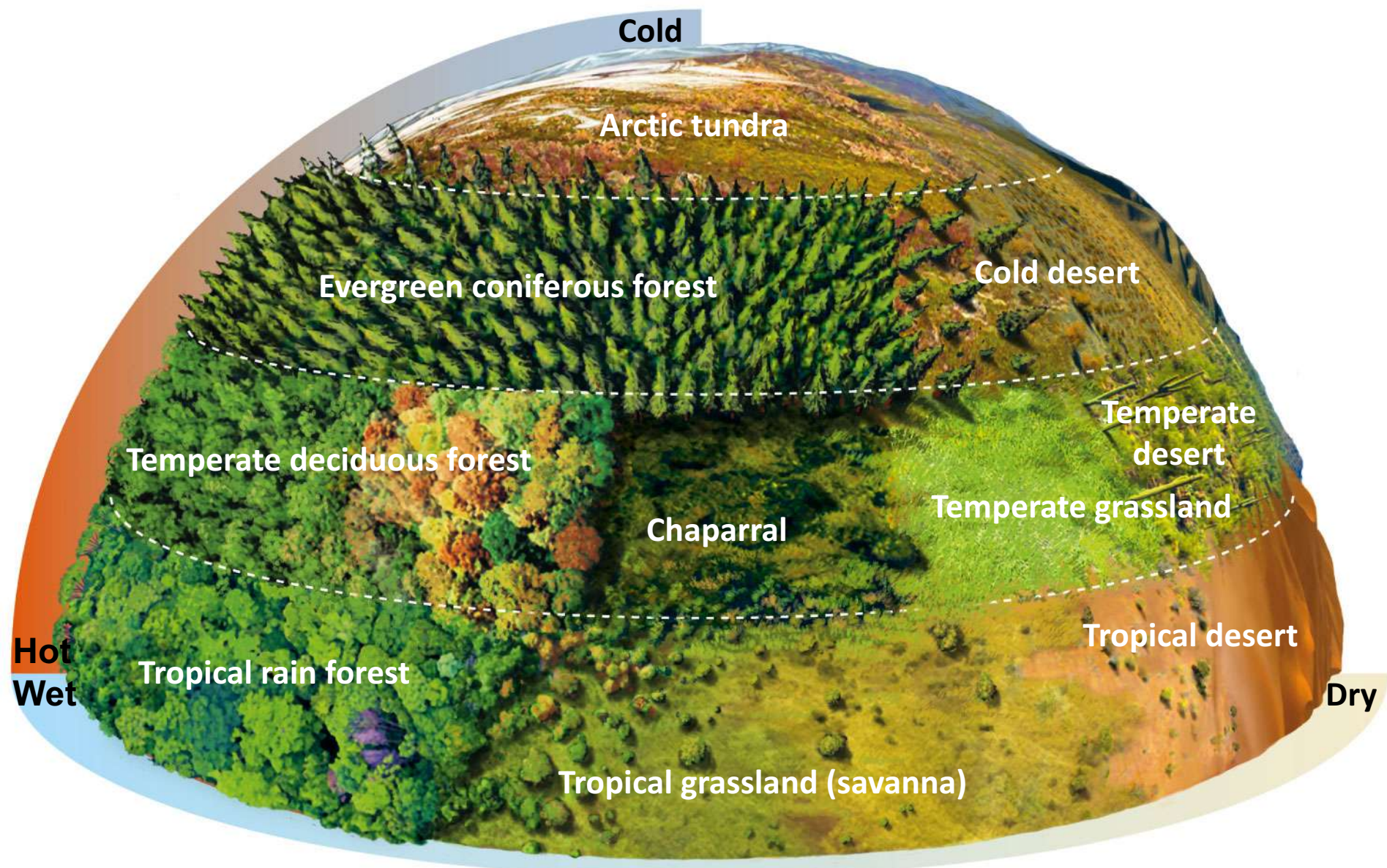


Fig. 7-9, p. 154

Global Plant Biodiversity

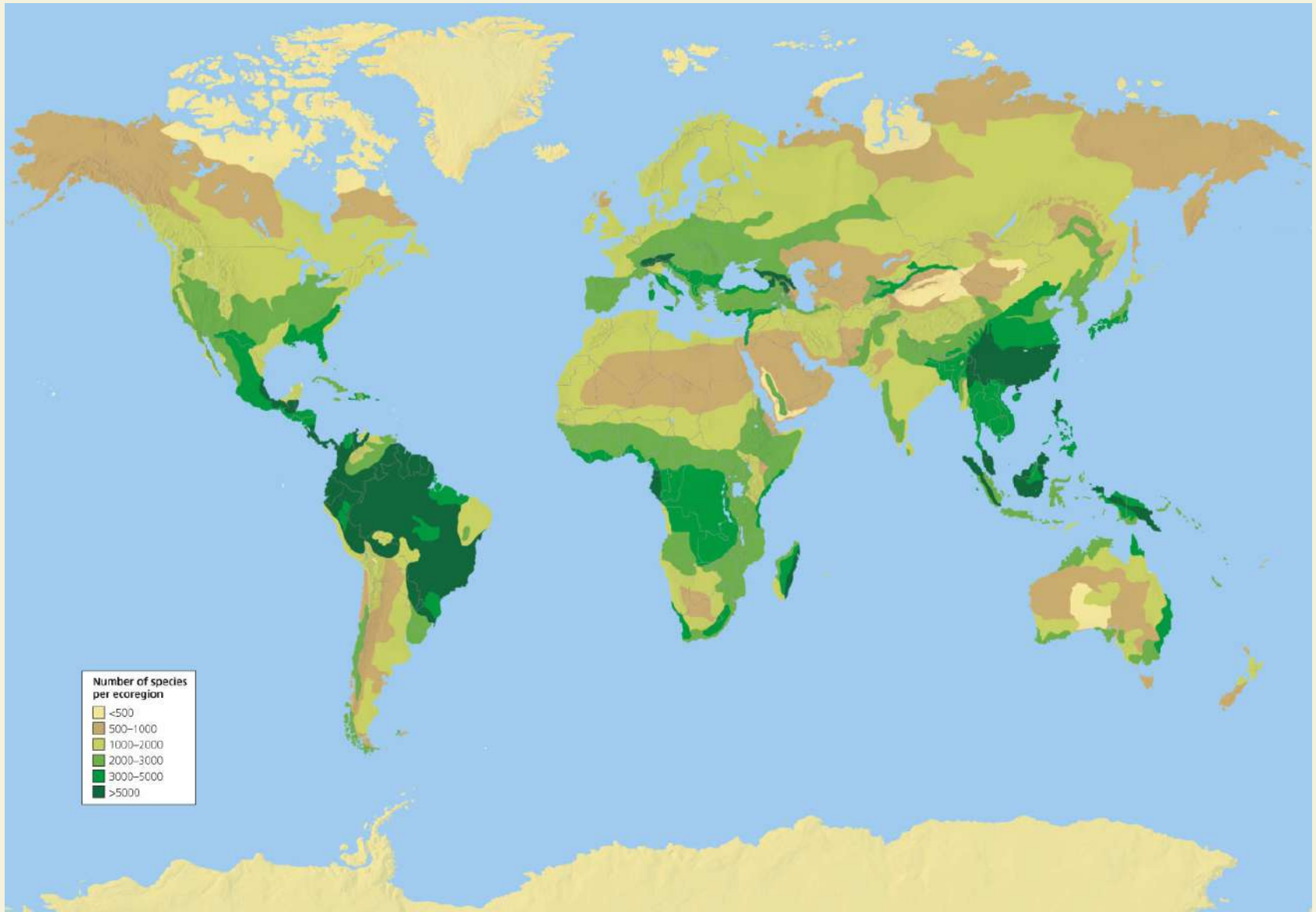


Figure 6, Supplement 8

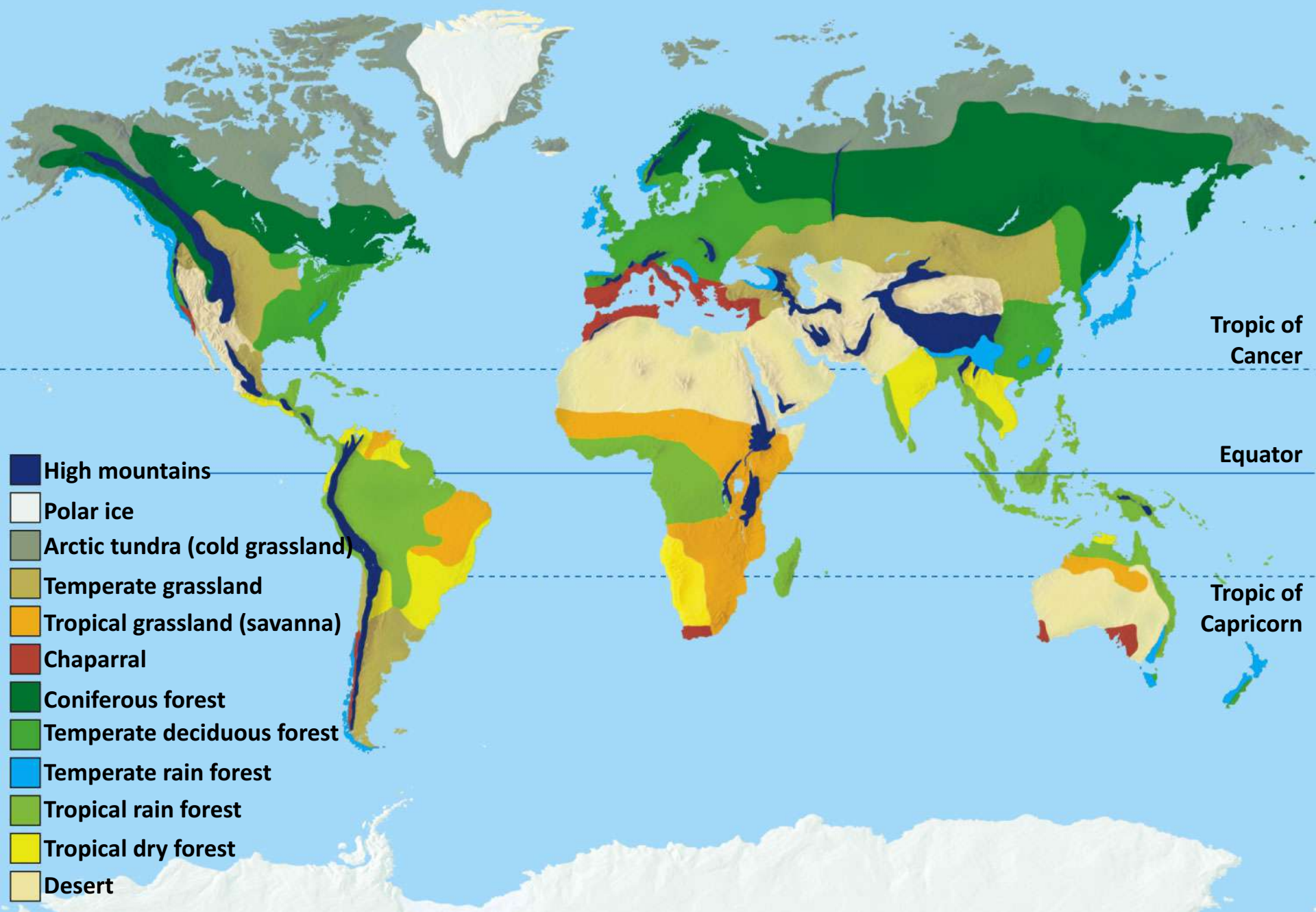


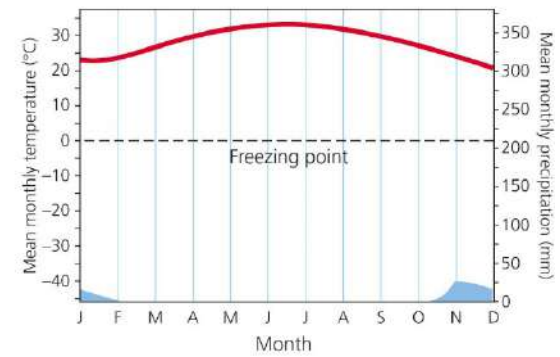
Fig. 7-7, p. 153

There Are Three Major Types of Deserts

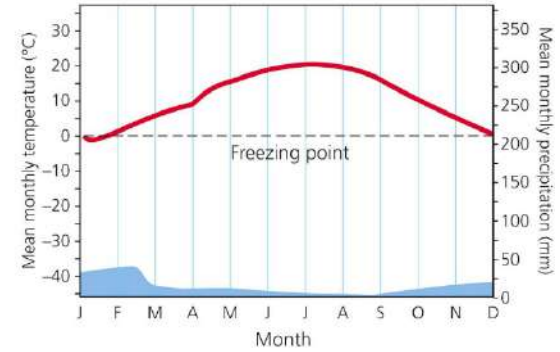
1. Tropical deserts
 2. Temperate deserts
 3. Cold deserts
- Common Characteristics:
 - Fragile ecosystem
 - Slow plant growth
 - Low species diversity
 - Slow nutrient recycling
 - Lack of water



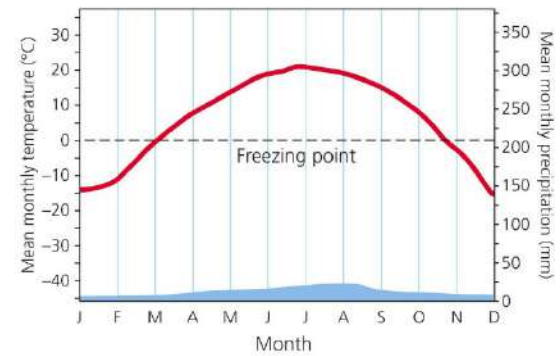
Tropical desert



Temperate desert



Cold desert



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 - cactus
 - Deep tap roots
- Animal strategies and adaptations
 - Physiology and anatomy
 - Behavior

Wildflowers Bloom after Rain in Arizona



Fig. 7-A, p. 156

There Are Three Major Types of Grasslands

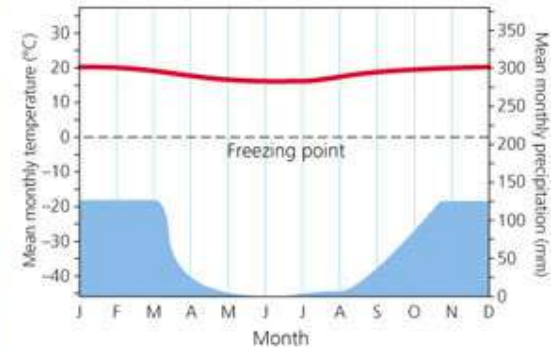
- Tropical
 - Savanna
 - Grazing animals
 - Browsing animals
- Temperate
 - Cold winters and hot and dry summers
 - Tall-grass prairies
 - Short-grass prairies
 - Often converted to farmland

There Are Three Major Types of Grasslands

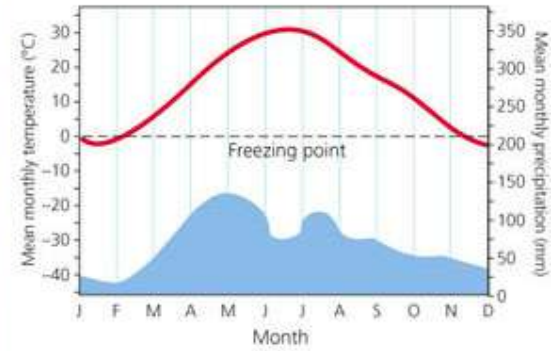
- Arctic tundra: fragile biome
 - Plants close to ground to conserve heat
 - Most growth in short summer
 - Animals have thick fur
 - **Permafrost**
 - Underground soil that stays frozen
- Alpine tundra: above tree line in mountains



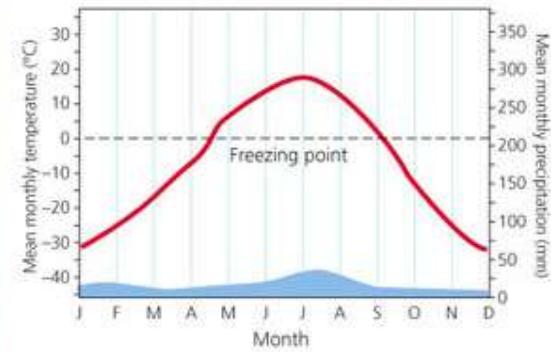
Tropical grassland (savanna)



Temperate grassland



Cold grassland (arctic tundra)



Temperate Tall-Grass Prairie Ecosystem in North America

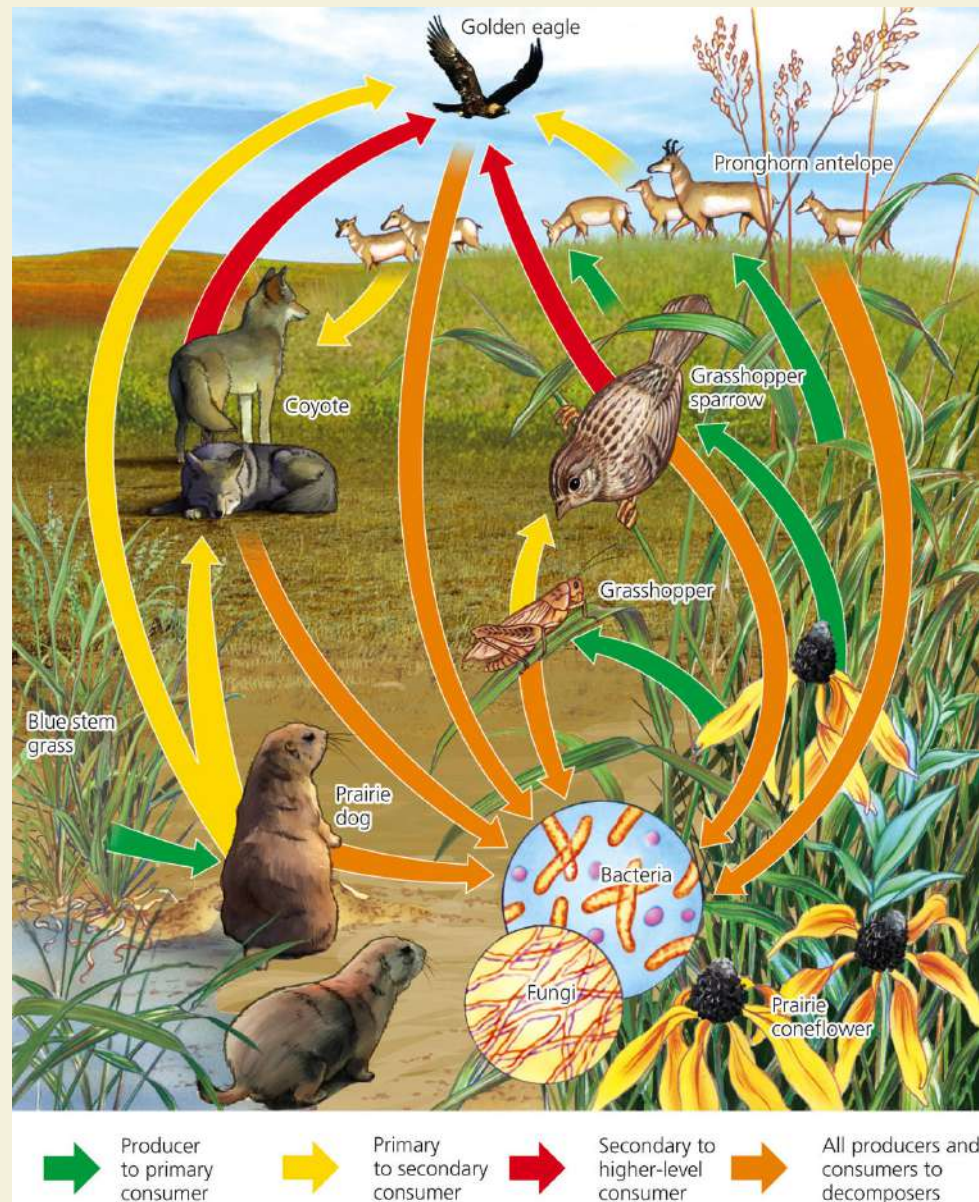


Figure 2, Supplement 6

Monoculture Crop Replacing Biologically Diverse Temperate Grassland



Fig. 7-12, p. 158

Temperate Shrubland: Nice Climate, Risky Place to Live

- **Chaparral is another name for temperate shrubland**
- Near the sea: nice climate
- People enjoy living here
- Prone to fires in the dry season

There Are Three Major Types of Forests

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

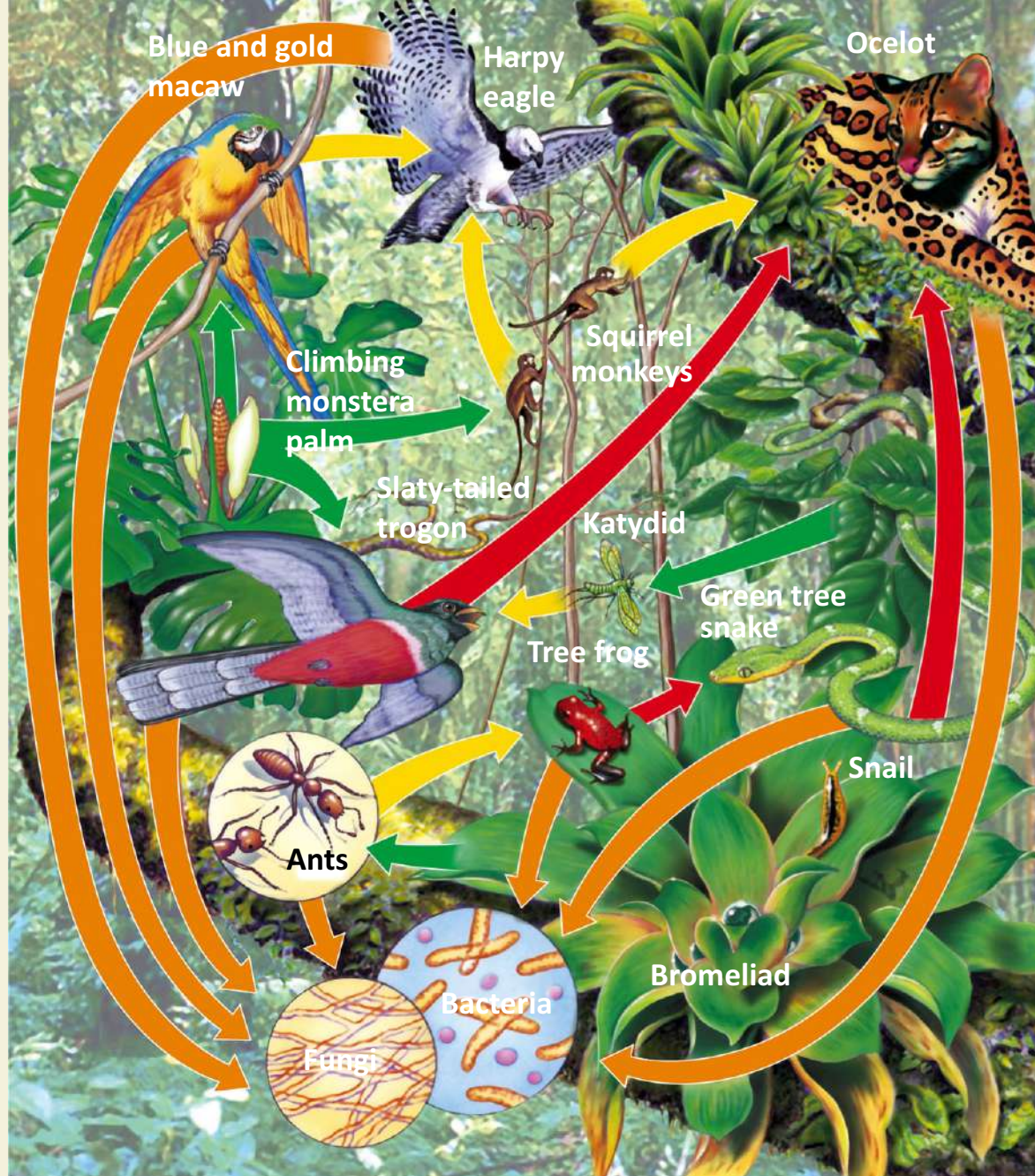


Fig. 7-14, p. 161

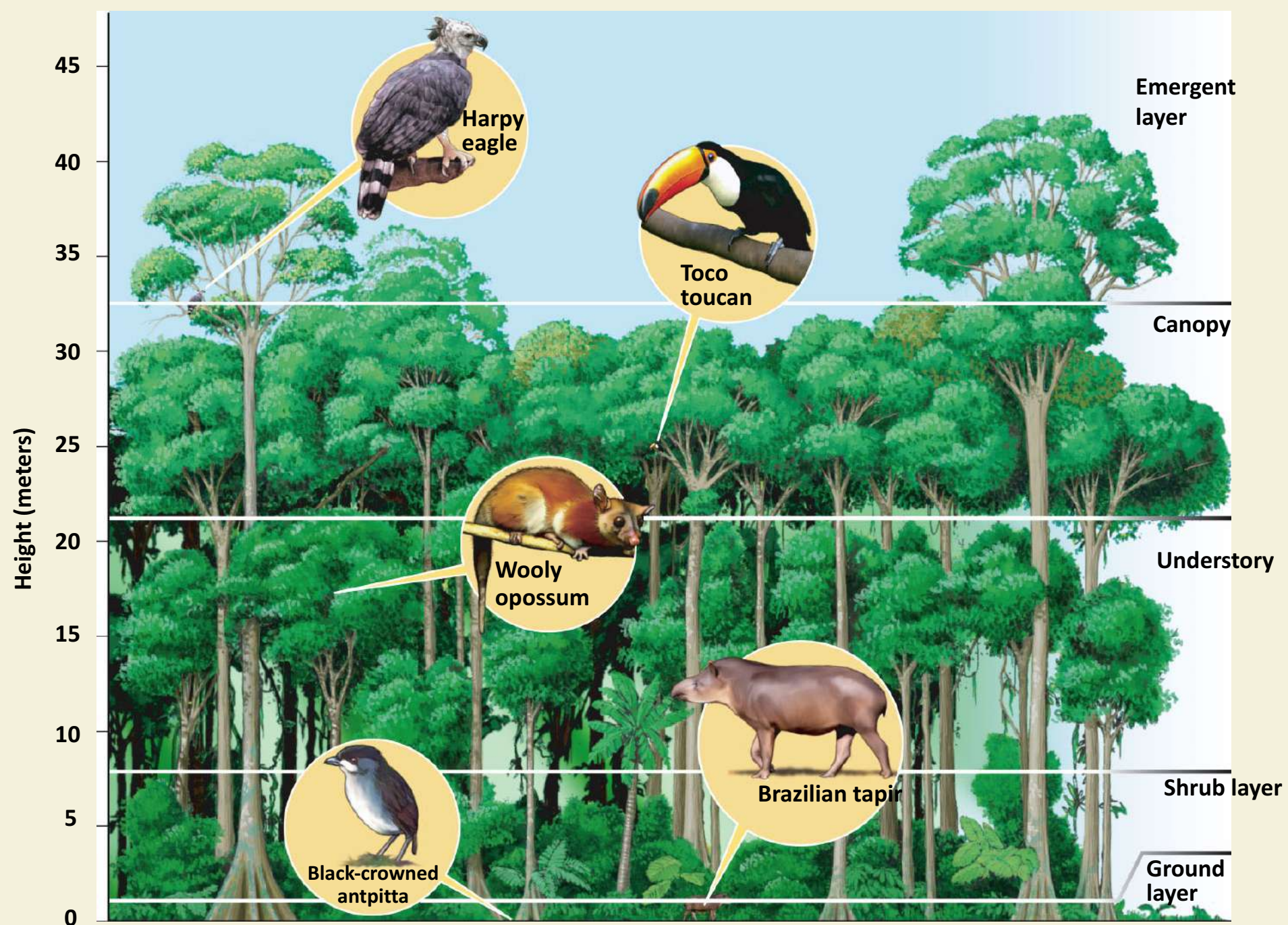
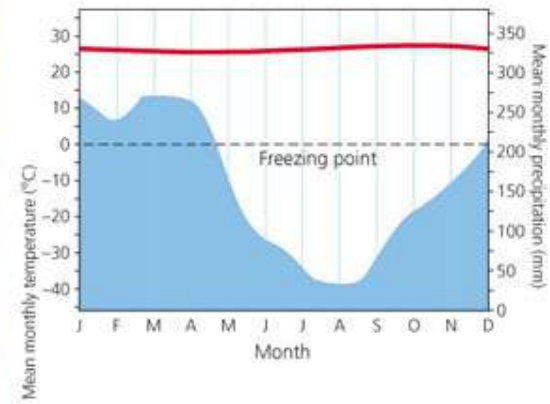


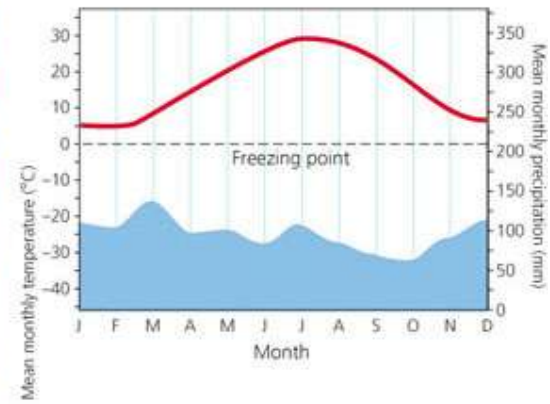
Fig. 7-15, p. 162



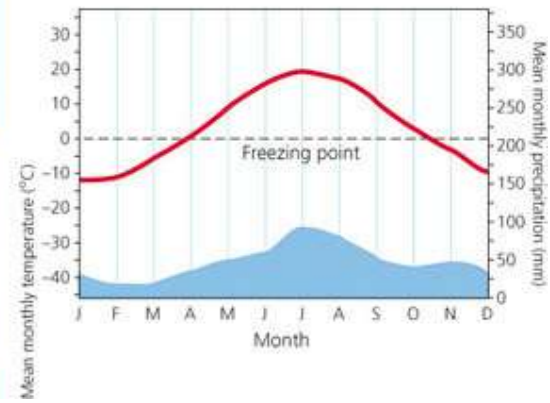
Tropical rain forest



Temperate deciduous forest



Northern evergreen coniferous forest (boreal forest, taiga)



There Are Three Major Types of Forests

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

Temperate Deciduous Forest Ecosystem in North America



Figure 4, Supplement 6

There Are Three Major Types of Forests (4)

- Evergreen coniferous forests: boreal and **taigas**
 - Temperature and moisture
 - Few species of cone: bearing trees
 - Slow decomposition: significance
- Coastal coniferous forest
 - Also called temperate rain forests

Evergreen Coniferous Forest Ecosystem in North America



Figure 5, Supplement 6

Temperate Rain Forest in Washington State



Mountains Play Important Ecological Roles

- Mountain ecosystems contain:
 - 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



Fig. 7-17, p. 163

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

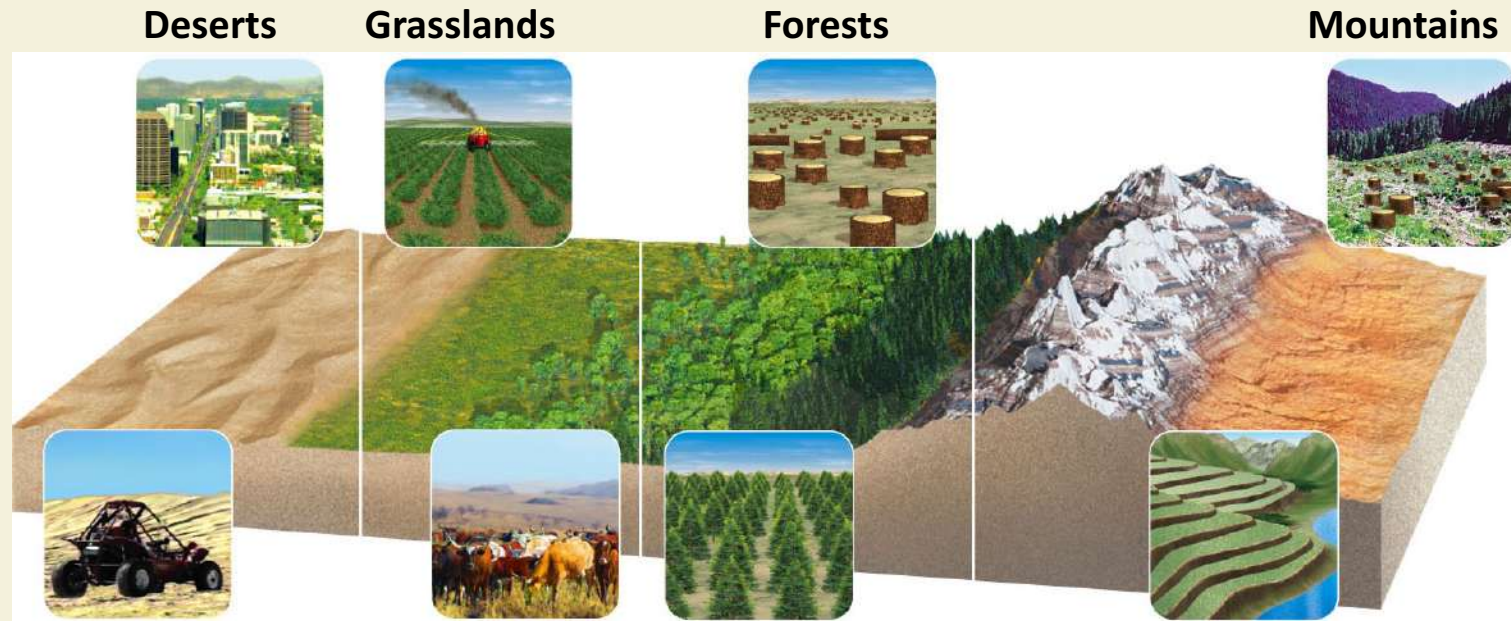
- **Concept 7-3** *In many areas, human activities are impairing ecological and economic services provided by the earth's deserts, grasslands, forests, and mountains.*

Humans Have Disturbed Most of the Earth's Lands

- 62% of the world's terrestrial ecosystems are being degraded or used unsustainably
- Concerns:
 - Loss of biodiversity
 - Changing biomes
 - Reduction of vegetation needed to remove CO₂
- Solutions:
 - Protect biodiversity
 - Restore biomes

Natural Capital Degradation

Major Human Impacts on Terrestrial Ecosystems



Large desert cities
Destruction of soil and underground habitat by off-road vehicles

Soil salinization from irrigation

Depletion of groundwater

Land disturbance and pollution from mineral extraction

Conversion to cropland
Release of CO₂ to atmosphere from burning grassland

Overgrazing by livestock

Oil production and off-road vehicles in arctic tundra

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

Agriculture

Timber and mineral extraction

Hydroelectric dams and reservoirs

Increasing tourism

Air pollution blowing in from urban areas and power plants

Soil damage from off-road vehicles

Water supplies threatened by glacial melting

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.