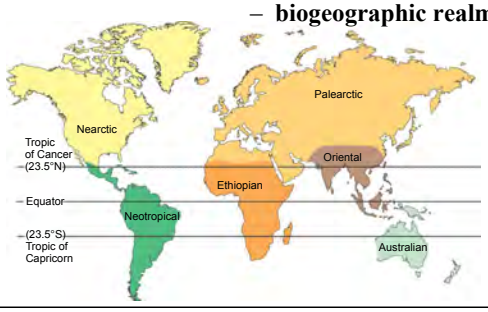
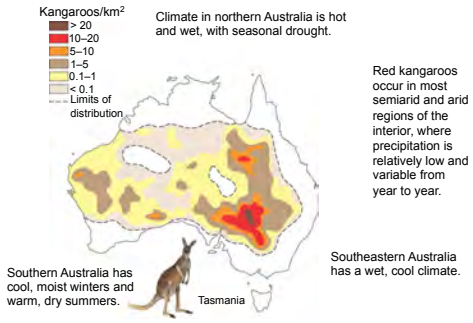
Biogeographic realms

- By 1800s, many naturalists began to identify broad *patterns of distribution*
  - **biogeographic realms**



Environmental components affect the distribution and abundance of organisms



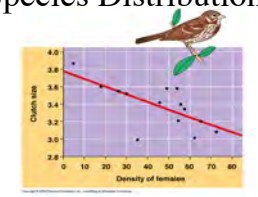
Factors that Limit Species Distribution

- **Abiotic (nonliving) Limiting Factors**
  - Temperature
  - Water
  - Soil type
  - Sunlight
  - Salinity
  - Wind stress
  - Altitude, depth

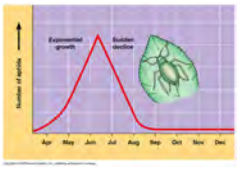
- **Biotic (living) Limiting Factors**
  - Food source
  - Competition
  - Predators
  - Social factors, mates
  - Pathogens, parasites
  - Vegetation

Factors that Limit Species Distribution

- **Density Dependent Limiting Factors**
  - Limited resources
    - Food
    - Water
    - Safe refuge
    - Predation
    - Competition
    - Living space
  - Disease, Pollution



- **Density Independent Limiting Factors**
  - Natural disasters
    - Hurricanes
    - Floods, landslides, volcanoes
    - Drought, frost
  - Environmental insult
    - Deforestation
    - Pesticide
    - Fire
  - Climatic change



Climate

- The prevailing weather conditions in a particular area
- Four major abiotic components:
  - Temperature, water, sunlight, and wind

- Macroclimate: patterns on global & regional scales
- Microclimate: very fine, small-scale patterns
  - scale determined by size & mobility of the organisms
  - e.g., conditions encountered by the community of organisms underneath a fallen log

Latitude is an important correlate for temperature, sun exposure, and rainfall

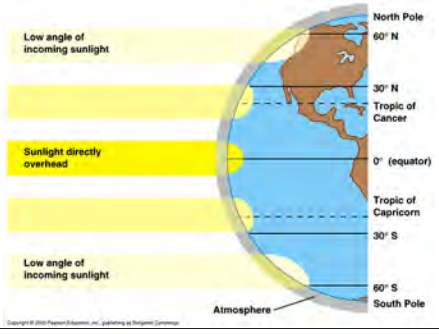


Figure 52.3

The equator receives maximal solar heating producing predictable patterns of wind and rainfall

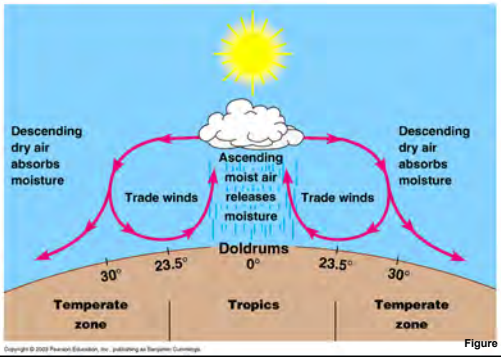
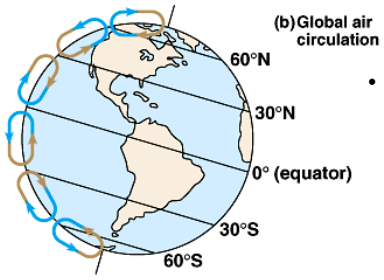


Figure 52.3

WET and DRY

GLOBAL AIR CIRCULATION AND PRECIPITATION PATTERNS

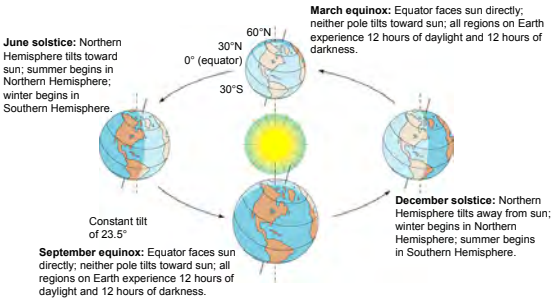


- Uneven heating causes wet and dry areas

Figure 52.3

Seasons

SEASONAL VARIATION IN SUNLIGHT INTENSITY



June solstice: Northern Hemisphere tilts toward sun; summer begins in Northern Hemisphere; winter begins in Southern Hemisphere.

March equinox: Equator faces sun directly; neither pole tilts toward sun; all regions on Earth experience 12 hours of daylight and 12 hours of darkness.

December solstice: Northern Hemisphere tilts away from sun; winter begins in Northern Hemisphere; summer begins in Southern Hemisphere.

September equinox: Equator faces sun directly; neither pole tilts toward sun; all regions on Earth experience 12 hours of daylight and 12 hours of darkness.

Figure 52.4

Coriolis Effect

Effect of the earth's rotation upon objects/fluids in motion over long distances
- **Winds, ocean currents, long-range artillery**

- **Causes motion to veer off**
  - **In Northern Hemisphere, veer clockwise**
  - **In Southern Hemisphere, veer counter-clockwise**
  - **No effect at equator**

Global air circulation and precipitation patterns

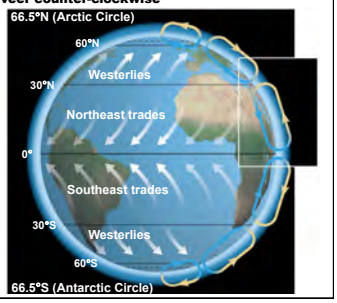


Figure 52.3

OCEAN CURRENTS

- Heat absorbed by ocean waters at the equator is distributed northward.
- Greatly moderates climate extremes.
- Warm zones especially expanded along western boundary currents.

c.f., Figure 52.5

Climate fluctuations are reduced by proximity to bodies of water

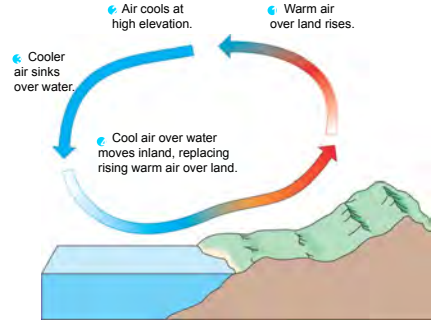
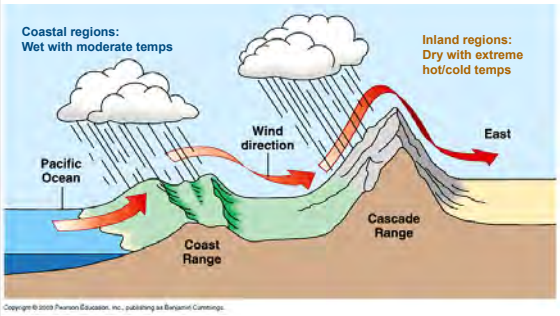


Figure 52.6

General global pattern modified by "rain shadow" to leeward side of mountain ranges



Influence rainfall, temperature, and photoperiod.

Figure 52.6

Biomes:

the major types of ecosystems

Terrestrial biomes

- Primary determining factors
  - Temperature (latitude, altitude)
  - Water availability (rainfall)
- Secondary determining factors
  - Substrate (soil type)
  - Photoperiod (latitude again)
  - Wind (evaporative cooling, physical stress)
  - Disturbance (fire, volcano, mudslide, storm, etc.)

Terrestrial Biomes

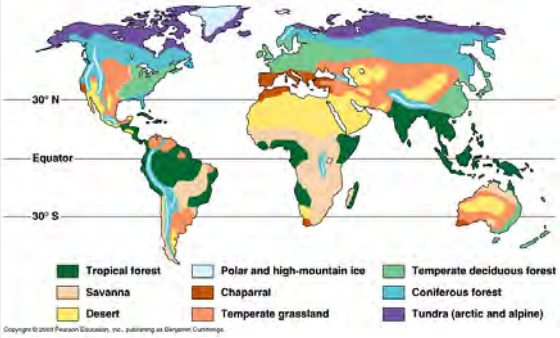
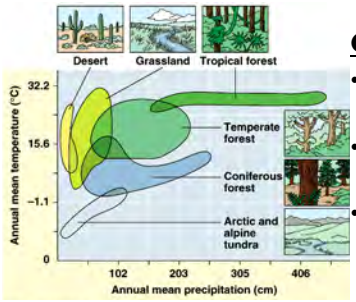


Figure 52.8

CLIMATE IMPACTS ORGANISMS



Climatograph

- Annual mean temperature
- Annual mean precipitation
- Controls vegetation patterns

Figure 52.9

Convergence

Similar form & function in unrelated organisms from similar ecosystems

Cactus from Americas **Euphorb from Africa**

Figure 52.10

TROPICAL FORESTS

- Warm, stable temperature
- 100+ inches of rain
  - Rain forest: consistent
  - Dry forest: seasonal
- Low nutrient soils
- Rapid decomposition and recycling
- Most complex
  - Patchy & stratified
- High diversity

SAVANNA BIOME

- Warm temperature
- Low but consistent rainfall
- Less structure and diversity
- Fire and grazing prevent tree invasion

DESERT BIOME

- Temperature extremes
- Precipitation infrequent
- Evaporation exceeds precipitation
  - Life keyed to rainfall
  - Adaptations for water conservation
- 30° north and south
- Rain shadow

CHAPARRAL BIOME

"Mediterranean climate"

- Cool offshore currents
- Mild rainy winters
- Long hot summers
- Frequent fires
- Vegetation adapted to fire

TEMPERATE GRASSLANDS

- Cold winters
- Seasonal drought
- Occasional drought
- Grazing and fire
- Prevent invasion by shrubs and trees
- Deep fertile soils
- Human impact

TEMPERATE DECIDUOUS (BROADLEAF) FOREST

- 35° to 50° north and south
- Ample precipitation
- Warm summers and cold winters
- Deciduous vegetation
- Rich soils
- Many human impacts

CONIFEROUS FORESTS

<u>Largest terrestrial biome</u>

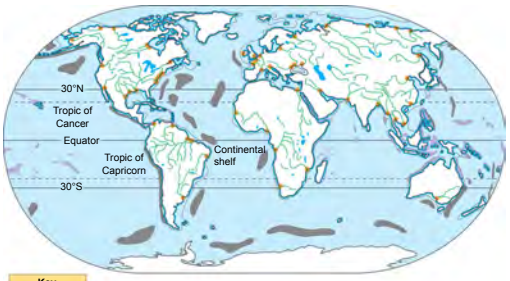
- Short summers
- Harsh winters
- Poor soils
- Cone bearing trees
- Fire maintained
- Temperate rain forests in northwestern North America

TUNDRA BIOME

- Northern latitudes
- Alpine regions above treeline
- Short, warm summers
- Long, bitter cold winters
- Permafrost
- Low growing vegetation

Aquatic Biomes

>75% of Earth's surface



Stratification of aquatic biomes

- Many aquatic biomes are stratified into zones (layers) defined by light penetration, temperature, and depth

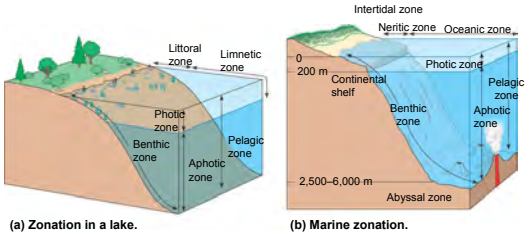


Figure 52.12

LAKES

- Oligotrophic: few nutrients→few producers →clear water
- Eutrophic →abundant nutrients →abundant phytoplankton →murky, green water

LAKES

Oligotrophic lake in Grand Teton, Wyoming

Eutrophic lake in Okavango delta, Botswana

LAKES

- Lakes are sensitive to seasonal temperature change
  - Often experience seasonal turnover

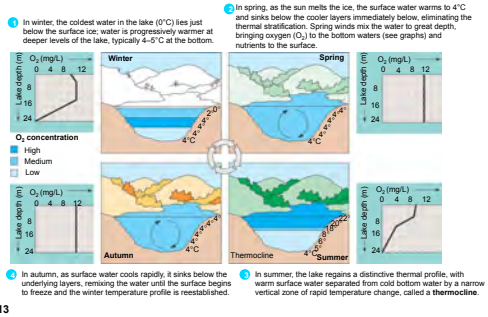


Figure 52.13

WETLANDS

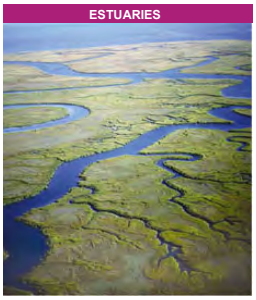
- Alternate between aquatic and terrestrial

WETLANDS

Okefenokee National Wetland Reserve in Georgia

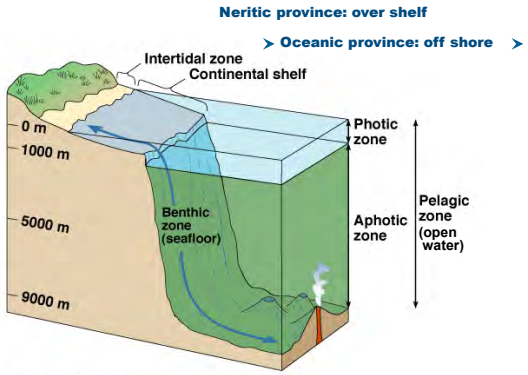
ESTUARIES

- Transition between freshwater and marine

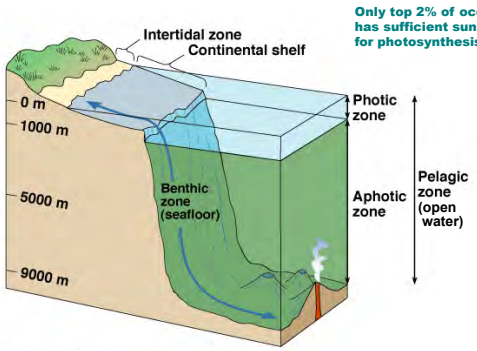


An estuary in a low coastal plain of Georgia

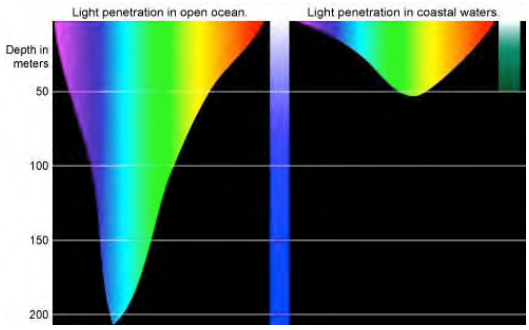
OCEAN ZONES



OCEAN ZONES



Light absorption & penetration in the sea



TROPICAL NERITIC BIOME

- Warm, stratified, oligotrophic waters
- Coral reefs — "oases in the desert"

Coral reef in the Red Sea

TEMPERATE NERITIC BIOME

- Cold, eutrophic waters → most productive
- Upwelling: surface water blown offshore; replaced by deep water
- Phytoplankton blooms & kelp forests

< 1% of ocean area, but > 50% of fish productivity

Bull kelp

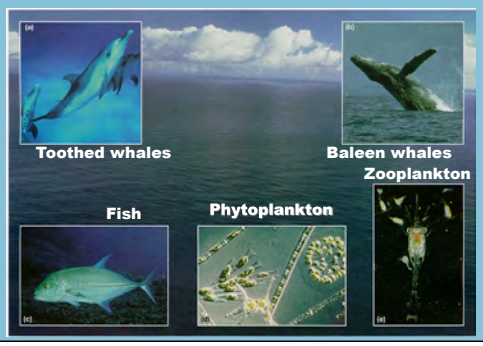
ABYSSAL BENTHIC BIOME

- Dependent upon organic "marine snow" raining down from euphotic surface waters
- Isolated pockets of chemoautotrophs

A deep-sea hydrothermal vent community

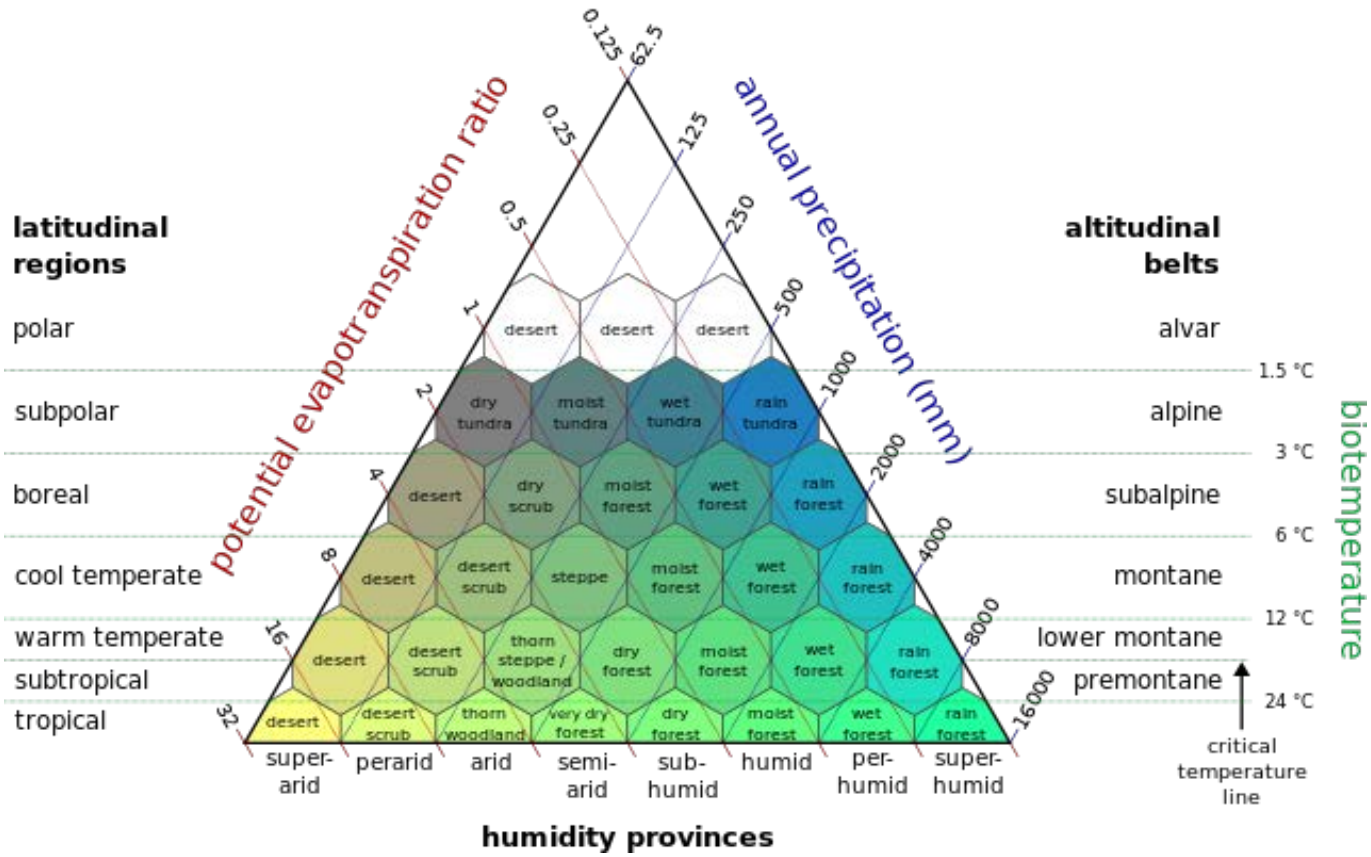
OCEANIC BIOME

Earth's largest ecosystem! (>90% of biosphere)



Holdridge lifezone classification chart

For use with the ***Climate Zones & Biomes*** guest lectures



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