Geographical Ecology, Climate, & Biomes

tutorial by Paul Rich

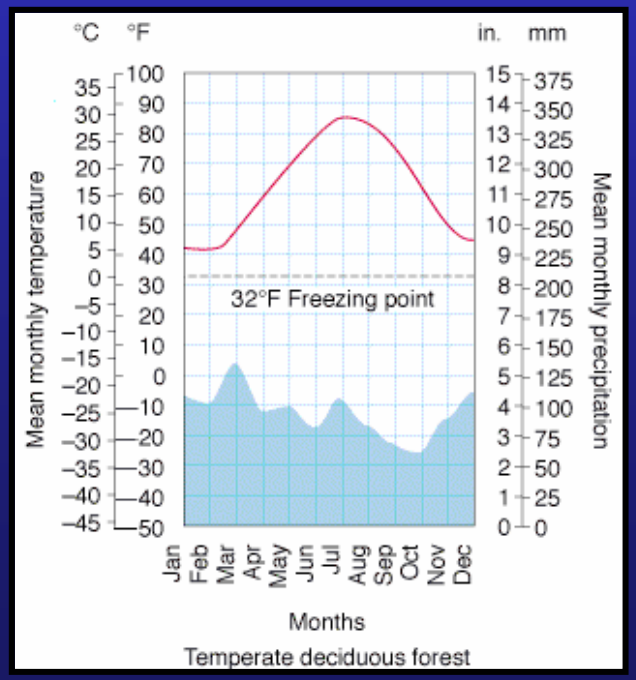
Outline

1. Weather & Climate
   global patterns, El Niño, microclimate
2. Biomes
   generalized effects of latitude & altitude
3. Desert Biomes
4. Grassland, Tundra, & Chaparral Biomes
5. Forest Biomes
6. Mountain Biomes
7. Perspectives on Geographical Ecology

1. Weather & Climate

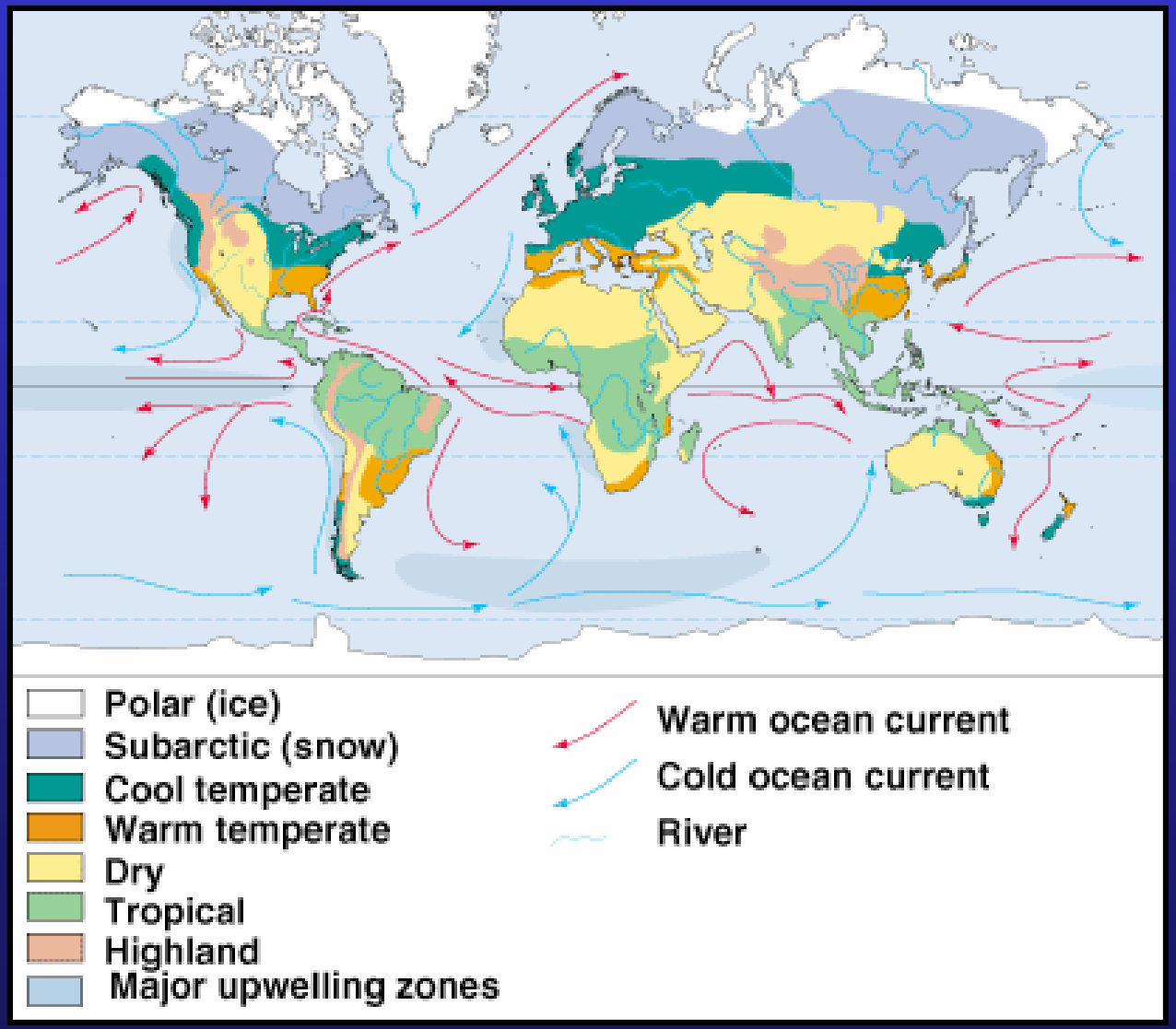
- **Weather**: short–term properties of troposphere (temperature, pressure, humidity, precipitation, solar radiation, cloud cover, wind direction & speed);
- **Climate**: general, long–term weather of a region.

Today's forecast
Clear
79 °F
Barometer: 30 in
Dewpoint: 17°
Humidity: 37%
Visibility: 10 miles
Wind: 10 mph NW



Weather & Climate

Global *temperature* & *precipitation* patterns determined by uneven heating of Earth by Sun & lead to distinct climate zones according to latitude.



Global Patterns

Major Factors Influencing Climate:

- Incoming solar radiation patterns
  - lead to uneven heating of troposphere from beneath
- *Air circulation patterns* are determined by:
  - uneven heating of Earth's surface;
  - seasonal changes due to Earth's tilt on axis & revolution about the sun;
  - Earth's rotation on its axis;
  - long–term variation in incoming solar energy.
- *Ocean currents*
  - influenced by factors that influence air circulation plus differences in water density.

Geometry of the Earth & Sun

Earth's rotation (24 hr period), tilted axis (23.5º), & revolution about the sun (365¼ day period) play a major role in weather & climate.

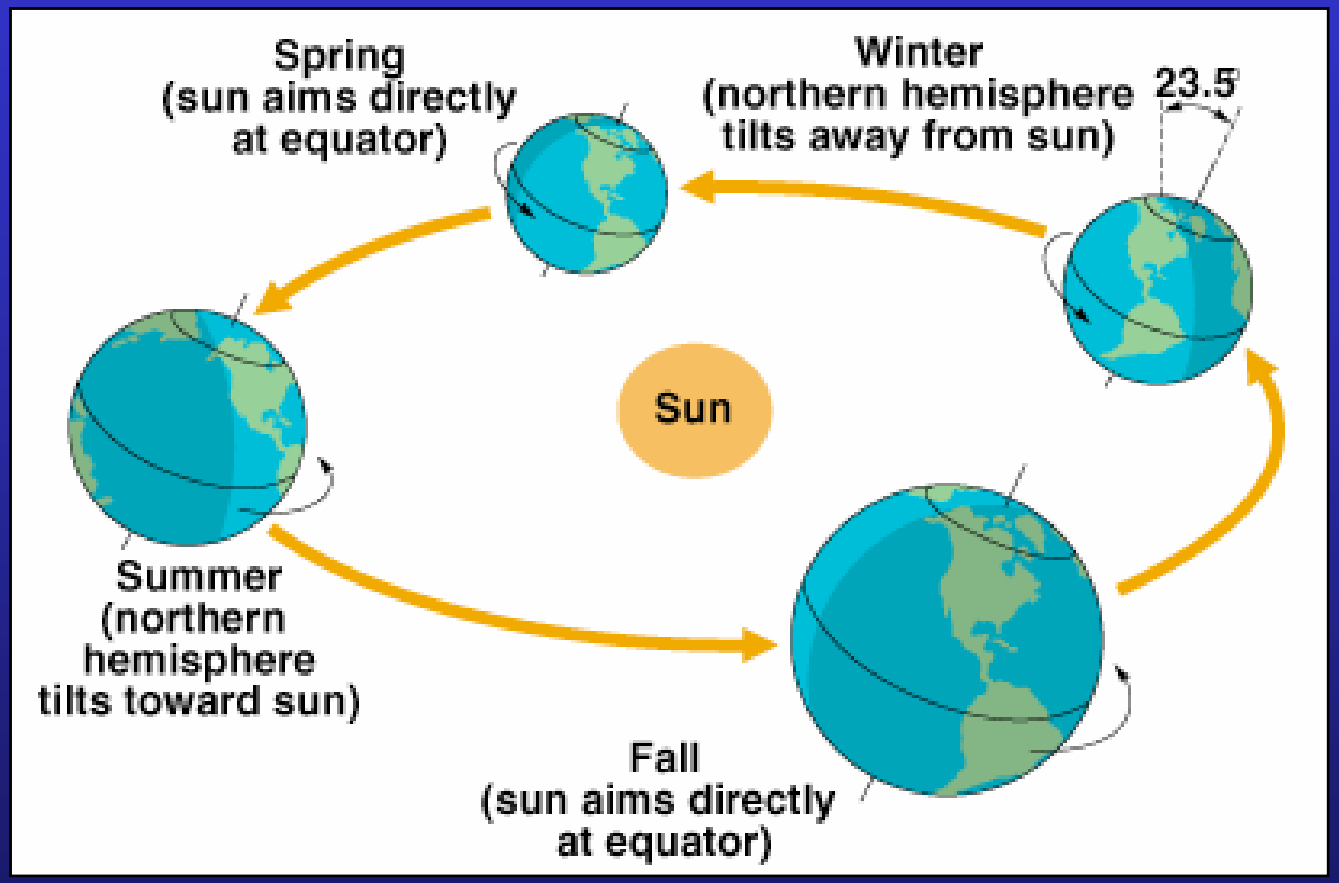


Fig. 7–3

Convection Currents

Vertical convection currents mix air in the troposphere & transport heat & water from one area to another in circular convection cells. Relative humidity increases as the air rises (right side) & decreases as it falls (left side).

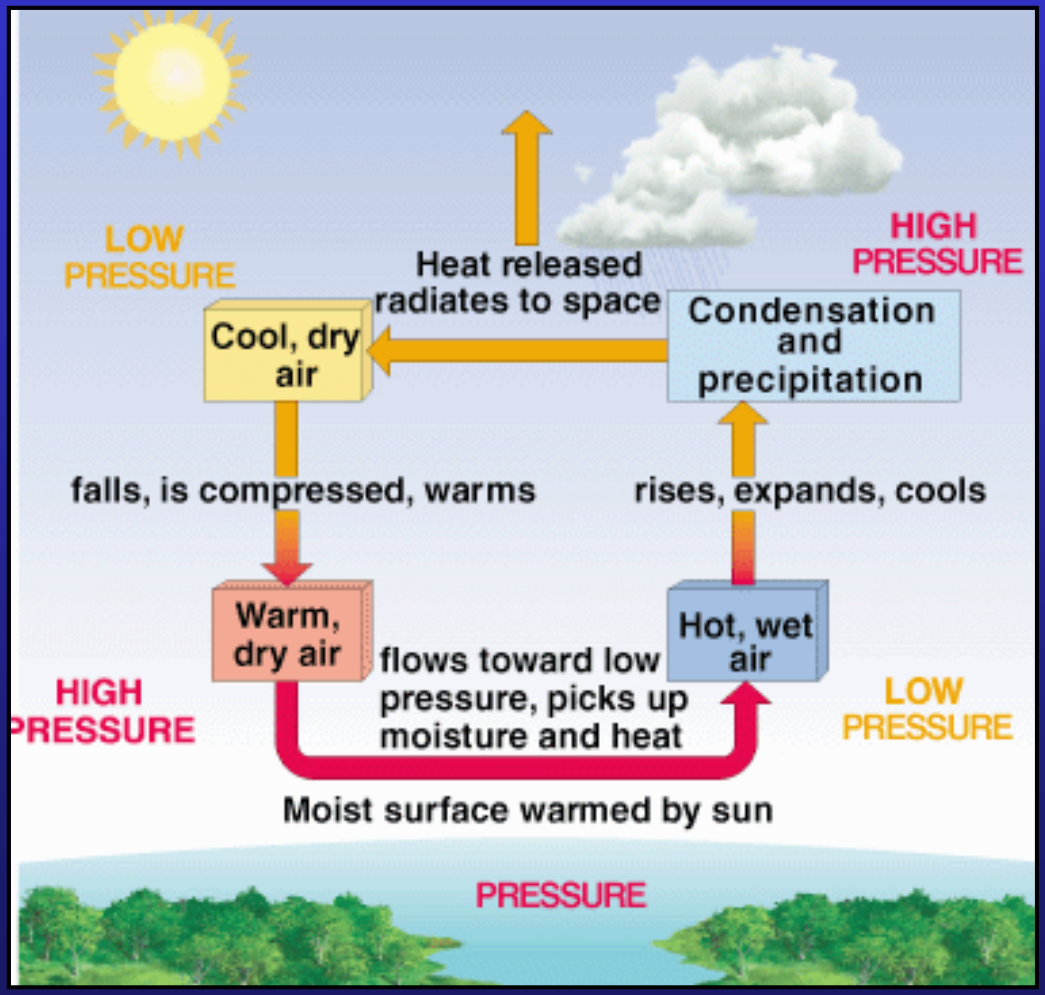


Fig. 7–5

Global Air Flow

Conceptual model of global air circulation and biomes.

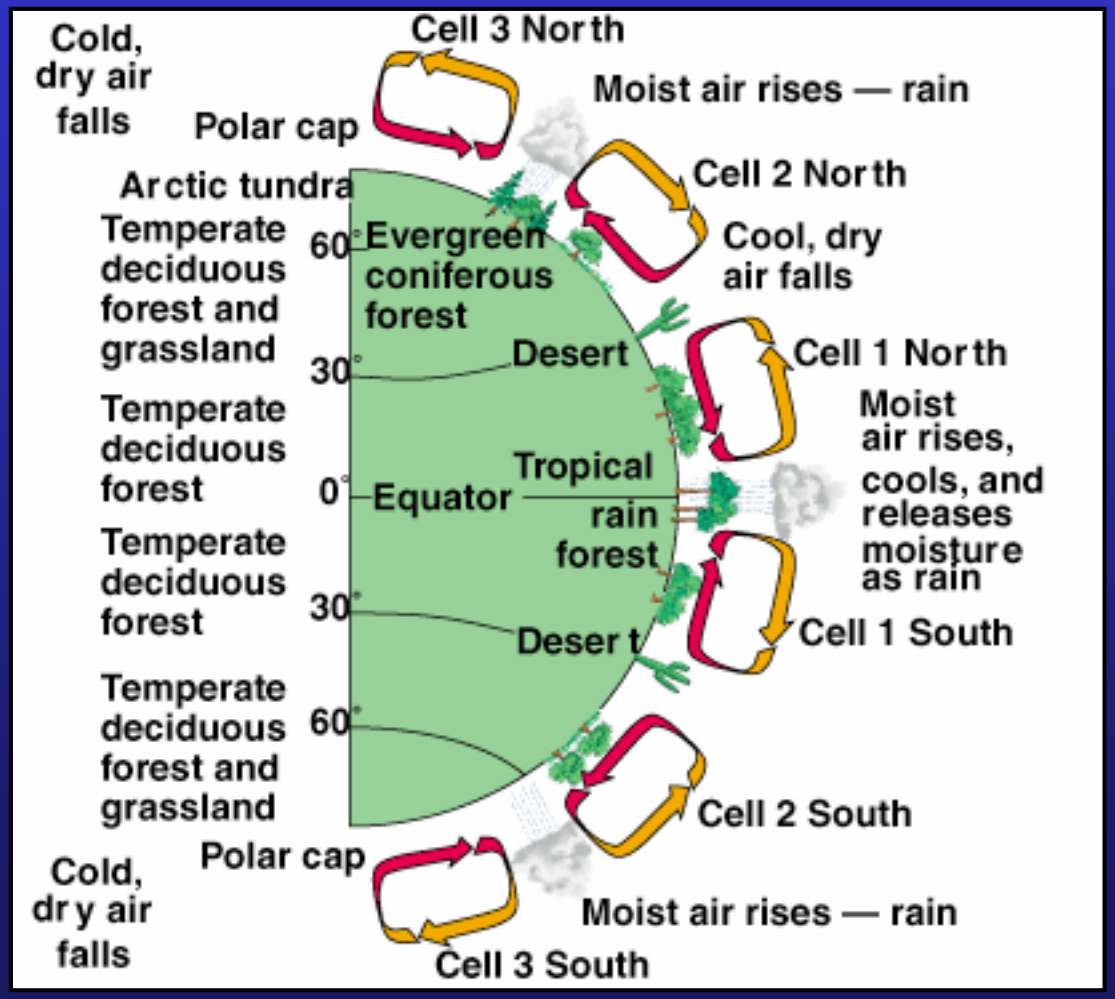


Fig. 7–6

Air Circulation Patterns

Prevailing winds include westerlies at temperate latitudes, tradewinds in the subtropics, & doldrums (stiller air) along the equator.

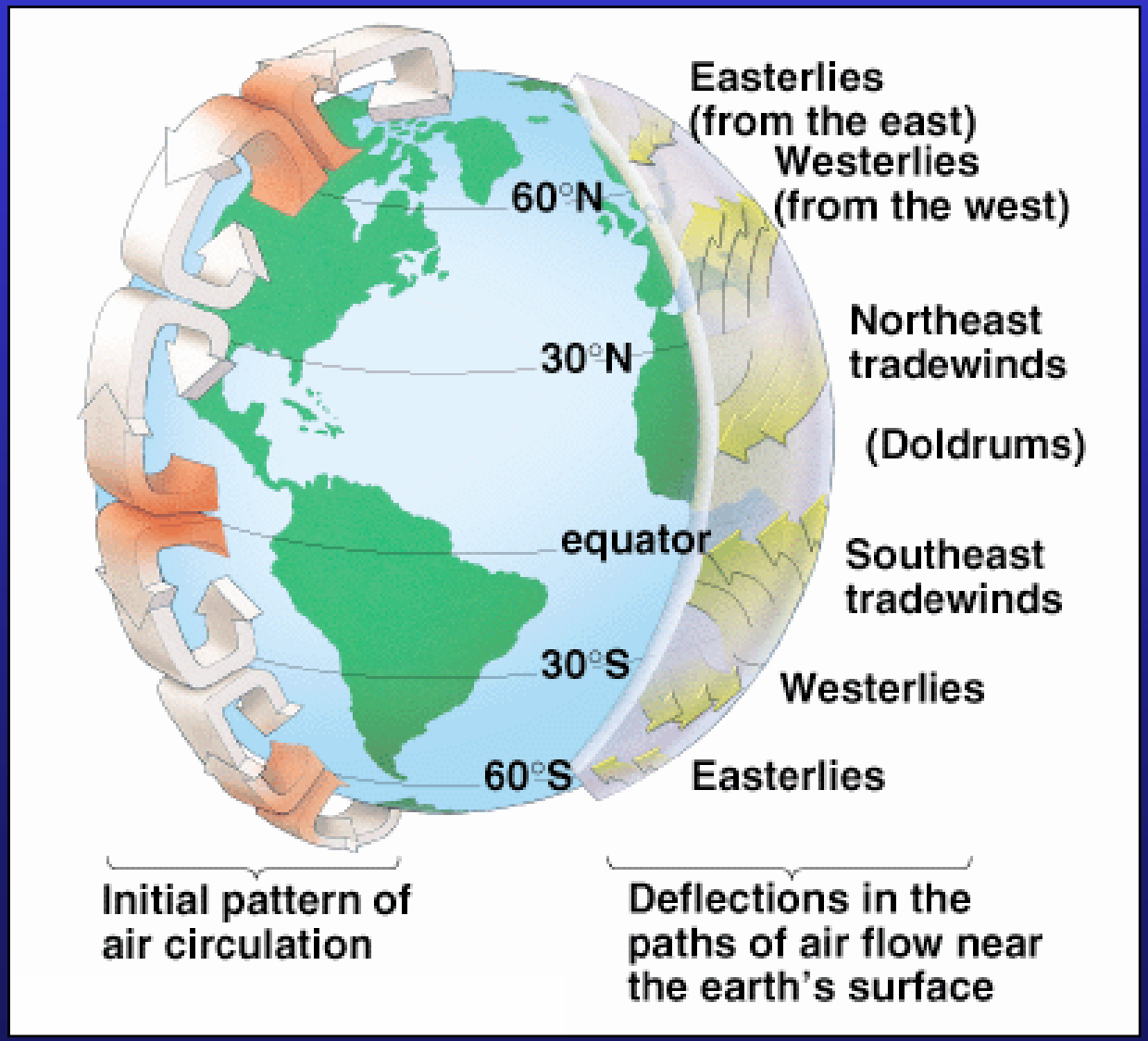


Fig. 7–4

Air Circulation Patterns

Major Patterns:

- Air circulation is driven by solar energy
  - air heated from beneath becomes unstable
  - solar energy becomes kinetic energy of air movement
- **Coriolis Effect**: as Earth rotates surface turns faster beneath air masses near equator than near poles, resulting in deflection clockwise in N hemisphere & counterclockwise in S hemisphere;
- Huge cells of air movement result in global patterns of low & high pressure:
  - *low pressure* near 0º latitude (tropics), leads to high rainfall as warm, moisture–laden air rises;
  - *high pressure* at 30º N & S latitudes, results in deserts as dry air descends;

Ocean Currents

Major Patterns:

- Large circular patterns of movement in ocean basins, clockwise in N hemisphere & counterclockwise in S hemisphere (result of Coriolis Effect), see Fig. 7–2;
- Kinetic energy is transferred from air circulation (winds) to water at ocean surface

  solar energy –> wind kinetic energy –> ocean kinetic energy
- Deep currents driven by cooling & by increased salinity – both make water denser & cause to sink;
- Currents redistribute heat & moderate coastal climate

  Example: Gulf stream brings warm water far north to cause NW Europe to be warm (otherwise Europe would have subarctic climate).

Upwelling

Upwelling brings deep, cool, nutrient–rich waters up to replace surface water, leading to increased primary productivity, with large populations of phytoplankton, zooplankton, fish, & fish–eating birds.

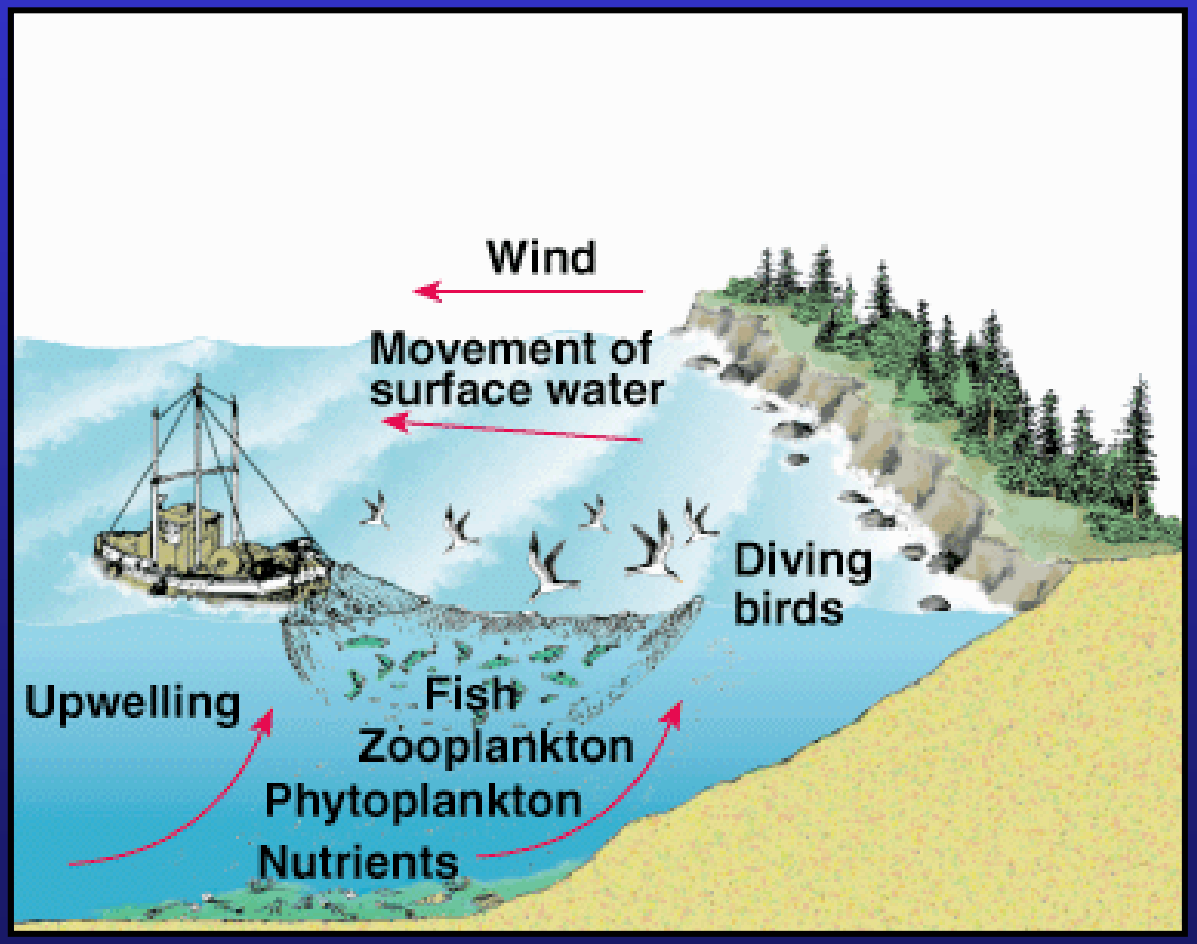
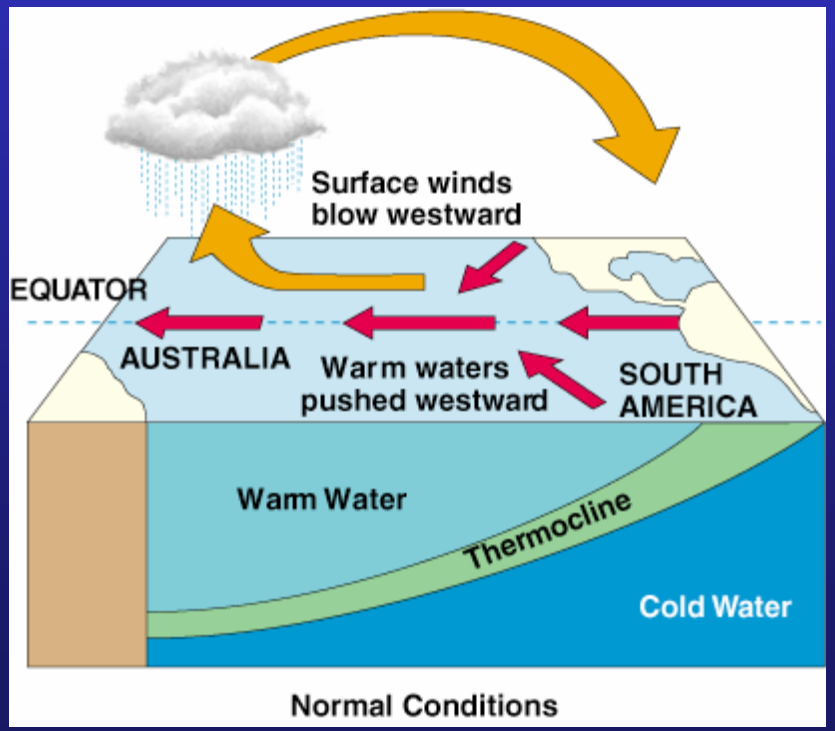
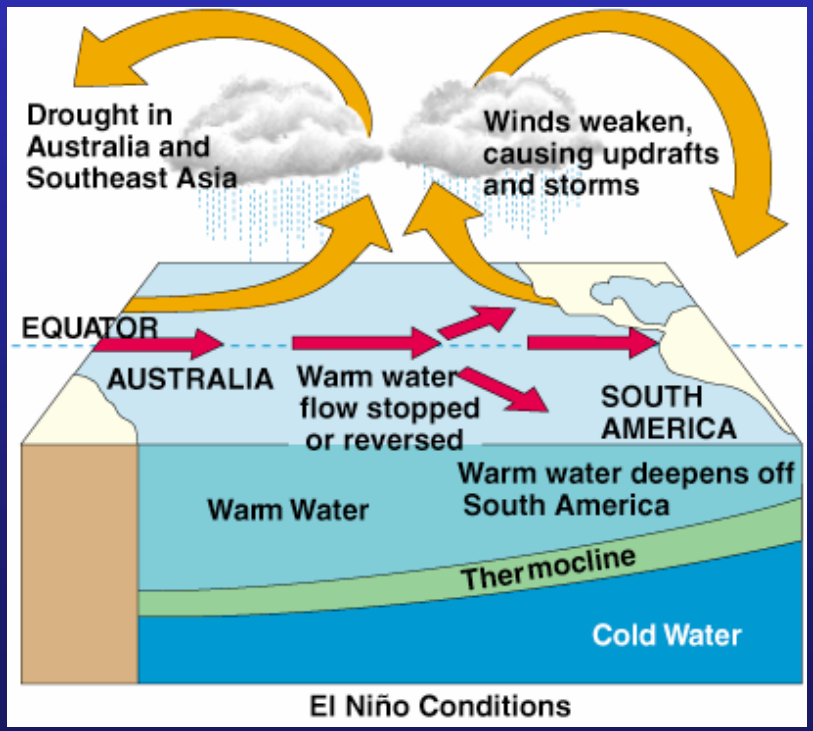


Fig. 7–7

El Niño–Southern Oscillation (ENSO)

A periodic shift in global climate conditions (every 3–4 yrs) wherein prevailing westerly winds in the Pacific Ocean weaken or cease, the surface water along N. & S. America become warmer, upwelling decreases, & primary productivity along the coast declines sharply; strong ENSO affects over two–thirds of the globe.

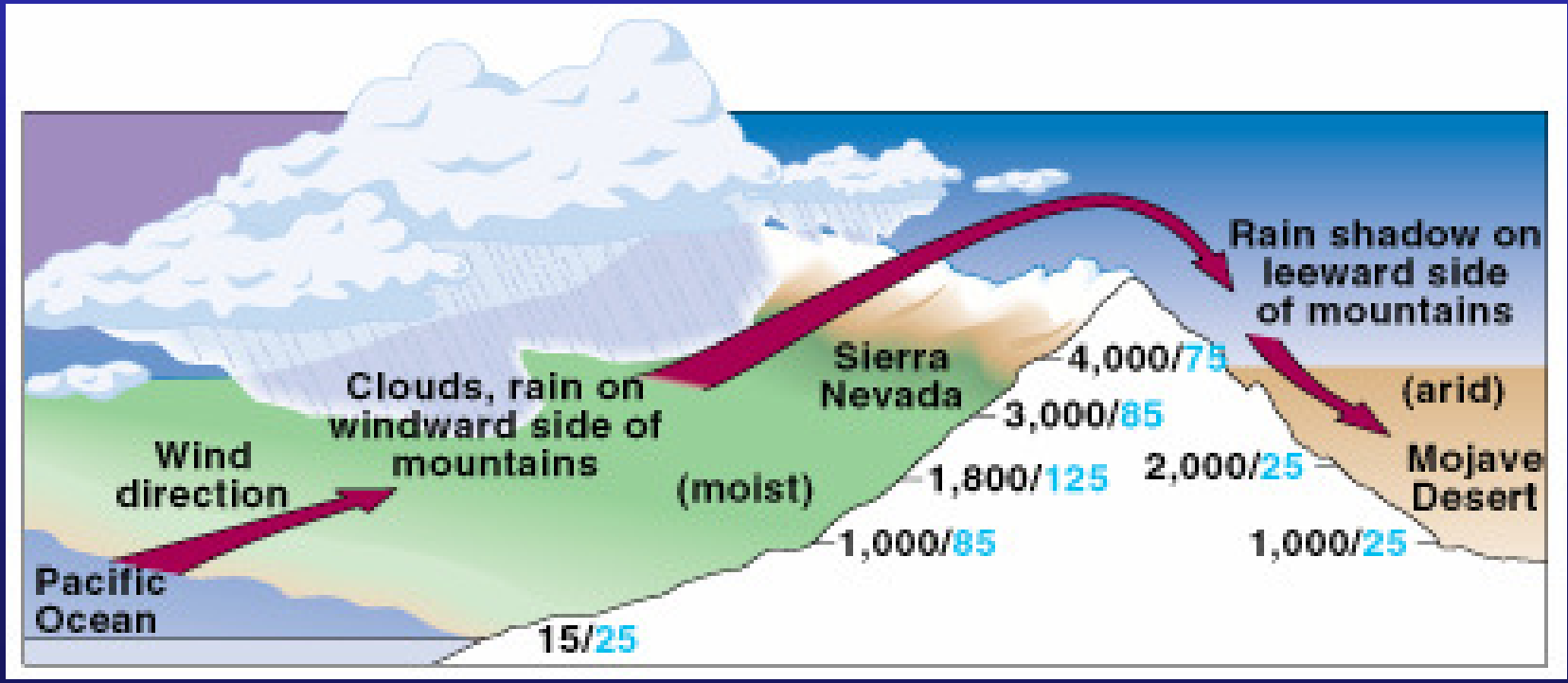




Video: http://video.nationalgeographic.com/video/player/environment/environment-natural-disasters/landslides-and-more/el-nino.html

Microclimate

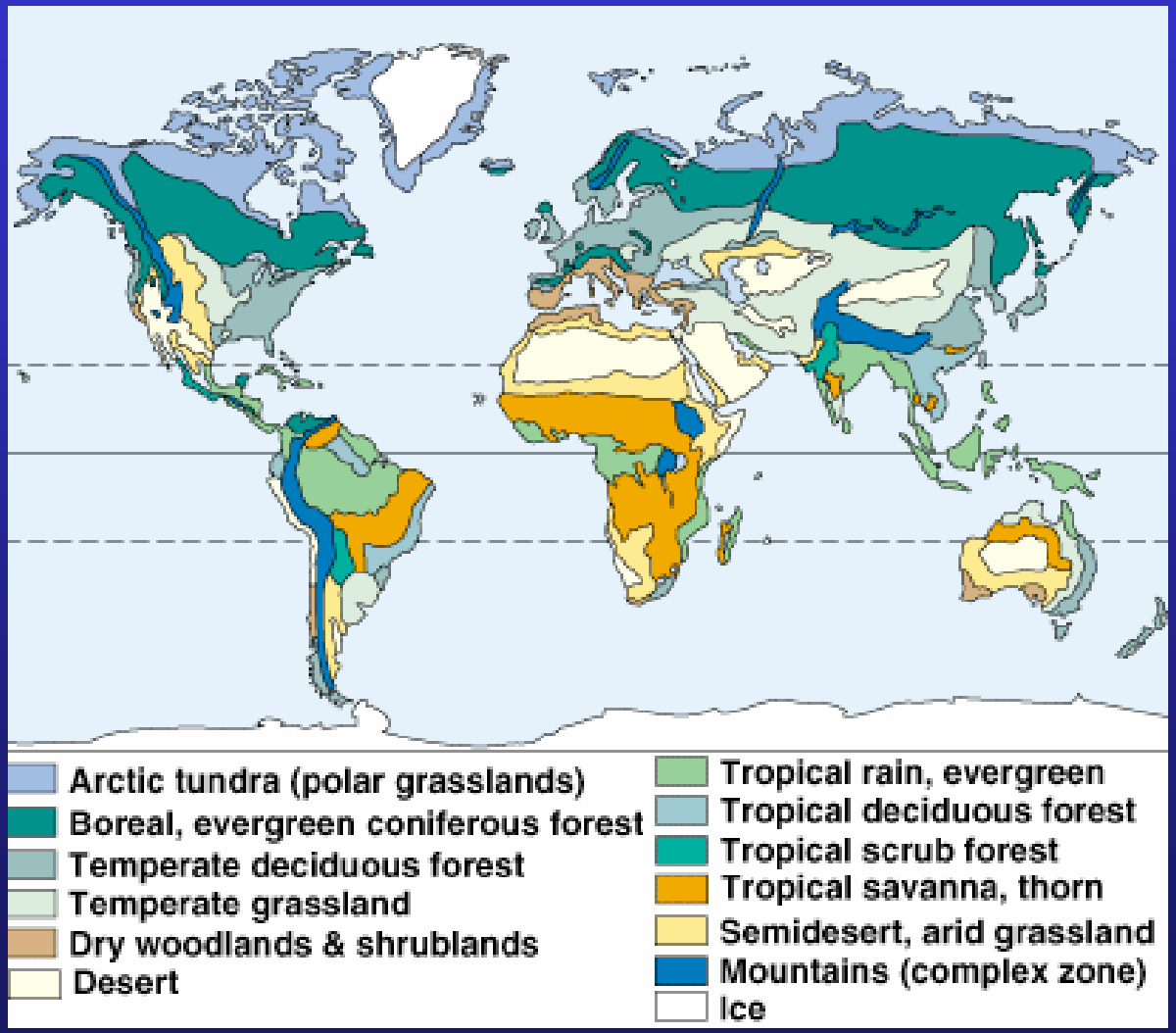
*Topography, water bodies, & other local features create local climate conditions known as **microclimate**. For example mountains commonly result in high rainfall on the windward side & low rainfall in the **rain shadow** of the leeward side.*



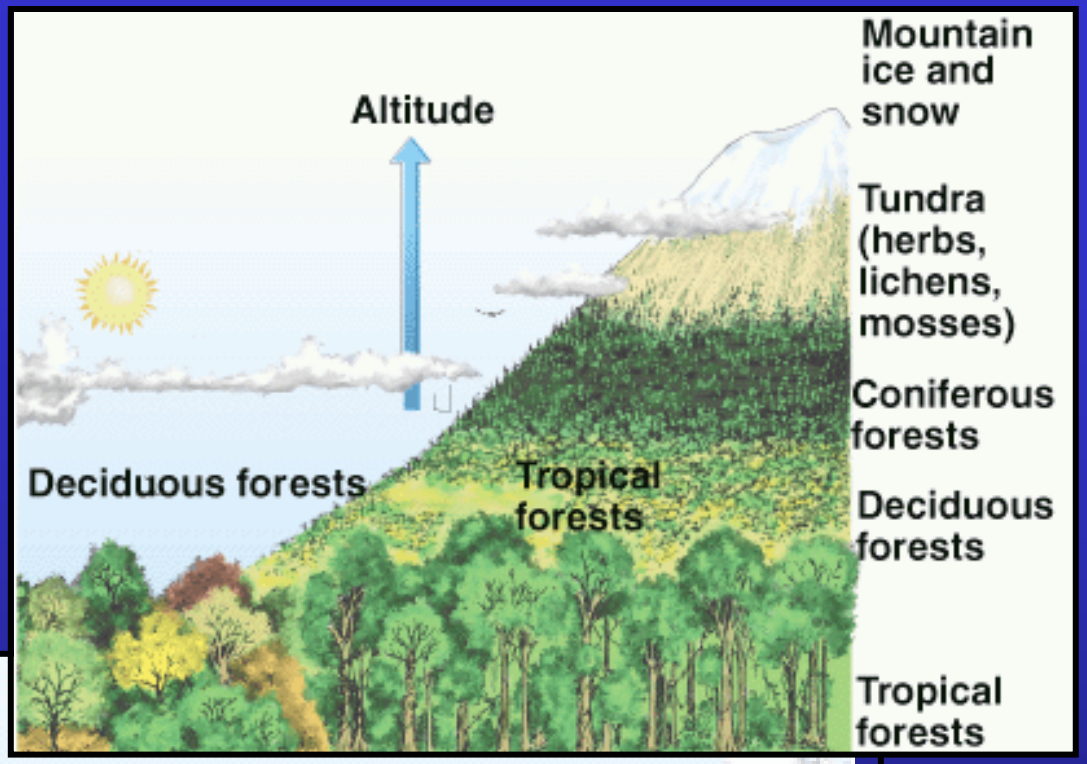
2. Biomes

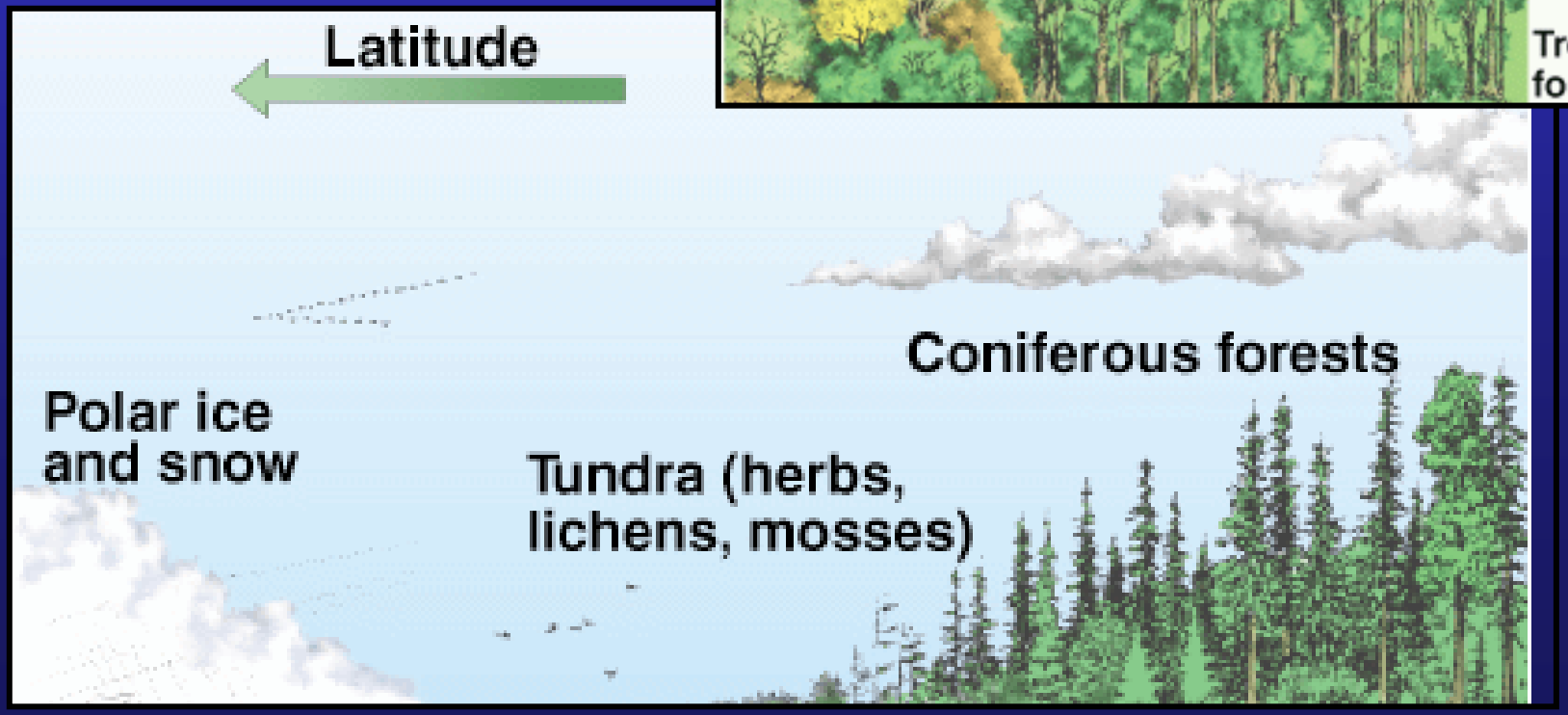
Biome: major type of terrestrial ecosystem

- determined primarily by climate (temp & precipitation)
- similar traits of plants & animals for biomes of different parts of world; because of similar climate & evolutionary pressures (convergence)



Generalized effects of latitude & altitude on climate & biomes.





3. Desert Biomes

Climate graphs showing typical variation in annual temperature & precipitation for tropical, temperate, & polar deserts.

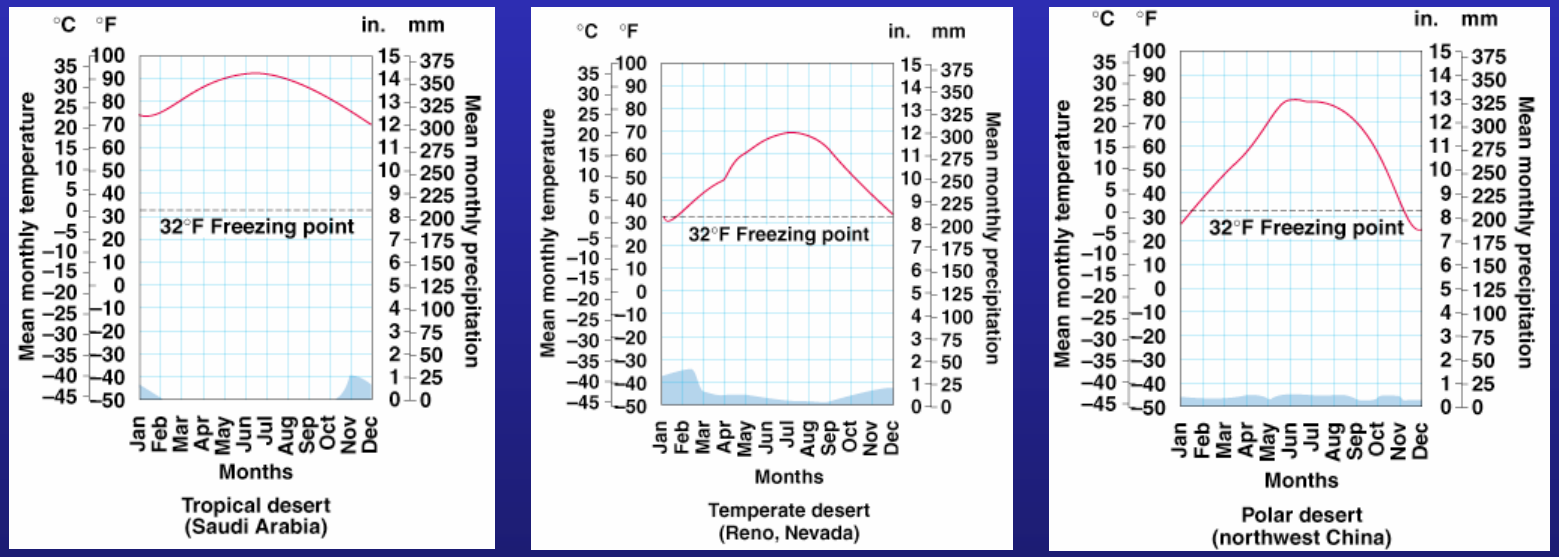


Fig. 7–14

Desert Biomes

Characteristics:

- typically < 25 cm (10 in) annual precipitation;
- sparse, widely spaced, mostly low vegetation
- cover 30% of land surface, especially at 30° N and 30° S latitude;
- largest deserts on interiors of continents;
- plants either are typically deep rooted shrubs with small leaves, succulents, or short–lived species that flourish after rain;
- animals are typically nocturnal & have physical adaptations for conserving water & dealing with heat.

Desert Biomes

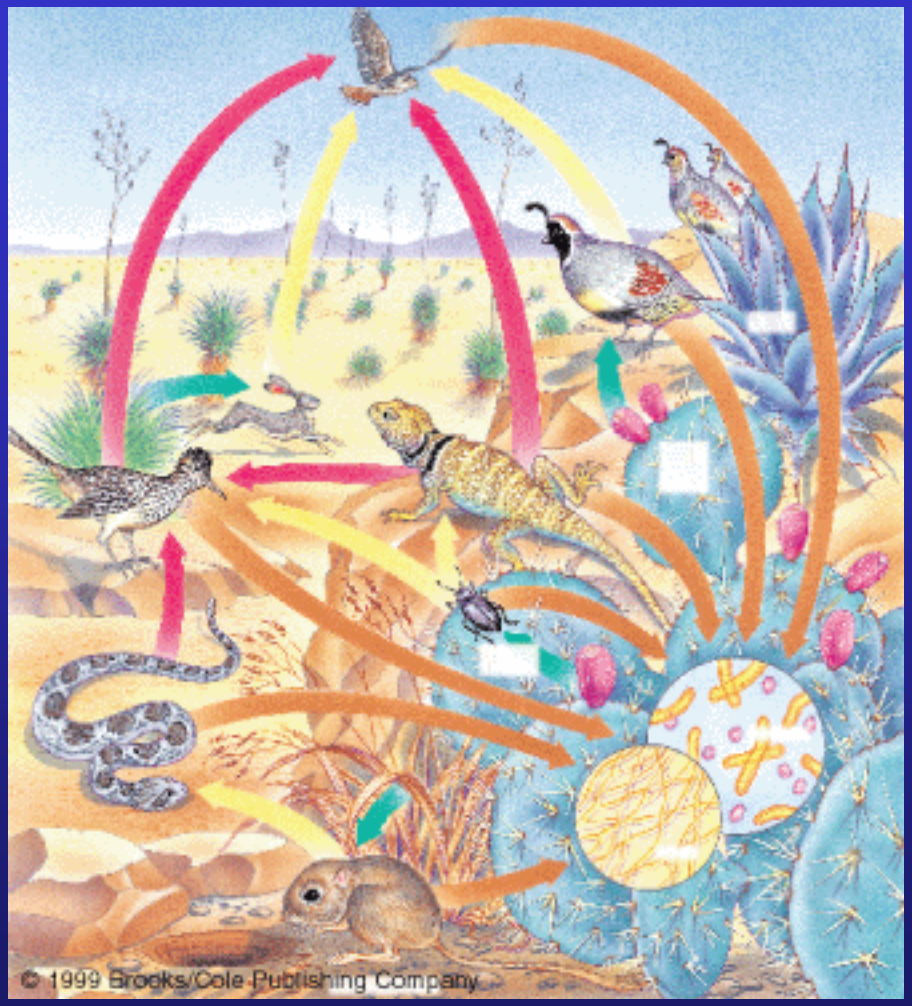
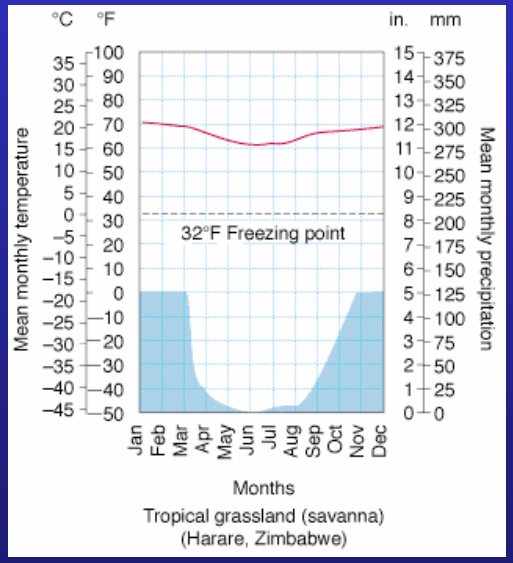
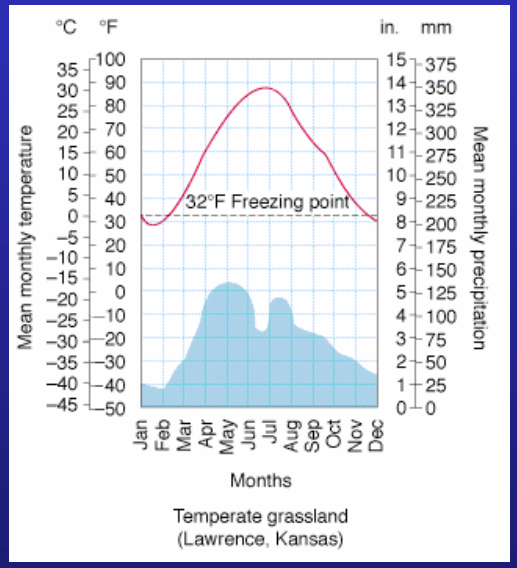


Fig. 7–15

4. Grassland, Tundra, & Chaparral Biomes

Climate graphs showing typical variations in annual temperature & precipitation in tropical, temperate, & polar grasslands.





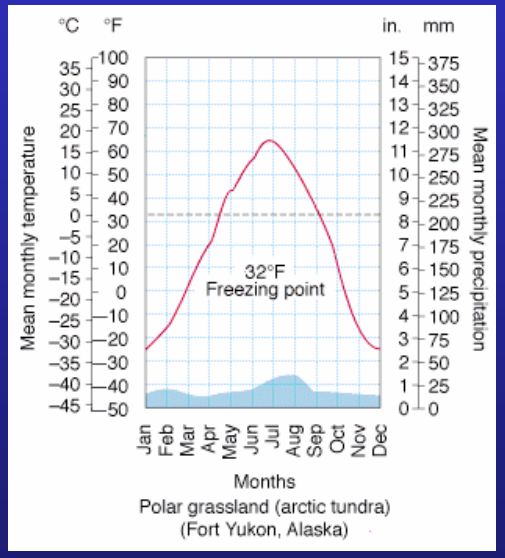


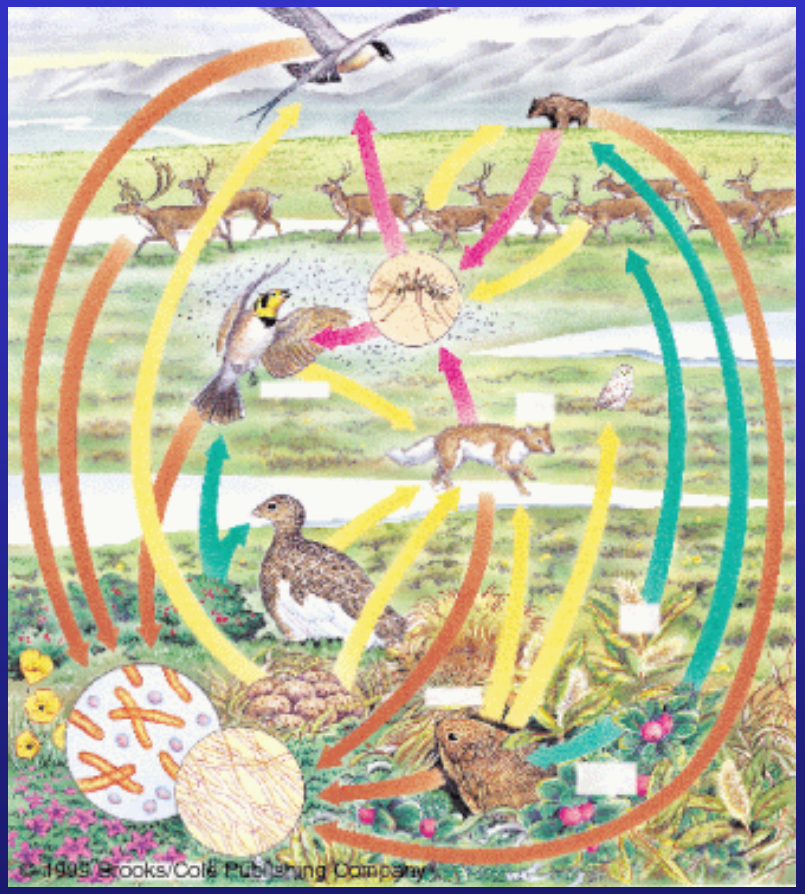
Fig. 7–17

Grassland Biomes

Characteristics:

- sufficient rainfall to support grass, but often too dry for forests;
- mostly found on interiors of continents;
- maintained by seasonal drought, grazing, & periodic fires that prevent invasion by shrubs & trees;
- plants include high diversity of grasses & herbaceous plants that typically have broad distributions & that have resistance to drought, grazing, & fire;
- animals include large & small herbivores, along with predators adapted to feed on these herbivores.

Grassland Biomes



Figs. 7–19 & 7–20

5. Forest Biomes

Climate graphs showing typical variations in annual temperature & precipitation in tropical, temperate, & polar forests.

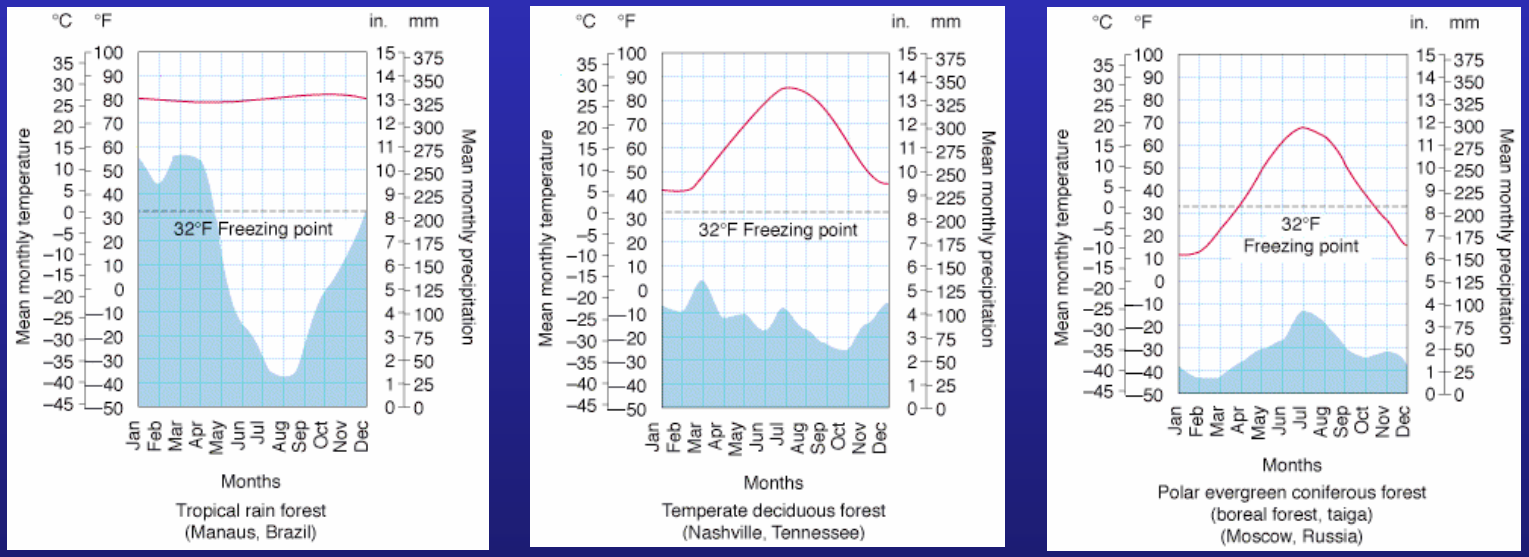


Fig. 7–22

Forest Biomes

Characteristics:

- sufficient rainfall to support growth of trees;
- three types:
  - tropical, typically broadleaf evergreen trees with high diversity;
  - temperate, typically deciduous broadleaf tree with moderate diversity;
  - boreal, typical conifers (needle leaves) with low diversity.
- community of plants & animals typically distributed in various layers:
  - understory of herbaceous plants & shrubs;
  - subcanopy of tree saplings;
  - canopy of full–grown trees.

See Figs. 7–24, 7–25, & 7–26

Forest Biomes

Fig. 7–23

6. Mountain Biomes

Characteristics:

- diversity of habitat because of diversity of altitude, slope orientation, corresponding microclimate, & soil over short distances;
- correspondingly complex patterning of vegetation;
- make up 20% of Earth's surface;
- each 100 m (300 ft) gain in elevation is approximately equal to a 100 km (62 mi) change in latitude;
- mountain regions contain majority of world's forests;
- timberline: elevation above which trees do not grow;
- snowline: evevation above which there is permanent snow;
- important as watersheds for lowlands.

7. Perspectives on Geographical Ecology

- Important Lessons
  - everything is connected;
  - temperature & precipitation result patterns result from interplay of incoming solar radiation & geometry of Earth's rotation & orbit;
  - temperature & precipitation are major determinants of the distribution of organisms;
  - understanding the range of biodiversity & its distribution provides a global perspective.
- Value of a Geographical Perspective
  - maps are excellent way to represent complex information & understand complex relationships.