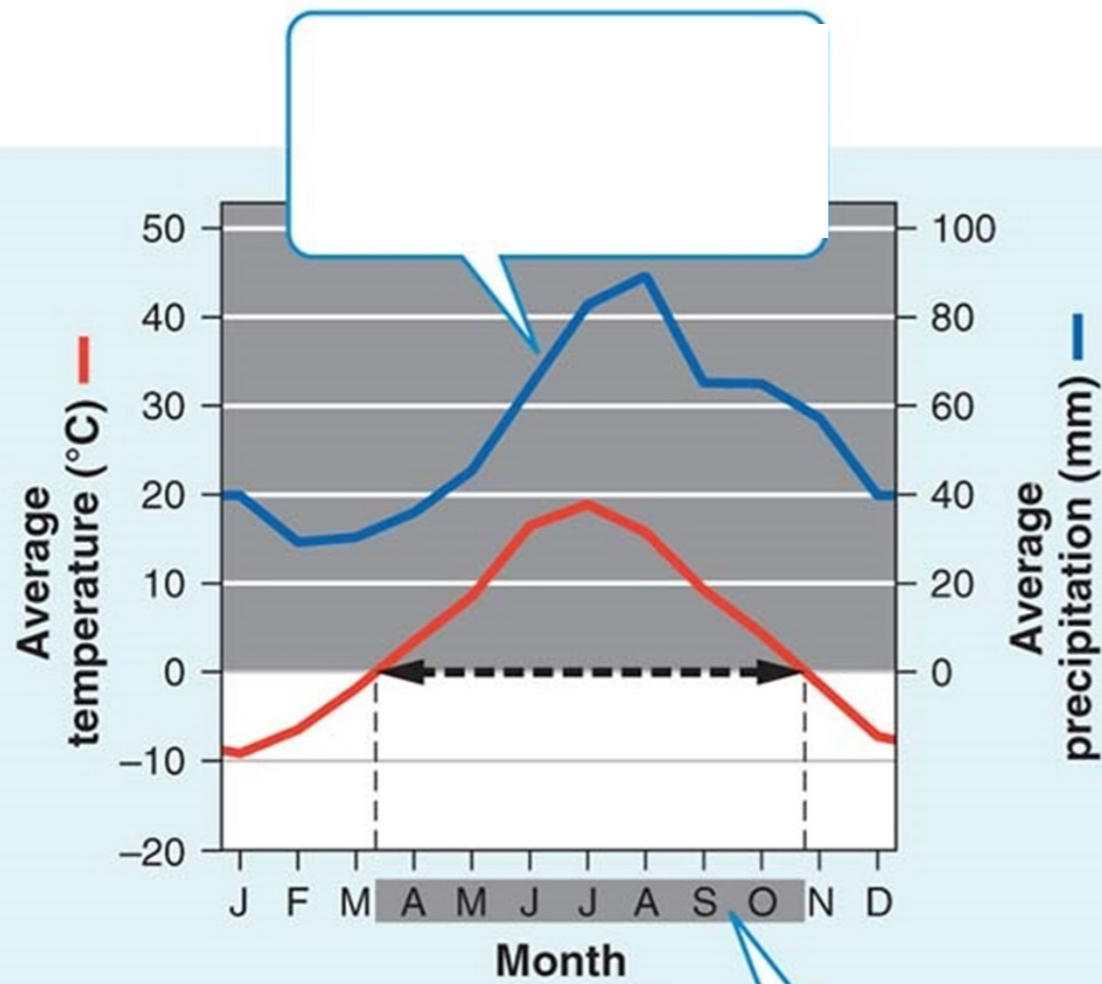


Agenda:

- Collect global trade winds HW
- Friday quiz
- Finish Ch. 4 notes
- Class time for HW

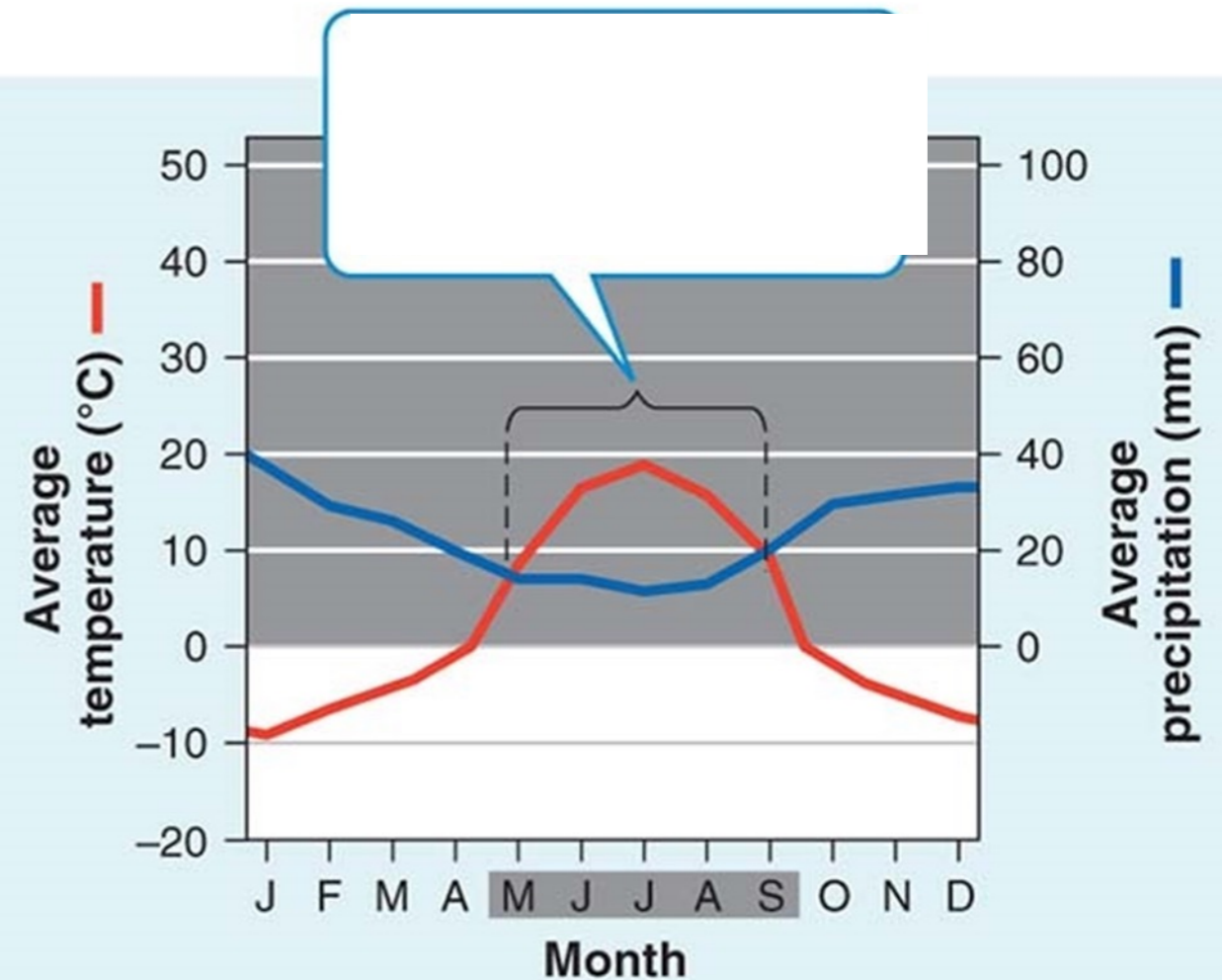
Bell Work

Which climate diagram shows growth limited by temperature and which one is limited by precipitation?



(a) Example 1

Shaded region indicates the growing season, when temperatures are above 0°C.



(b) Example 2

Variations in Climate Determine the Dominant Plant Growth Forms of Terrestrial Biomes

- **Biomes-** The presence of *similar plant growth forms* in areas possessing *similar temperature and precipitation patterns*.
- Categorized by particular combinations of average *annual temperatures* and *annual precipitation* →
- Notice that within each temperature range we can observe a *wide range* of precipitation

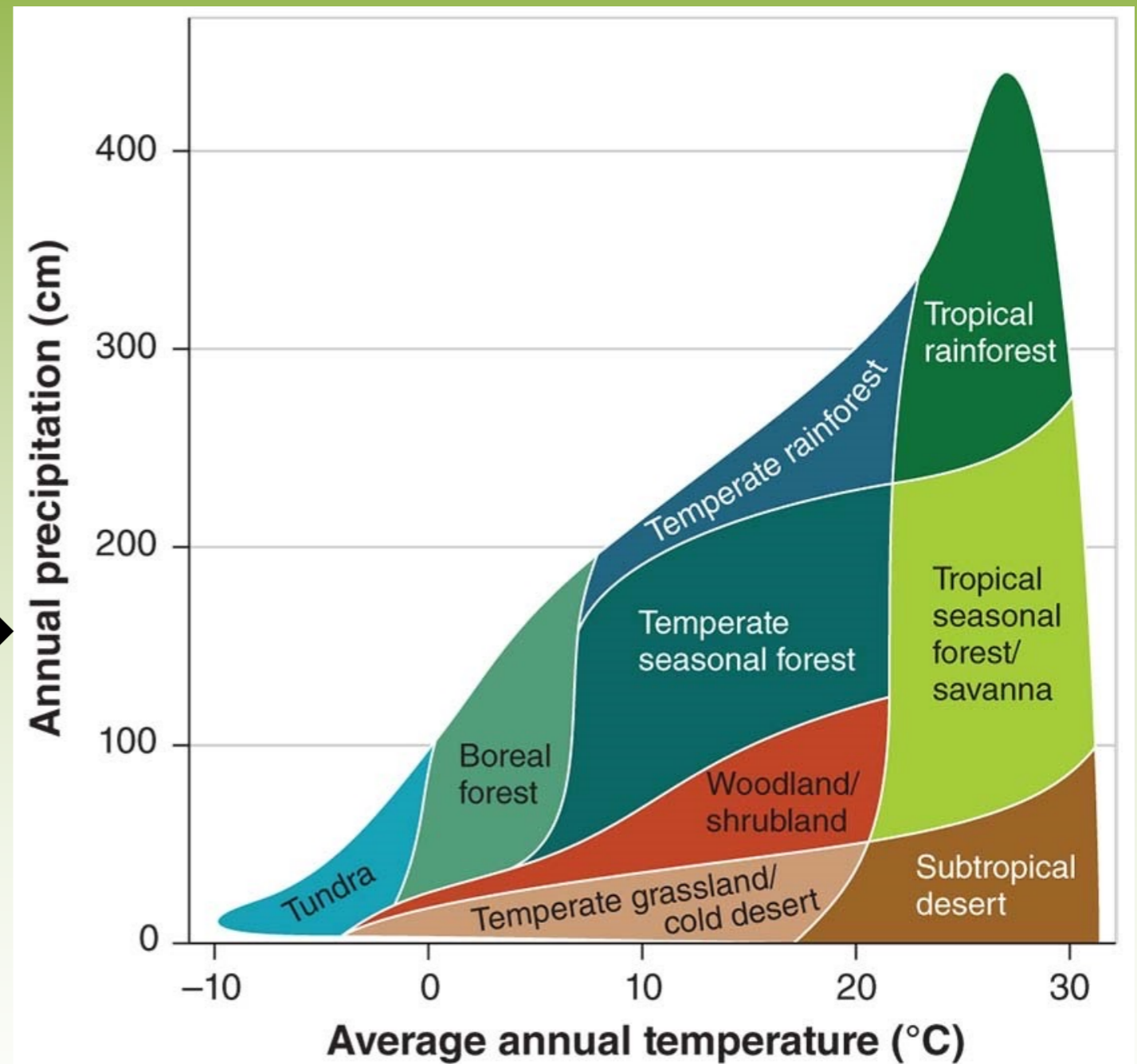


Figure 4.16
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Variations in Climate Determine the Dominant Plant Growth Forms of Terrestrial Biomes

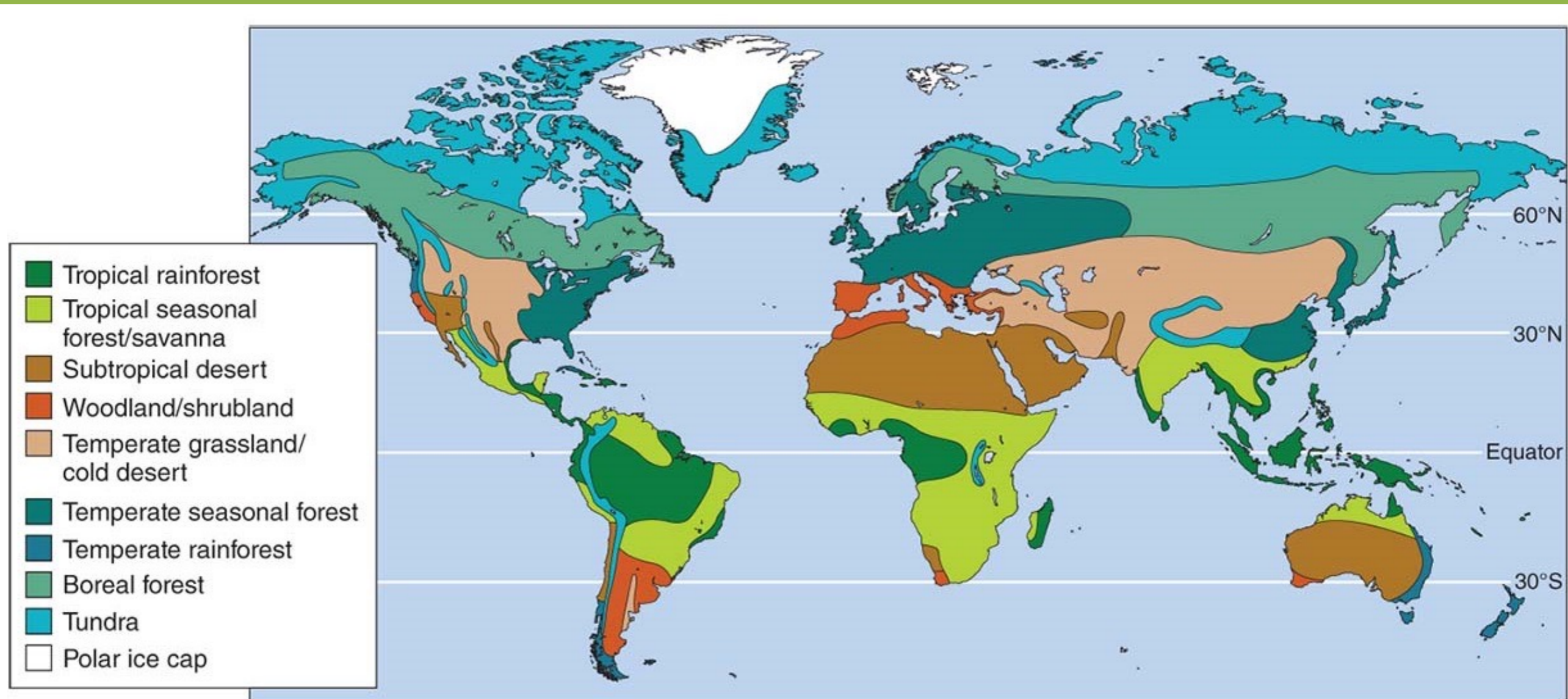
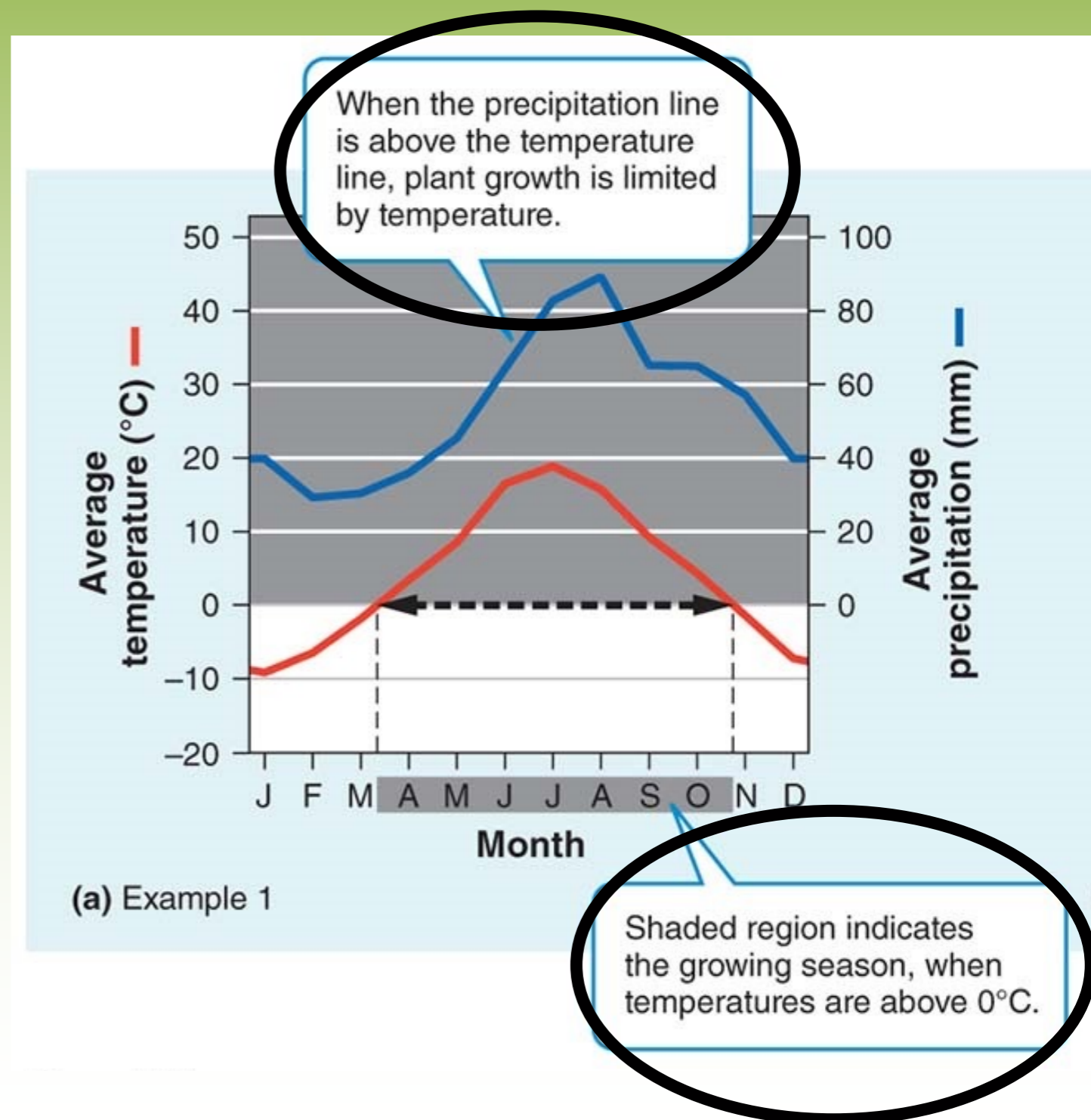


Figure 4.17
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Global locations of the world's biomes caused by a combination of convection currents, trade winds, seasons, and ocean currents

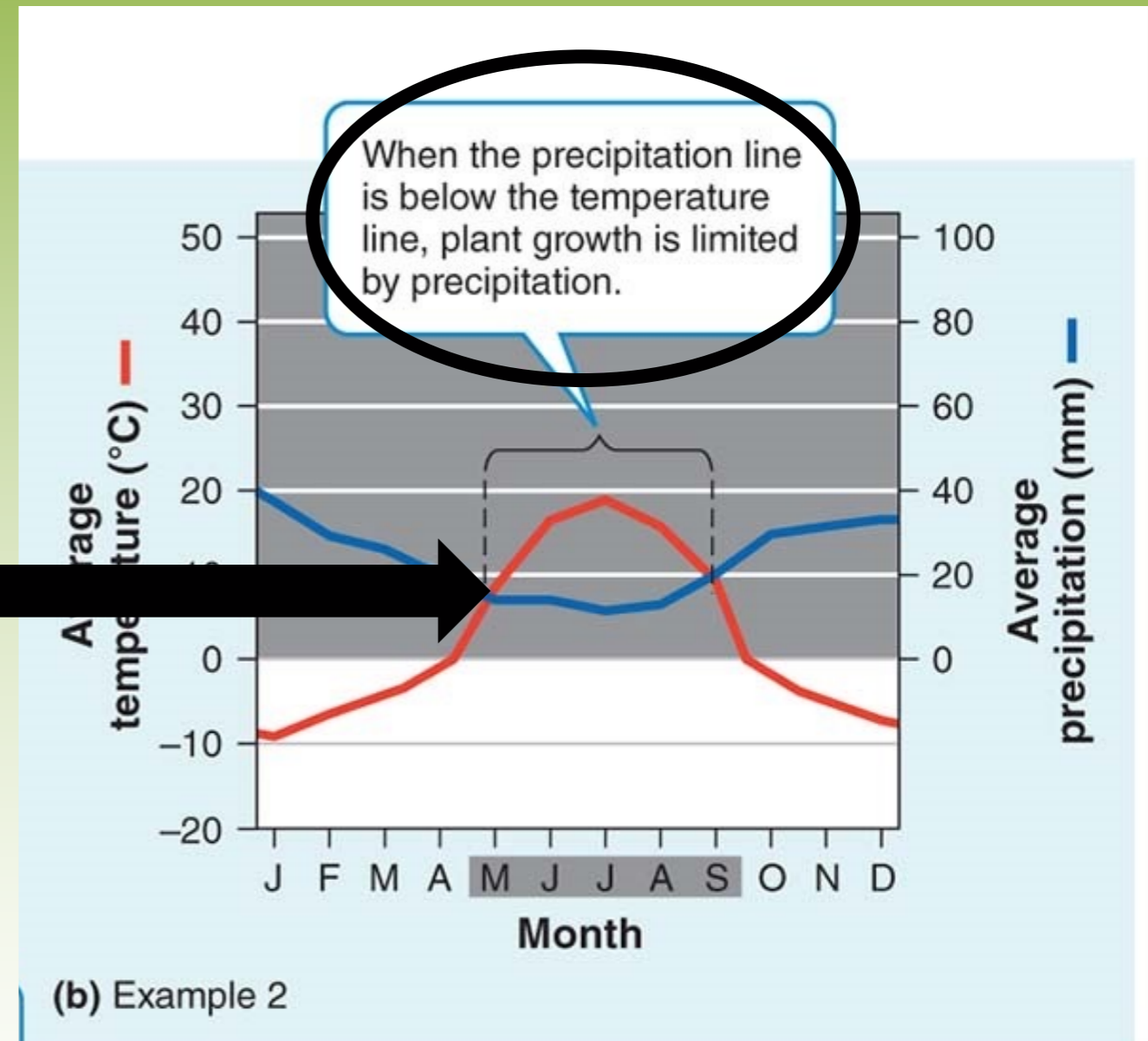
Variations in Climate Determine the Dominant Plant Growth Forms of Terrestrial Biomes

- Climate diagrams are helpful in visualizing *regional* patterns of temperature and precipitation
- When the precipitation *exceeds* temperature, plant growth is limited by *temperature*
- Indicates the **growing season** – months above 0°C (32°F)



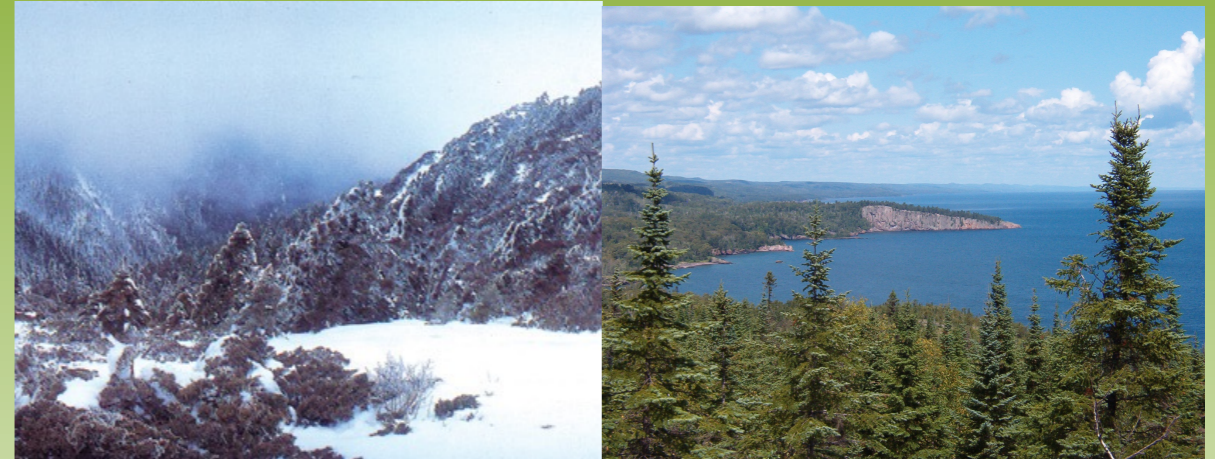
Variations in Climate Determine the Dominant Plant Growth Forms of Terrestrial Biomes

- *Plant growth* can be limited by *temperature or precipitation*
- When the precipitation line *intersects* the temperature line the amount of water available to plants *equals* the amount of water lost by plants due to transpiration
- Thus, where the precipitation line is *below* the temperature line, plant growth is limited by *precipitation*



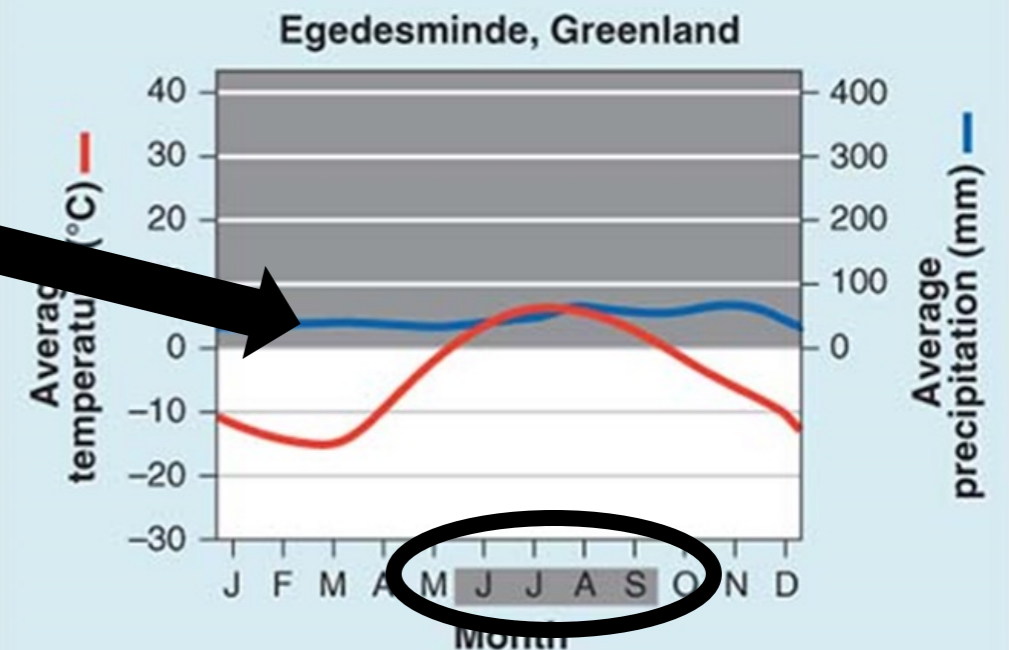
Variations in Climate Determine the Dominant Plant Growth Forms of Terrestrial Biomes

- Terrestrial biomes can be divided into three categories:
 1. Tundra and boreal forest
 2. Temperate
 3. Tropical
- Within these categories are a total of nine biomes
- We will examine each of these biomes in turn, looking at their temperature, precipitation, geographical distribution, and typical plant growth forms



Tundra

- Cold, *treeless* biome with *low-growing vegetation*. In winter, the soil is completely frozen.
- The tundra's *growing season is very short*, usually only about 4 months during summer.
- The underlying subsoil, known as **permafrost** is an impermeable, permanently frozen layer that *prevents water from draining and roots from penetrating*.
- Receives *little* precipitation, but enough to support small woody shrubs, mosses, and lichens
- Cold temperature *slow the rate of chemical reactions* so decomposition is slow resulting in *organic matter* in the soil, but *low levels of soil nutrients*



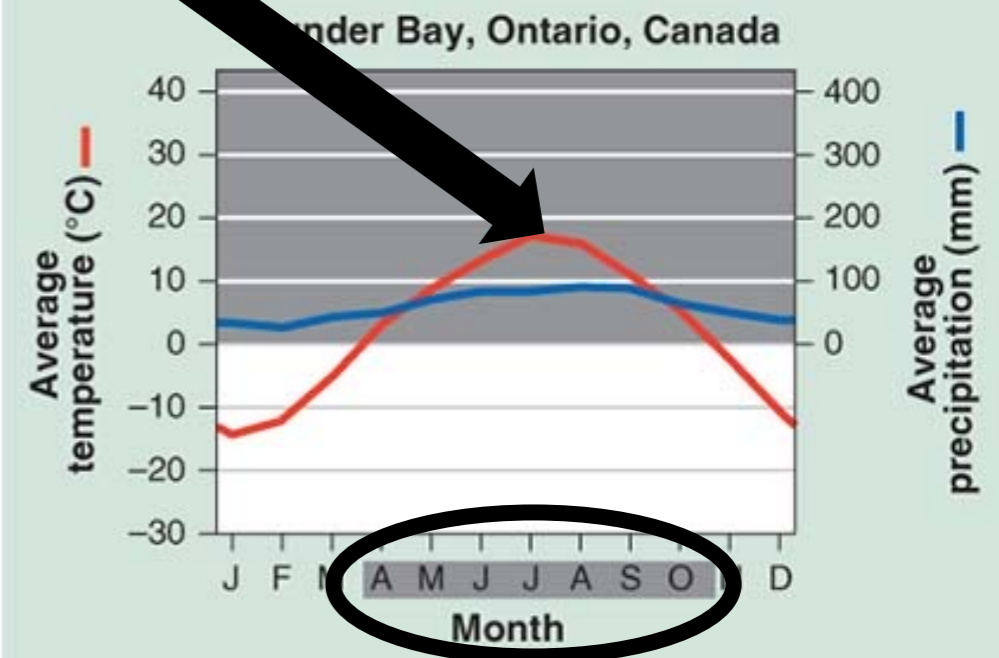
Tundra



Permafrost

Boreal Forest

- Forests made up primarily of *coniferous* (cone-bearing) evergreen trees that can tolerate cold winters and *short growing seasons*.
- This subarctic biome has a *very cold climate*, and plant growth is more *constrained by precipitation than temperature*
- The soil is thick in *organic matter*, but *nutrient-poor* due to *slow decomposition*.
- Contains other *deciduous trees* such as birch, maple, and aspen
- Because of low nutrient levels, boreal forests are *poor regions for growing crops*, but good *regions to harvest trees to be manufactured into pulp, paper, and building materials*



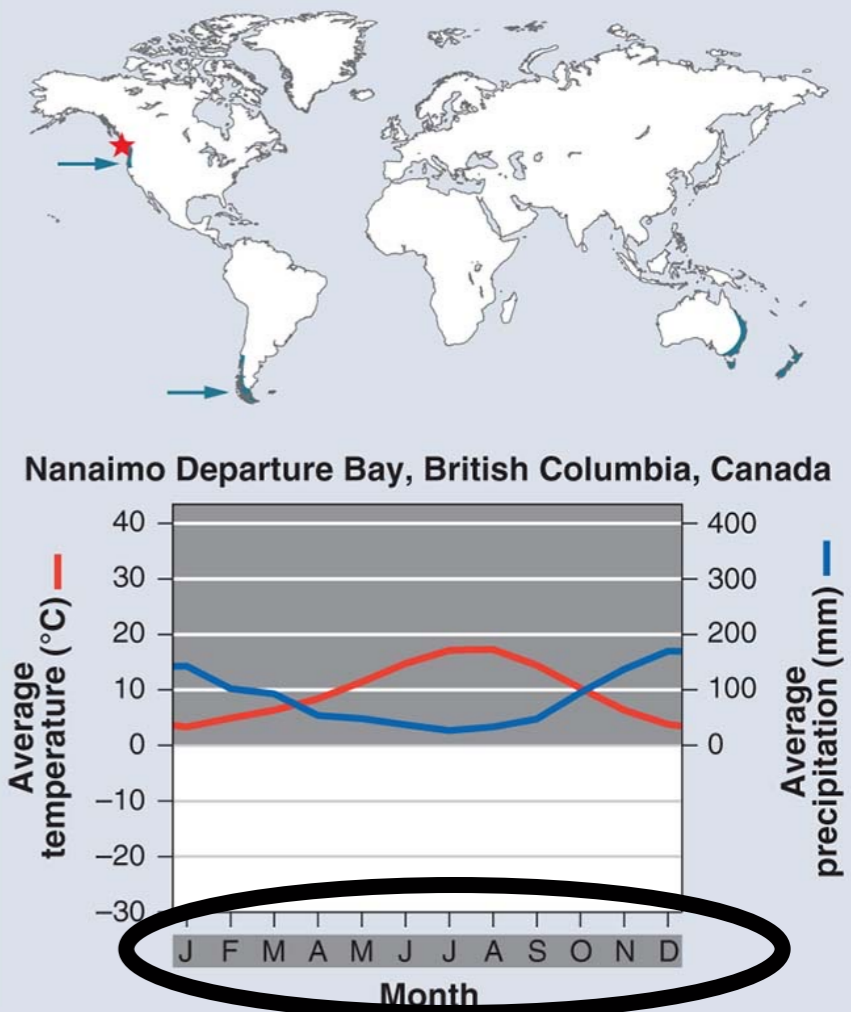
Boreal Forest



Taiga coniferous boreal forest

Temperate Rainforest

- *Moderate* temperatures and *high* precipitation typify the temperate rainforest.
- The temperate rainforest is a *coast biome* and can be found along the west coast of North America from northern California to Alaska, in southern Chile, on the west coast of New Zealand, and on the island of Tasmania.
- The *ocean currents* help moderate temperature fluctuations and provide a *source of water vapor*.
- This biome has a *nearly 12-month growing season* where winters are rainy and summers are foggy.
- The mild temperatures and high precipitation supports the growth of *very large trees*.



- Supports growth of very large trees that can live thousands of years
- Slow decomposition and rapid uptake of any nutrients by the large trees result in low nutrient soils

Much of this biome has been logged for lumber

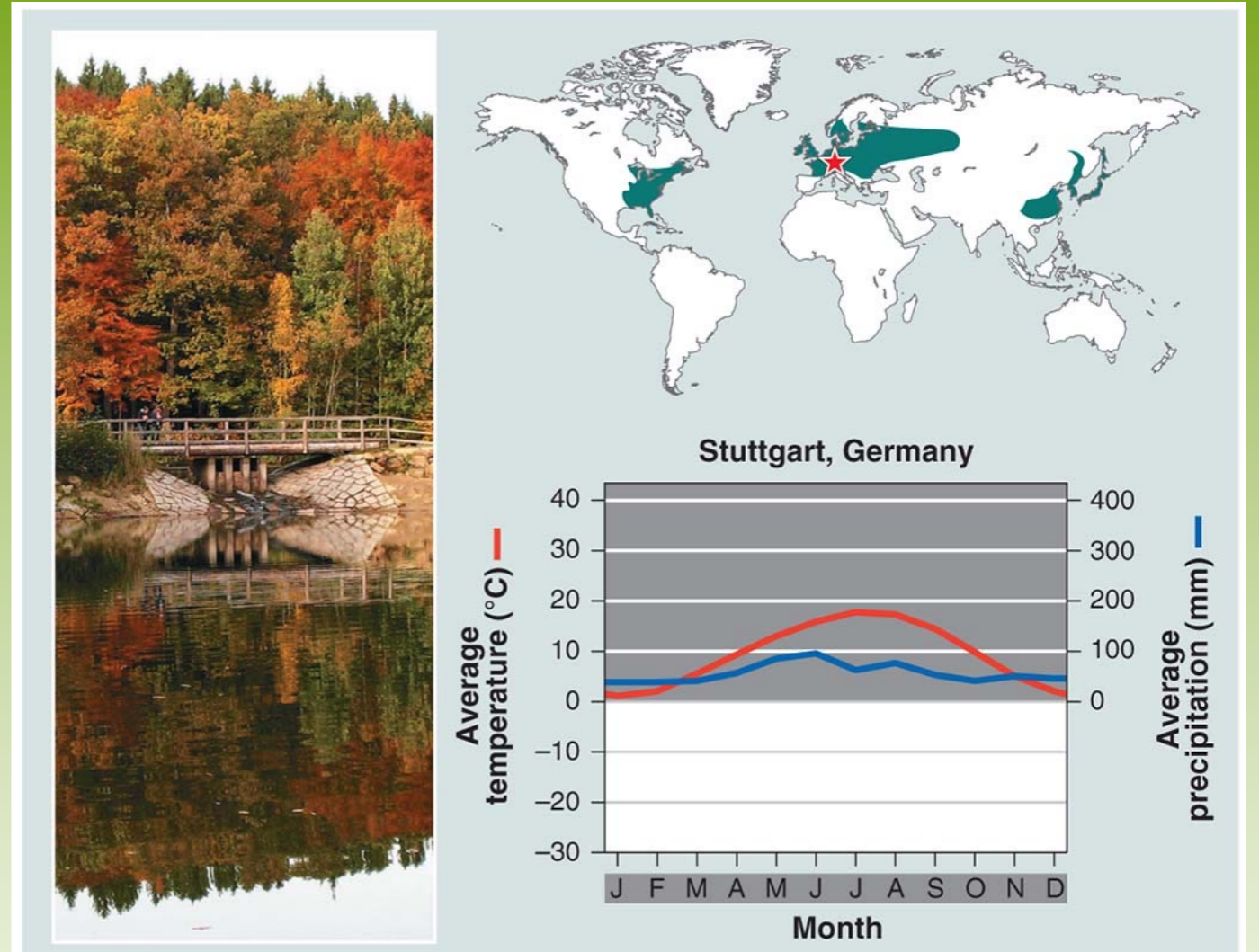
Temperate Rainforest



Chilliwalk River Provincial Park in British Columbia

Temperate Seasonal Forest

- Receive over 1 m (39 inches) of precipitation annually.
- Further from *moderating effect of the ocean*, they have much *warmer summers* and *colder winters* than temperate rainforests
- Found in the eastern United States, Japan, China, Europe, Chile and eastern Australia.
- Dominated by *broadleaf deciduous trees* such as birch, maple, oak and hickory.
- Warmer summer temperatures *favor decomposition* so soils contain *more nutrients* than those of boreal forests



- Combination of *soil fertility* and *long growing season* make temperate rainforests more productive than boreal forests, thus they were one of the first biomes to be converted to *agricultural land*

Temperate Seasonal Forest

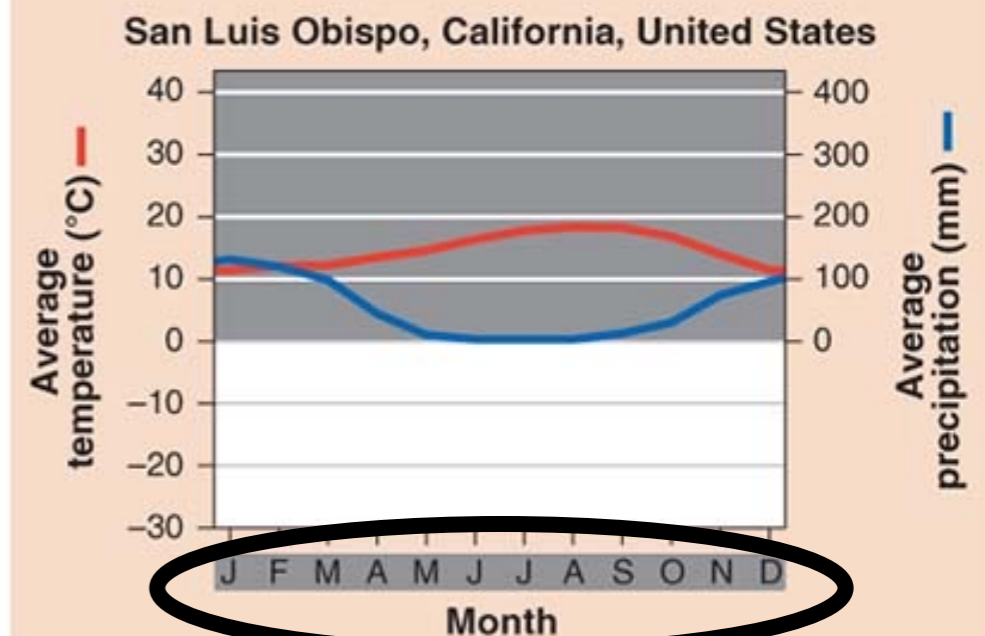


Temperate deciduous forest in the eastern United States

Woodland/Shrubland

- Found on the coast of southern California, southern Australia, southern Africa and in the area surrounding the Mediterranean Sea.
- *Hot, dry summers* and *mild, rainy winters* are characteristic of this biome.
- There is a *12-month growing season*, but plant growth is *constrained by low precipitation in summer* and by *relatively low temperatures in winter*.
- *Wildfires* are common and plants of this biome are well adapted to both *fire and drought*.
- Soils are *low in nutrients* because of leaching by the *winter rains*

Major agricultural uses of this biome are *grazing animals* and growing *drought-tolerant deep-rooted crops* such as grapes



Woodland/Shrubland

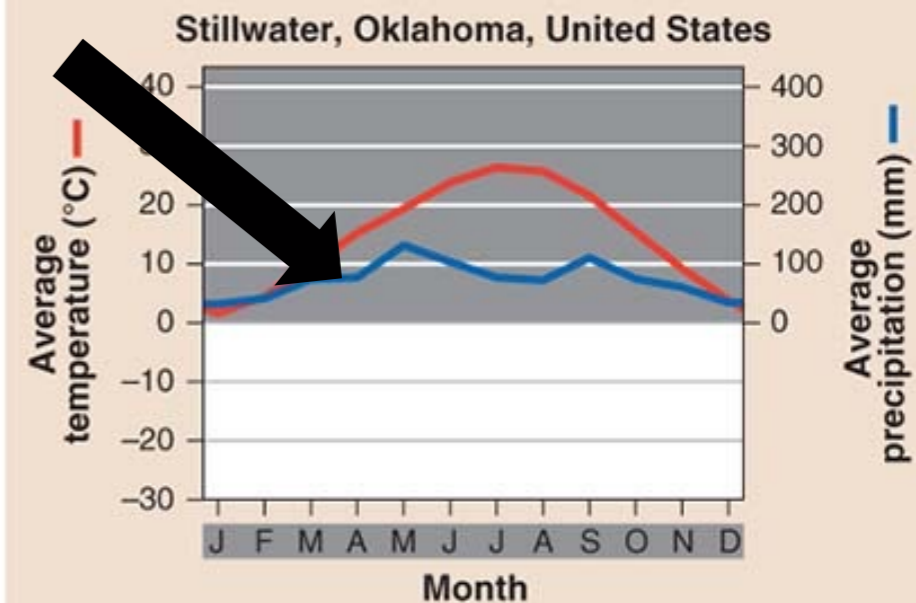


Wildfire in chaparral near Pine Valley, CA

Temperate Grassland/Cold Desert

- This biome has *the lowest average annual precipitation* of any temperate biome.
- These are found in the Great Plains of North America, in South America, and in central Asia and eastern Europe.
- *Cold, harsh winters* and *hot, dry, summers* characterize this biome.
- Plant growth is constrained by both *insufficient precipitation* in summer and *cold temperatures in winter*.
- Plants include grasses and non woody flowering plants that are *well adapted to wildfires* and *frequent grazing* by animals.
- Long growing seasons and rapid decomposition make nutrient rich soil

More than 98% tall grass prairie in the United States has been converted to agriculture



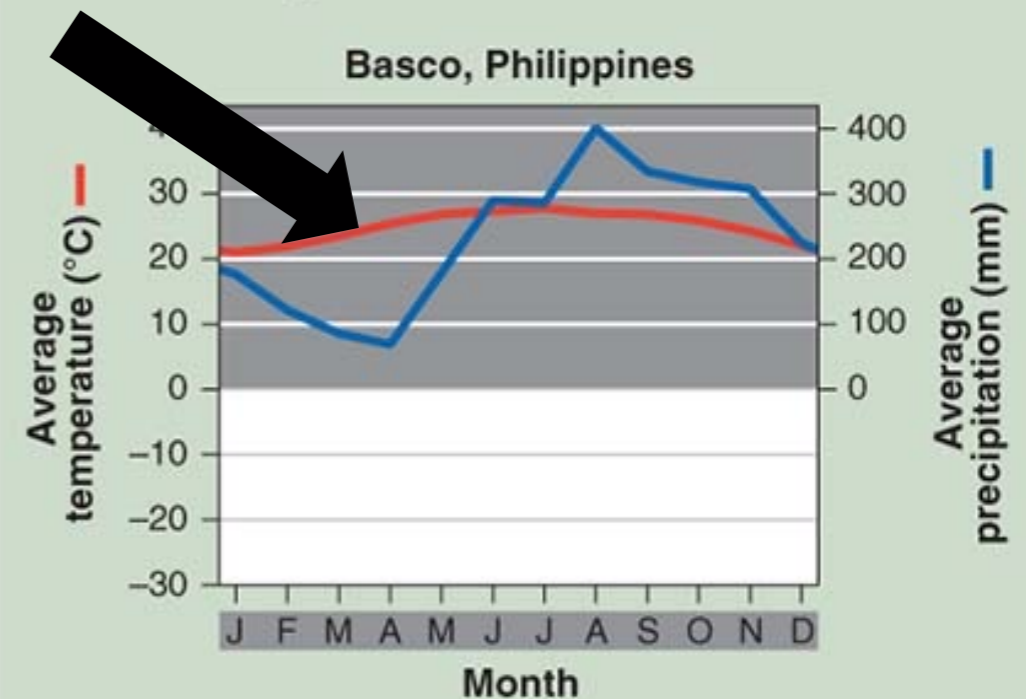
Temperate Grassland/Cold Desert



Tallgrass Prairie Nature Preserve in Osage County, Oklahoma

Tropical Rainforest

- In the tropics, average annual temperatures *exceed* 20°C.
- This biome is located approximately 20° N and S of the equator.
- They are found in Central and South America, Africa, Southeast Asia, and northeastern Australia.
- Precipitation occurs *frequently* and this biome is *warm and wet* with *little temperature variation*.
- Productivity is high and decomposition is rapid but the nutrients are quickly taken up by the lush vegetation, thus farmers must move to new deforested areas often
- Tropical rain forests have *more biodiversity per hectare* than any other terrestrial biome and contain up to *two-thirds* of Earth's terrestrial species.



Tropical Rainforest

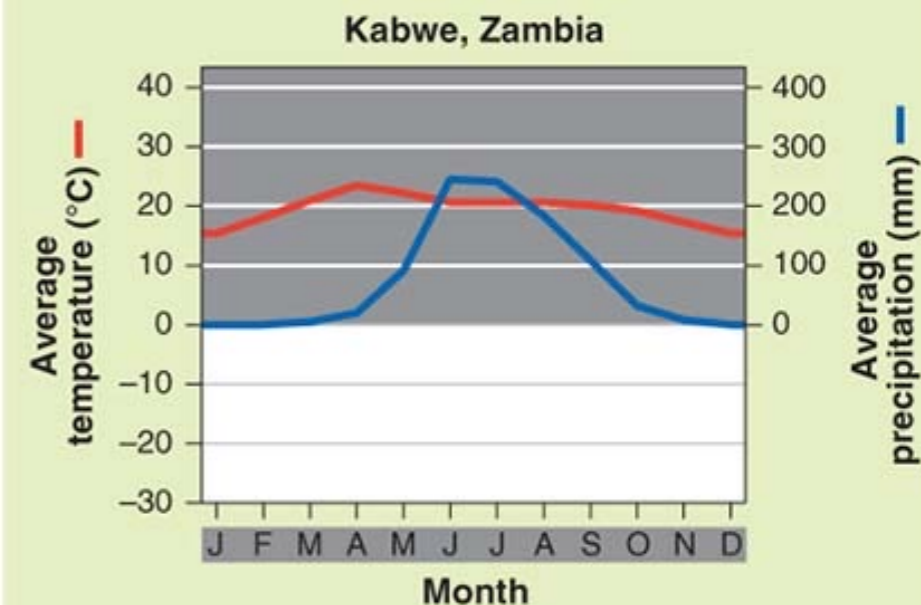


Amazon Rainforest in Brazil

Tropical Seasonal Forest/Savanna

- *Warm temperatures and distinct wet and dry seasons* characterize this biome and are caused by the ITCZ
- Tropical deciduous forests drop leaves during the *dry season* and sprout new leaves during the *wet season* and Savannas are *open landscapes*
- Tropical seasonal forests are common in much of Central America, on the Atlantic coast of South America, in southern Asia, in northwestern Australia, and in sub-Saharan Africa.
- Soil in this biome is *fairly fertile* and can be farmed due to *high decomposition rates*, but the *low amount of precipitation* constrains plants from using the soil nutrients that are released.

Grasses and scattered deciduous trees are common.



Tropical Seasonal Forest/Savanna



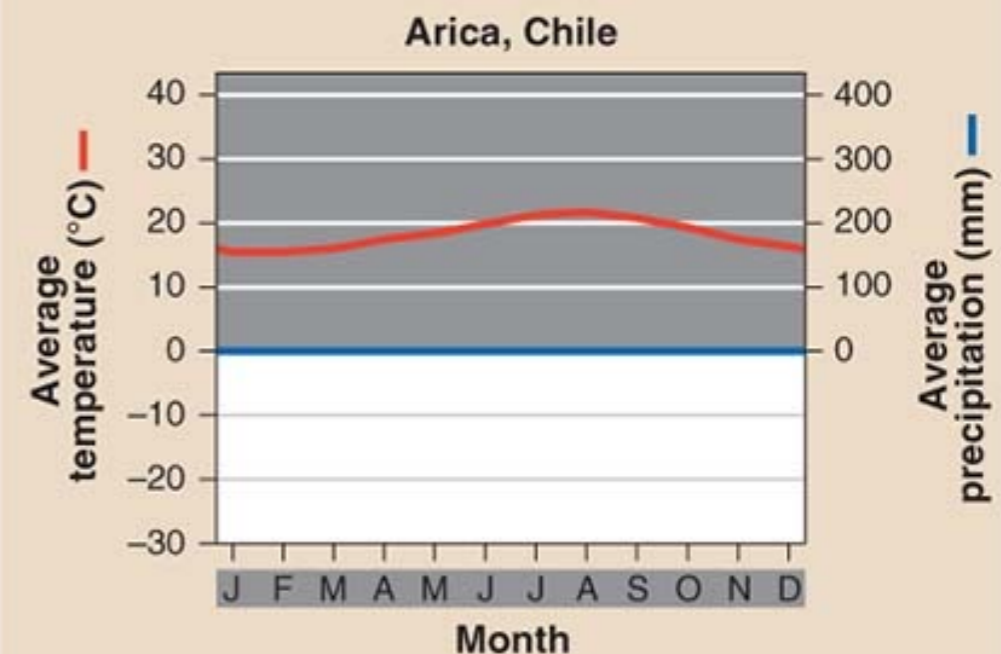
Tropical
deciduous
forest in Costa
Rica



Savanna in Africa

Subtropical Desert

- This biome is found at 30° N and S with hot temperatures and *extremely dry conditions*.
- The Mojave Desert in the southwestern United States, the Sahara in Africa, the Arabian Desert of the Middle East and the Great Victoria Desert of Australia are all subtropical deserts.
- *Cacti, euphorbs and succulent plants* are well adapted to this biome.
- Leaves of plants are *smaller or modified to spines* and most photosynthesis occurs along the *plant stem* to prevent water loss
- *Slow growth* of plants makes them particularly vulnerable to disturbance since they have *long recovery times*



Subtropical Desert



Mohave desert in Northern Arizona

Aquatic Biomes

- Categorized by *salinity*, *depth*, and *water flow*
- Two broad categories:
 1. **Freshwater biomes**: streams, rivers, lakes, and wetlands
 2. **Saltwater biomes**: shallow marine areas such as estuaries and coral reefs as well as the open ocean
- *Temperature* is an important factor in determining which species can live in a particular aquatic habitat, but is not used as a *determining factor* for biome categorization



Streams and Rivers

- Flowing fresh water that may originate from *underground springs* or as *runoff from rain* or *melting snow*.
- *Streams* (or creeks) are typically *narrow* and carry relatively small amounts of water where *rivers* are usually *wider* and carry larger amounts of water.
- *As water flow changes, biological communities also change*



Streams and Rivers

- In *fast-moving* water there are *few plants or algae* to act as producers so *organic matter* such as fallen leaves provide the *base of the food web*
- As fast-moving streams combine to form rivers the *water flow slows* and *rooted plants and algae* are better able to grow
- Turbulent waters are known as *rapids* where *atmospheric oxygen* is easily *dissolved* and can support trout and salmon that need *high oxygen levels*
- Slower-moving waters sustain animals such as cat fish that can *tolerate low-oxygen levels*



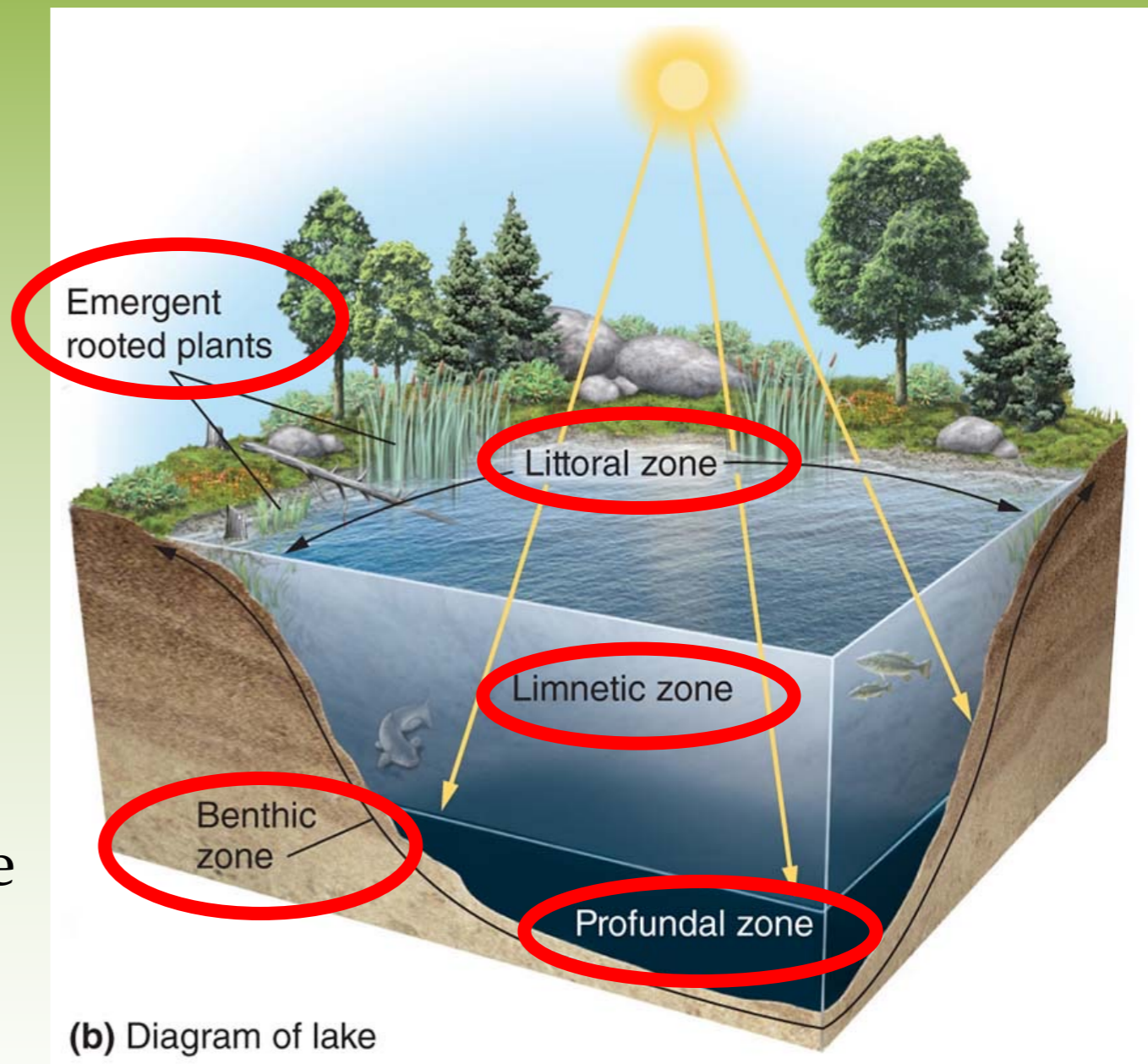
Lakes and Ponds

- *Standing water* that some of which is *too deep* to support emergent vegetation.
- Lakes are *larger* than ponds but there is *no clear point* at which a pond is considered large enough to be called a lake.
- Lakes and ponds can be divided into several *distinct zones*



Lakes and Ponds

- **Littoral zone**- the *shallow area* of soil and water near the shore where *algae and emergent plants* grow.
- **Limnetic zone**- *open water*, where rooted plants can no longer survive. **Phytoplankton** are the only *photosynthetic organisms*. This zone extends to as deep as sunlight can penetrate.
- **Profundal zone**- the zone where *sunlight cannot penetrate* and therefore *producers cannot survive*.
- **Benthic zone**- the *muddy bottom* of a lake or pond beneath the *limnetic* and *profundal zone*.



Freshwater Wetlands

- Aquatic biomes that are *submerged* or *saturated* by water for at least *part of each year*, but shallow enough to *support emergent vegetation*.
- These include:
 1. **Swamps** – wetlands that contain emergent trees
 2. **Marshes** – wetlands that contain non-woody vegetation
 3. **Bogs** – Acidic wetlands that contain sphagnum moss and spruce trees



Freshwater Wetlands

- Among the most *productive ecosystems* because they can take in *large amounts of rainwater* and release it slowly into *groundwater or streams* and *reduce the severity of floods or droughts*



- Also *filter pollutants* from the water

- Many *bird species* depend on wetlands during *breeding or migration*

- A third of *all endangered bird species* in the US spend part of their lives in wetlands even though this biome *only makes up 5%* of the nation's land area



Salt Marshes

- Found along the coast in *temperate climates* and contain *non woody emergent vegetation*.
- The salt marsh is one of the *most productive biomes* in the world.
- Many are found in *estuaries*, which are areas along the coast where *salt water mixes with fresh water from rivers*
- Freshwater contains *nutrient-rich organic material* creating abundant plant life in salt marshes which *filter contaminants* out of the water

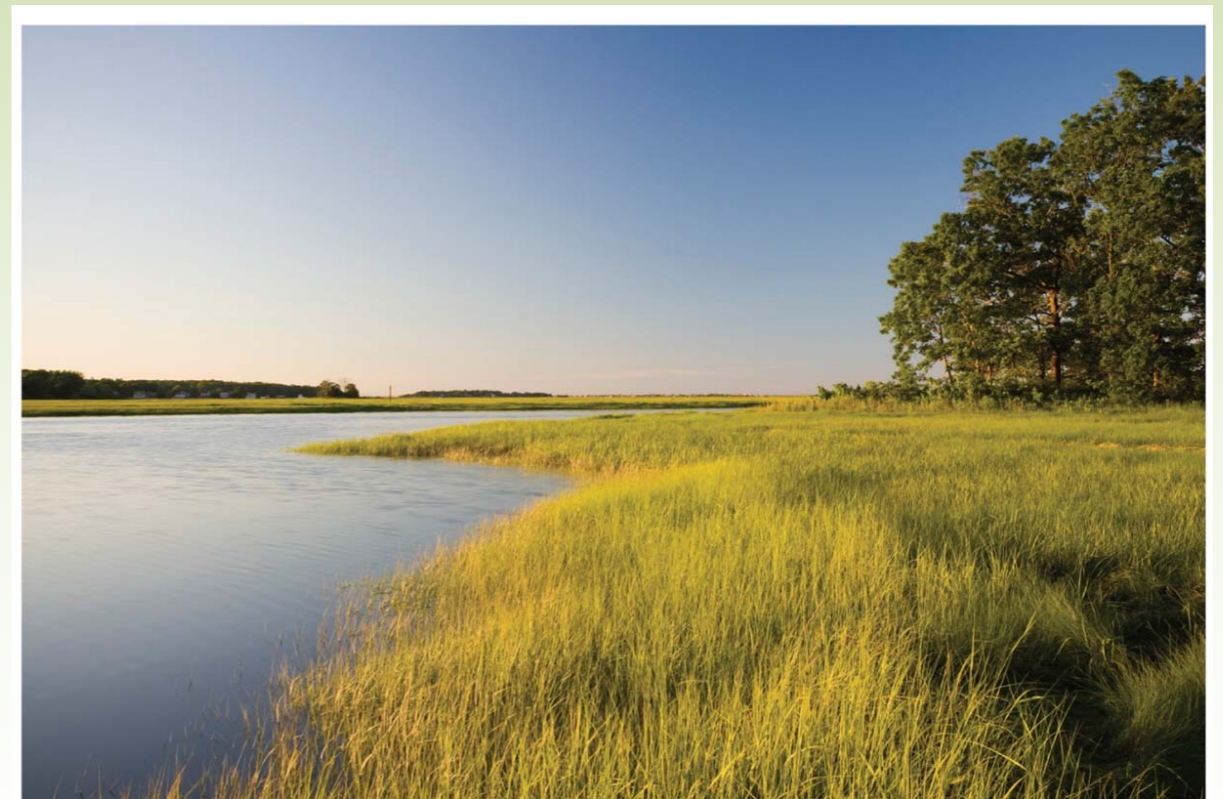
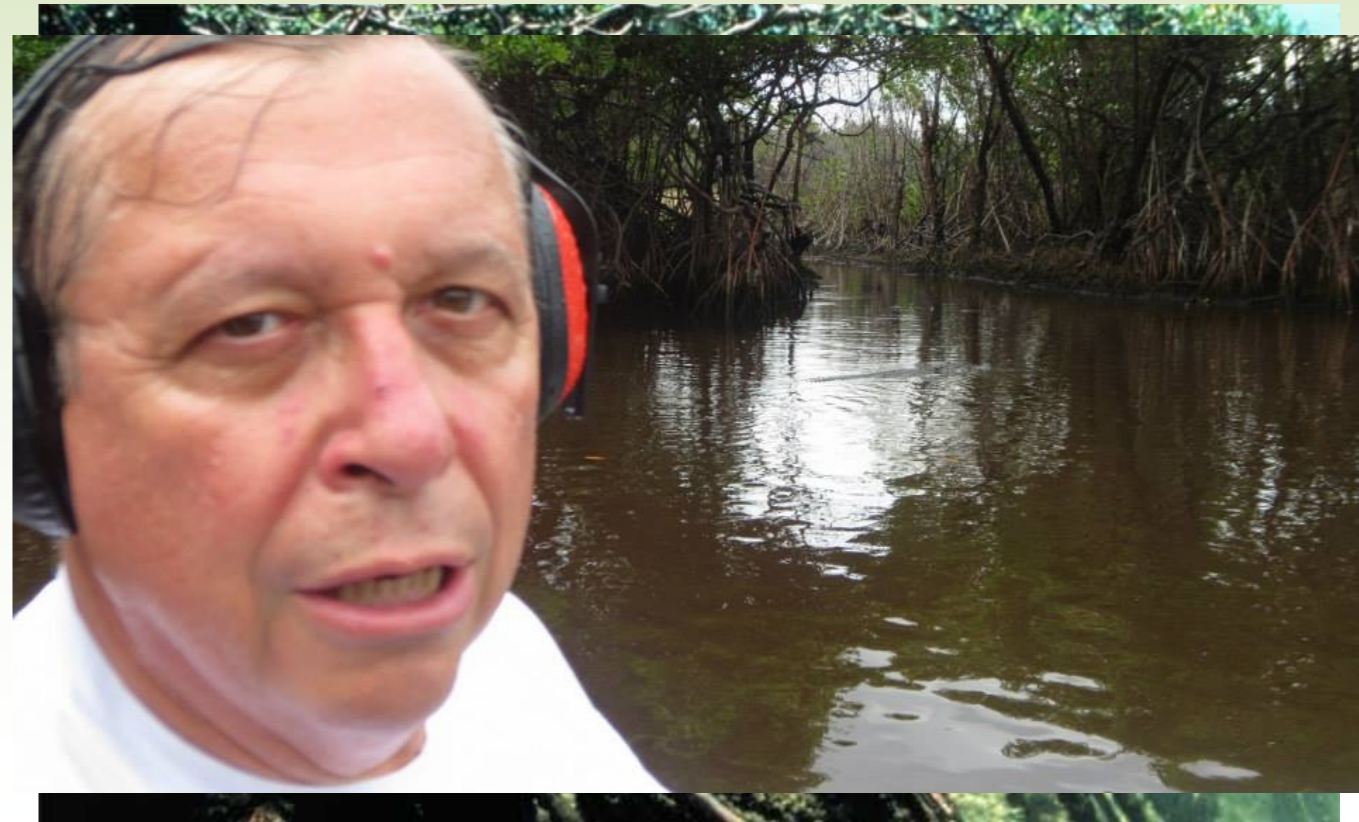


Figure 4.31
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Jerry and Marcy Monkman

Mangrove Swamps

- Found along *tropical and subtropical coasts* and contain *trees whose roots are submerged in water*.
- Mangrove trees are *salt tolerant* and help protect the coastlines from *erosion and storm damage*.
- Often grown in *estuaries*, but can also be found along *shallow coastlines* that lack inputs of freshwater
- Falling leaves and trapped organic material provide a *nutrient-rich* environment



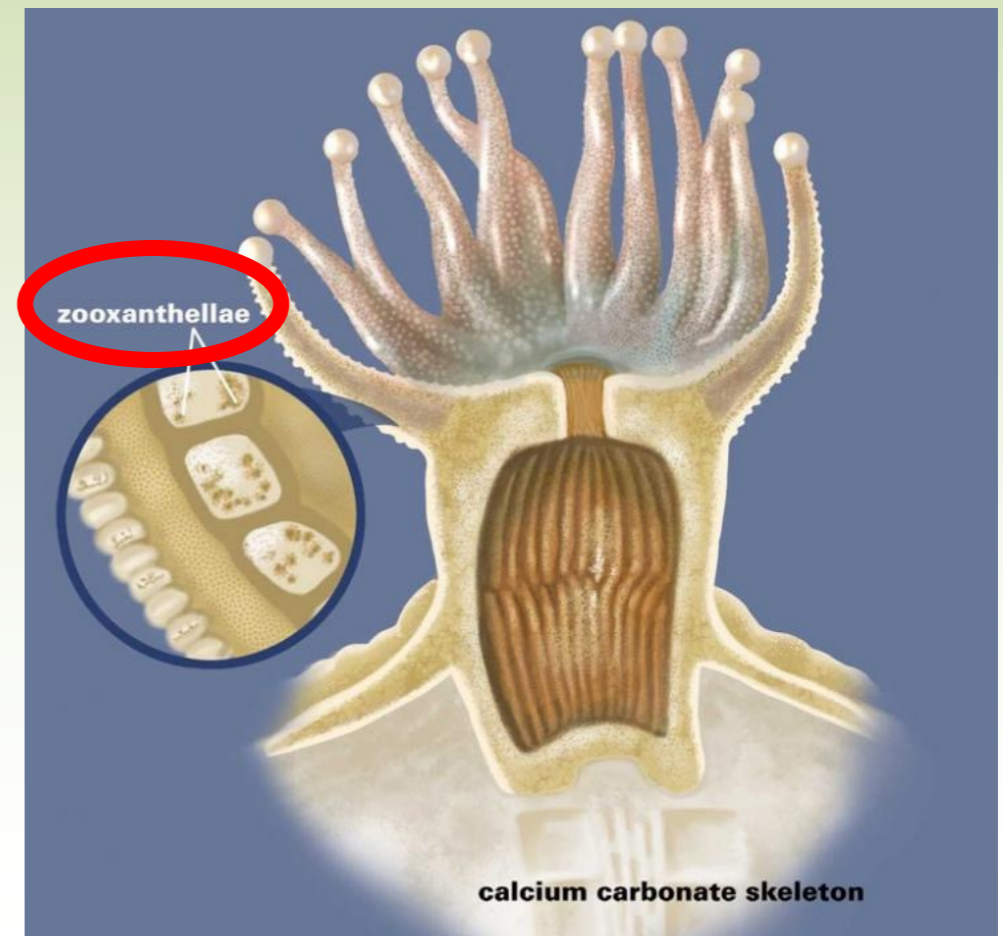
Intertidal Zone

- Narrow band of coastline that exists *between the levels of high tide and low tide*.
- Environmental conditions are *stable during high tide, but harsh during low tide*
- Waves that crash onto the shore in this biome can make it a challenge for *organisms to hold on* and not get washed away.
- Home to a wide range of *well adapted organisms* such as barnacles, sponges, mussels, crabs, and starfish



Coral Reefs

- Found in *warm, shallow waters* beyond the shoreline.
- Corals are *tiny animals* that secrete a layer of *limestone* to form an external skeleton and use tiny tentacles to draw in *plankton and detritus*
- Water is *nutrient poor* but corals have a *symbiotic relationship* with an algae (**zooxanthellae**) that *lives in their tissues*
- Corals *release CO²* and algae *use CO²* during photosynthesis to produce sugars which they *release to the coral*
- The coral in turn provides a *safe place to live*



Coral Reefs

- Most corals live in *vast colonies*
- As *individual* corals die and decompose, their *limestone skeleton* remains and many accumulate over time, forming the *basis* for *massive reefs*
- Earth's most *diverse marine biome* even though coral reefs are found in water that is relatively *poor in nutrients and food*.



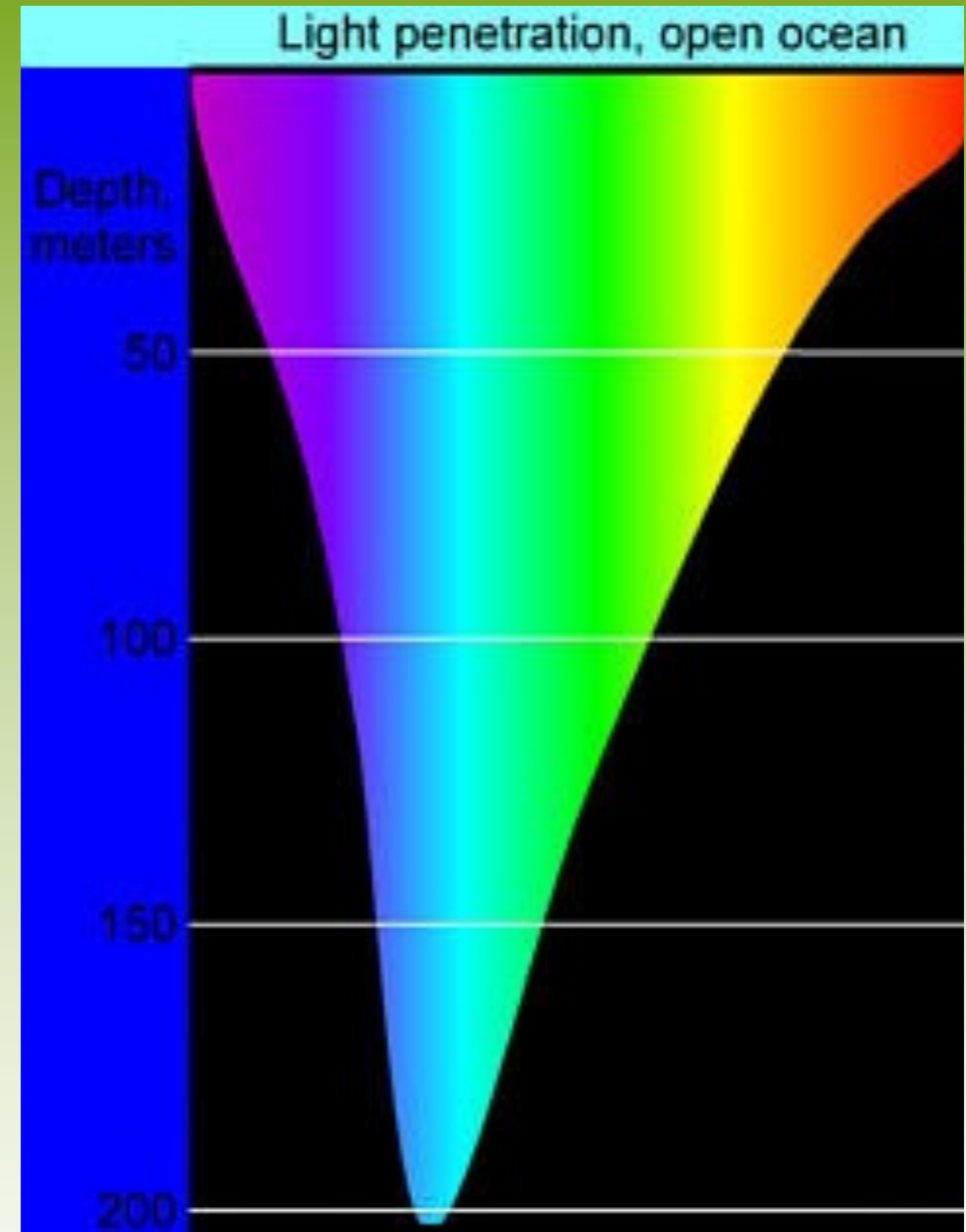
Coral Reefs

- Coral bleaching- when the algae inside the coral dies.
- Scientists believe this is due to a combination of *disease and environmental change*, including *lower ocean pH* and *abnormally high water temperatures*
- A serious problem because without the corals, the *entire coral reef biome is endangered*



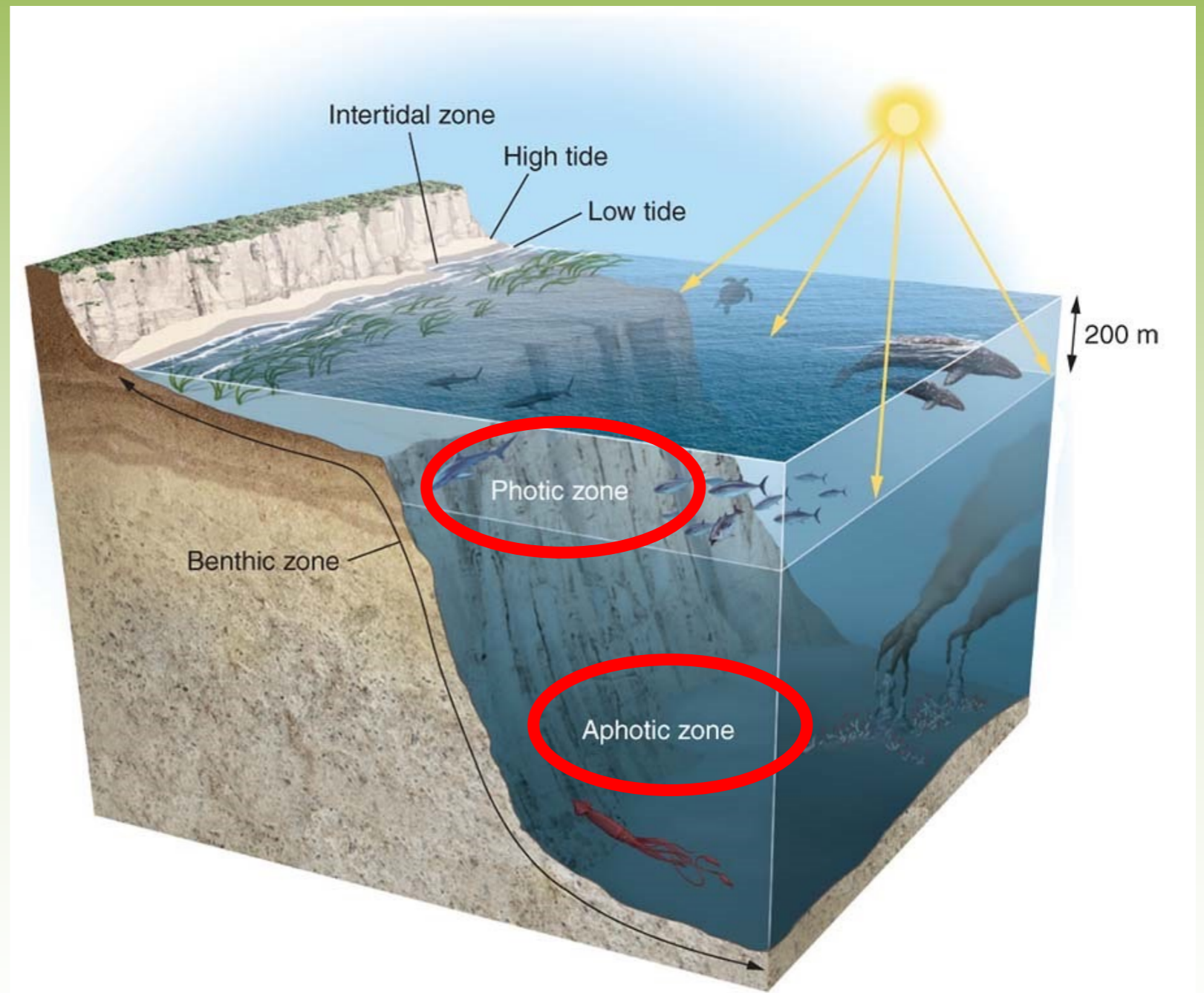
The Open Ocean

- The depth that light can penetrate in the open ocean is *dependent on the amount of sediment and algae suspended in the water.*
- Generally does not exceed 200 m (650 ft)



The Open Ocean

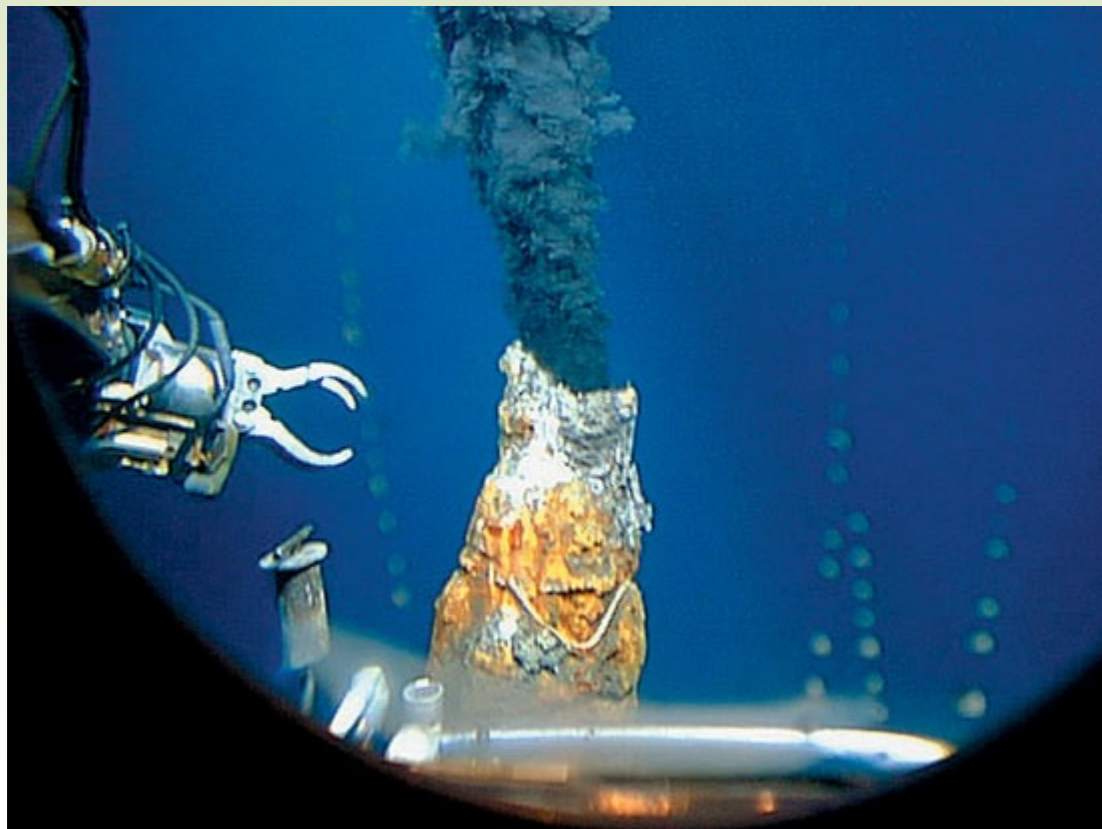
- **Photic zone**- the zone that receives enough *light to allow photosynthesis* to occur.
- **Aphotic zone**- the deeper water that *lacks sufficient light for photosynthesis*.



The Open Ocean

- Chemosynthesis- The process that occurs in the *aphotic zone* when some species of bacteria use *methane and hydrogen sulfide* to generate energy to form the basis of a deep-ocean food chain

Chemosynthesis



The Open Ocean

- The *aphotic zone* also contains a variety of organisms that can produce their *own light*
- A phenomenon called **bioluminescence** to help feed themselves in dark waters

