Agenda:

- Ch. 4 notes
- Class time to review lab packet and do pre-lab questions

Bell Work

1. What is thermohaline circulation?

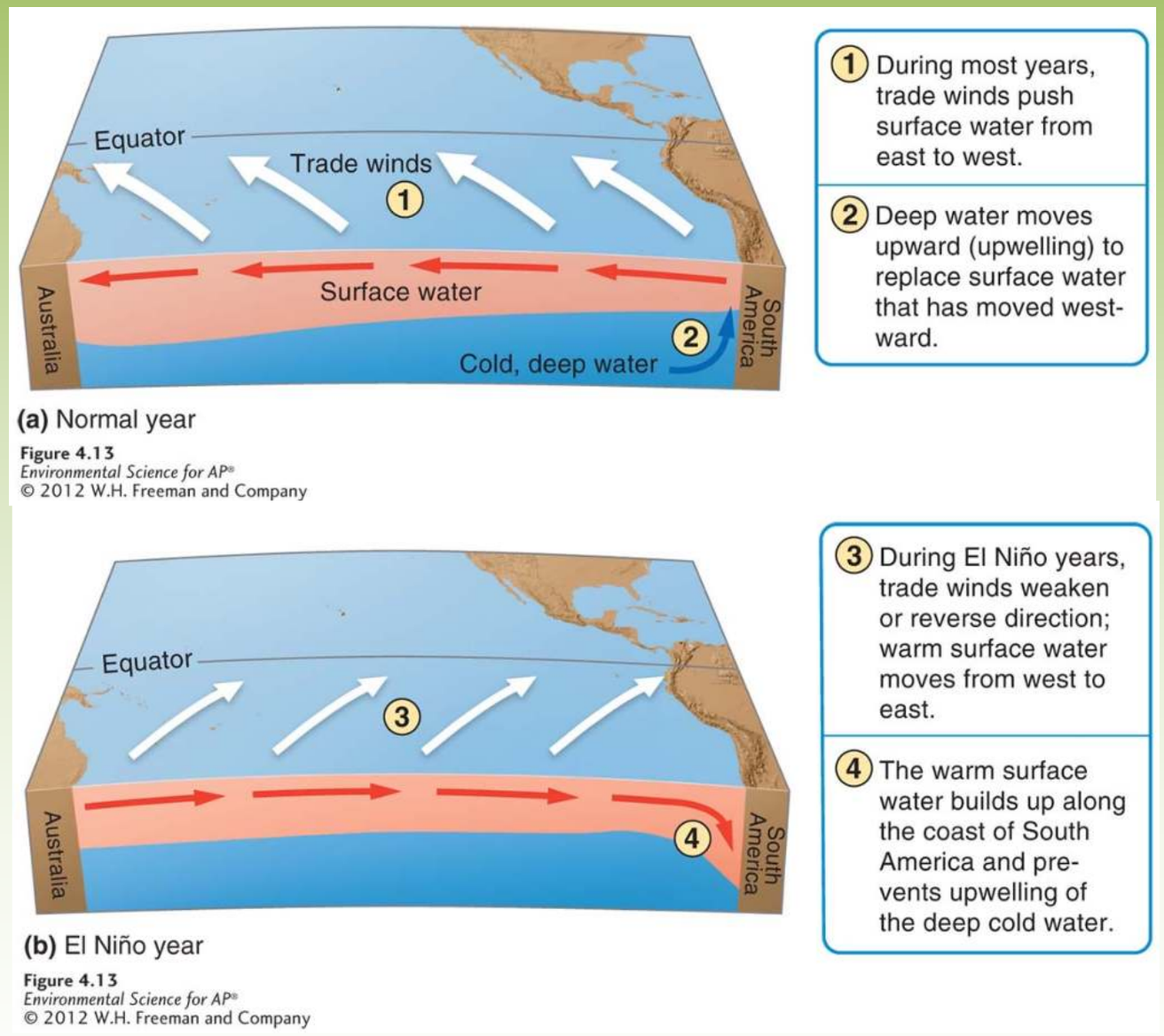
2. What is the ITCZ?

3. Why are upwellings important for the fishing industry?

El Nino-Southern Oscillation

- Every *3 to 7 years*, the interaction of the Earth's atmosphere and ocean cause surface currents in the tropical Pacific Ocean to *reverse direction*.

- Trade winds near South America weaken, which allows *warm equatorial water* from the western Pacific to move eastward toward the west coast of South America



El Nino-Southern Oscillation

- Movement of warm water *suppresses upwelling* off the coast of Peru and *decreases productivity there which declines fish populations*

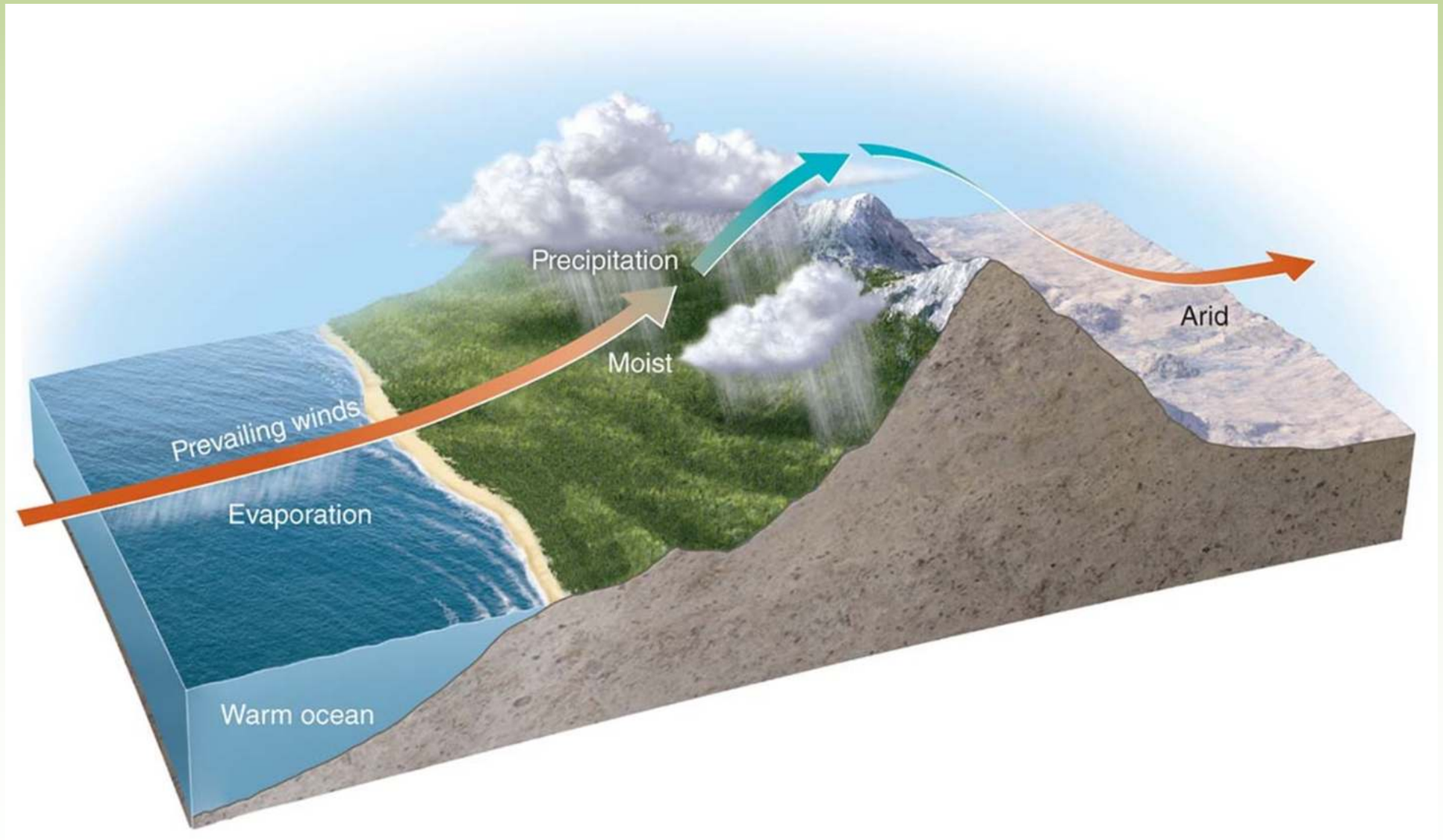
- Phenomenon is called ***El Niño*** and can last *weeks to years*

- *Periodic changes in winds and ocean currents* are collectively called the **El Niño-Southern Oscillation (ENSO)**

Global impact of ENSO includes *cooler and wetter conditions in the southeastern US* and *unusually dry weather in southern Africa and Southeast Asia*

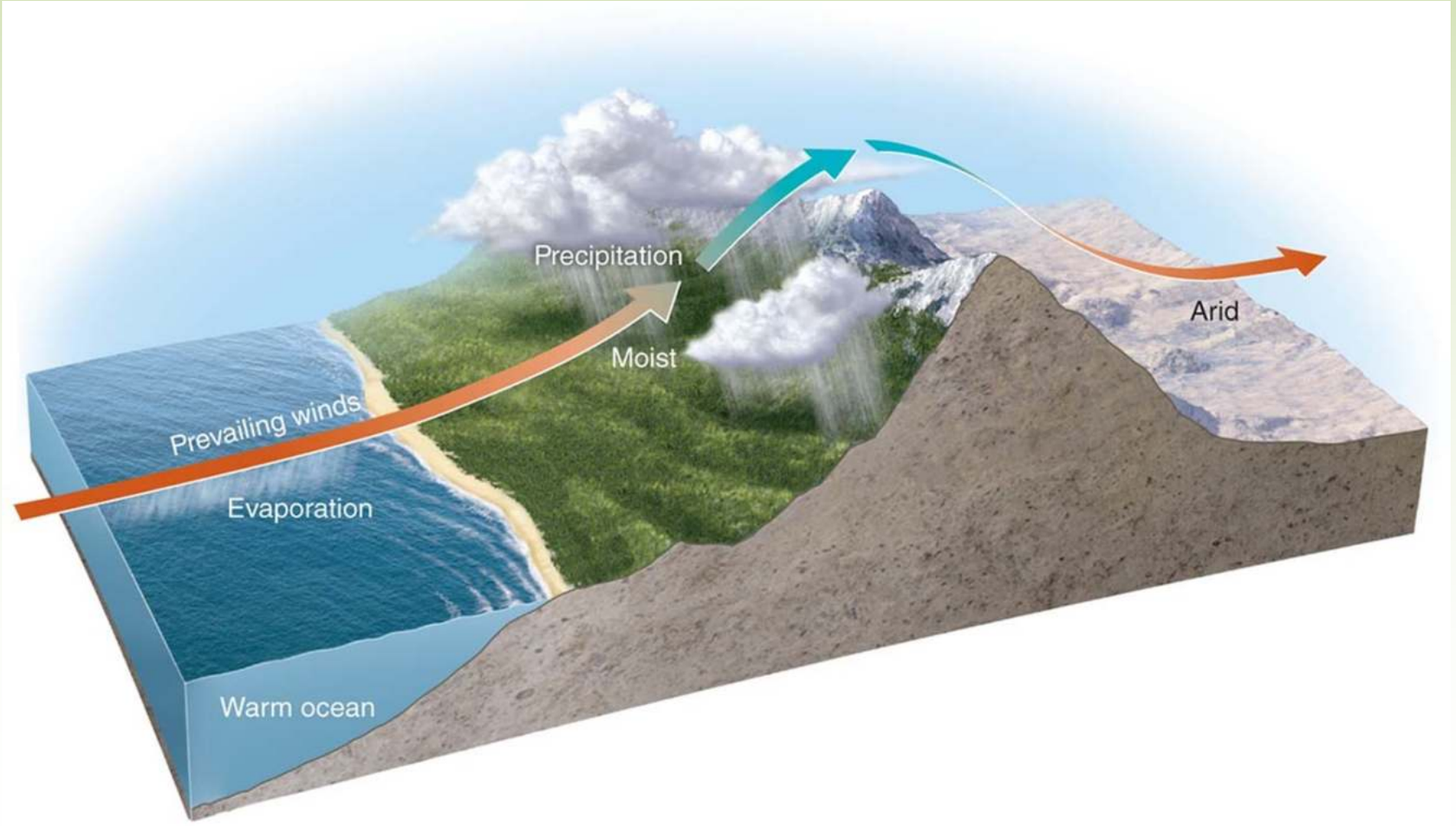
Rain Shadows

- When air moving inland from the ocean that contains a *large amount of water vapor* meets the *windward side* of a mountain range (the side facing the wind), it *rises* and begins to experience *adiabatic cooling*.
- Because water vapor condenses as air cools, clouds form and precipitation falls.



Rain Shadows

- The presence of the mountain range causes *large amounts of precipitation* to fall on its *windward side*.
- The cold, dry air then travels to the other side of the mountain range (the *leeward side*), where it *descends* and experiences *higher pressures*, which cause *adiabatic heating*.
- This air is now *warm and dry* and process *arid conditions* on the *leeward si*de forming the region called a **rain shadow**.



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

- **<u>Biomes-</u>** 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

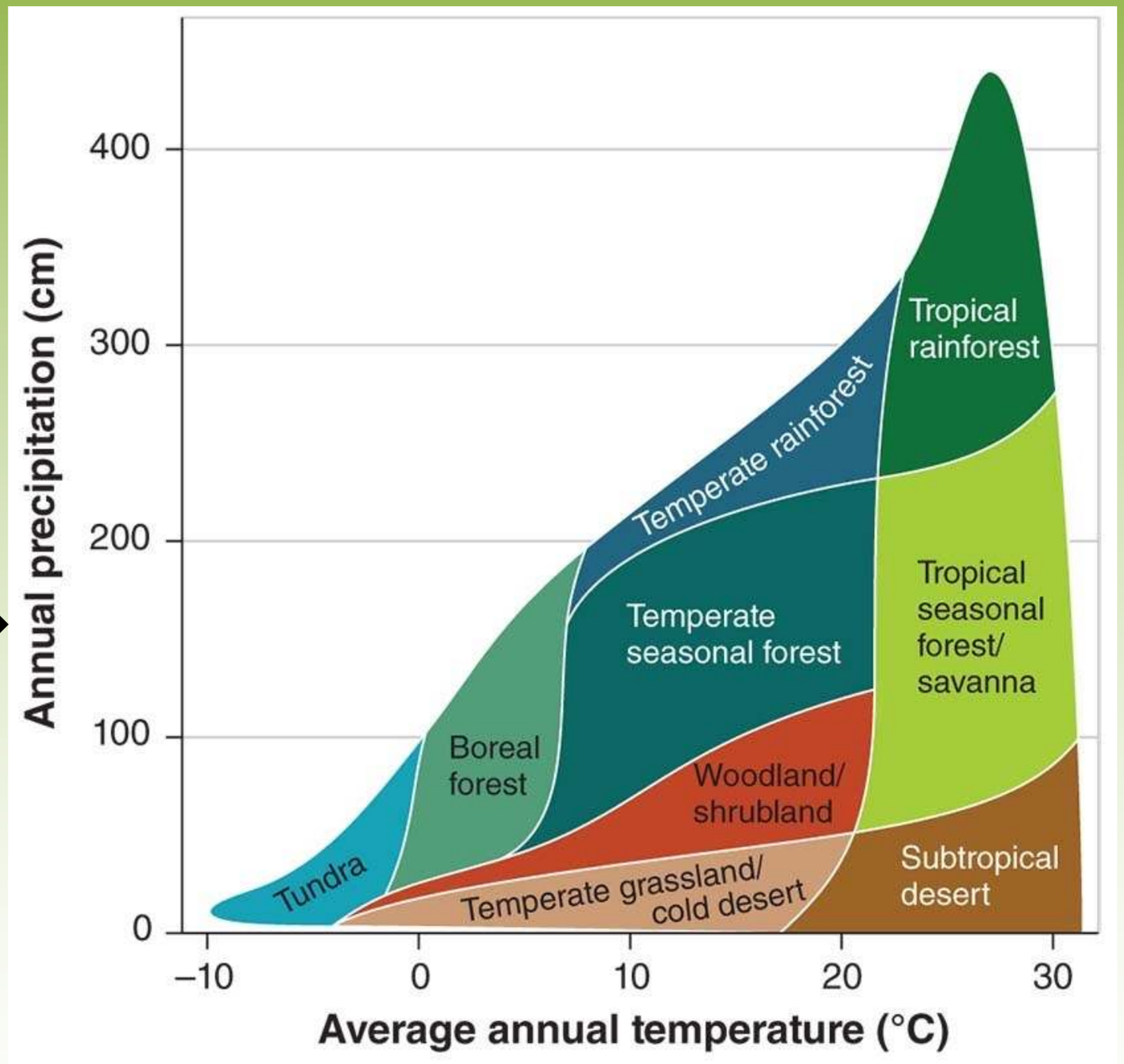


Figure 4.16
Environmental Science for AP®

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

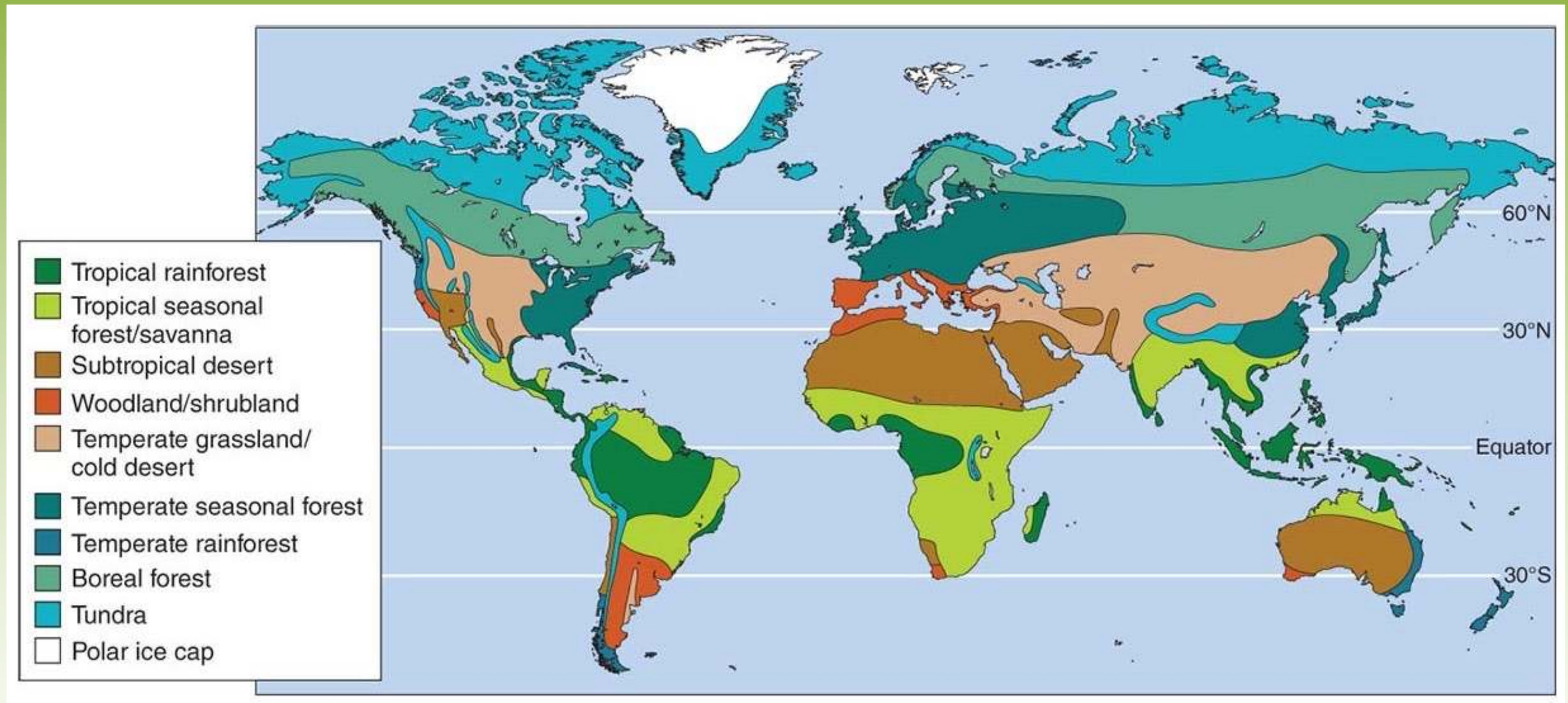
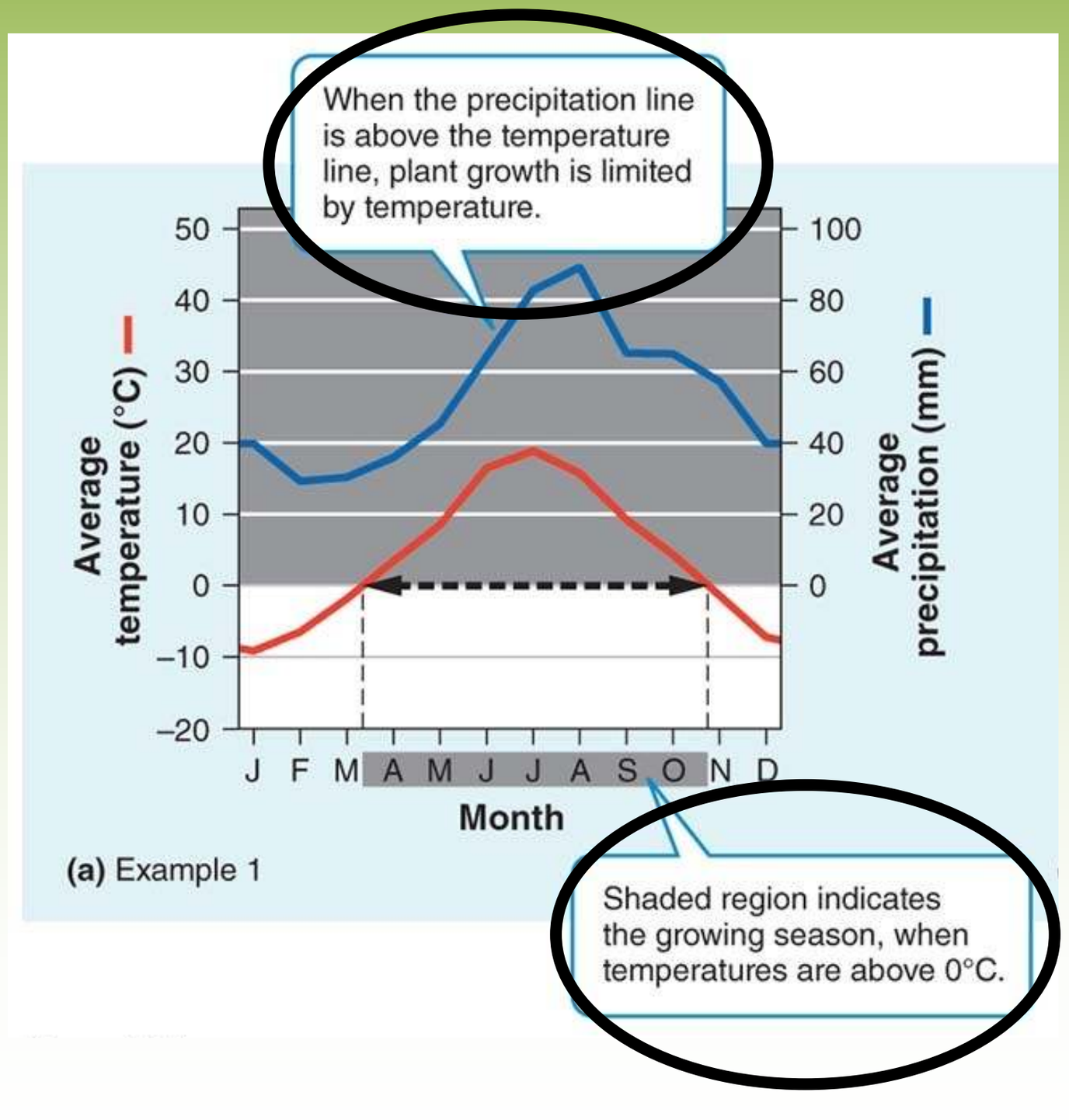


Figure 4.17
Environmental Science for AP®

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

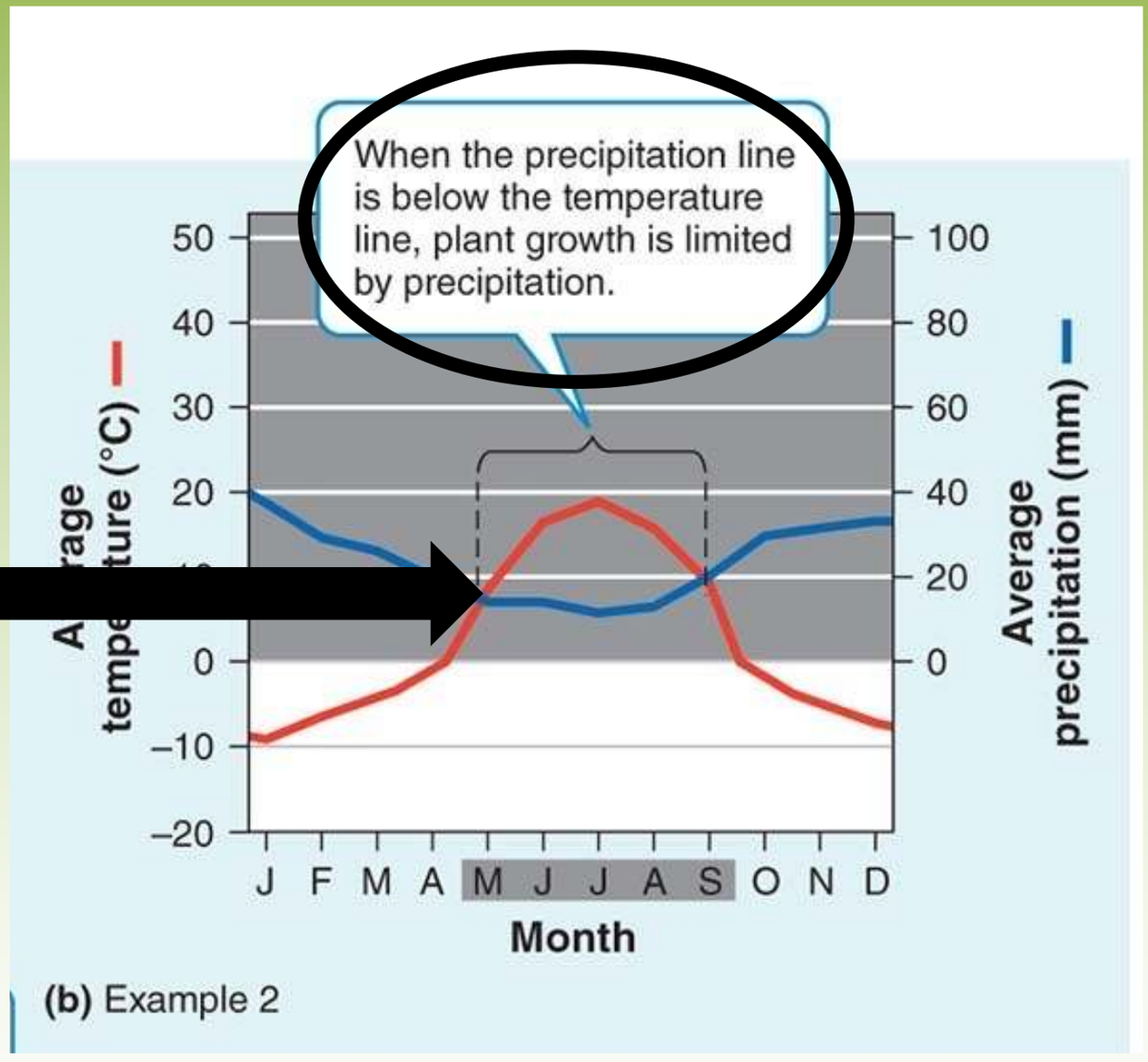
Variations in Climate Determine the Dominant Plant Growth Forms of Terrestrial Biomes

- 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*



(b) Example 2

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

- Climate diagrams help us understand human uses for biomes

- Areas with warm temperatures, long growing seasons, and abundant rainfall are highly productive and good for growing crops

- Warm regions with less abundant precipitation are good for growing grains for livestock such as cattle and sheep

- Colder regions are best used to grow forests for harvesting lumber

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

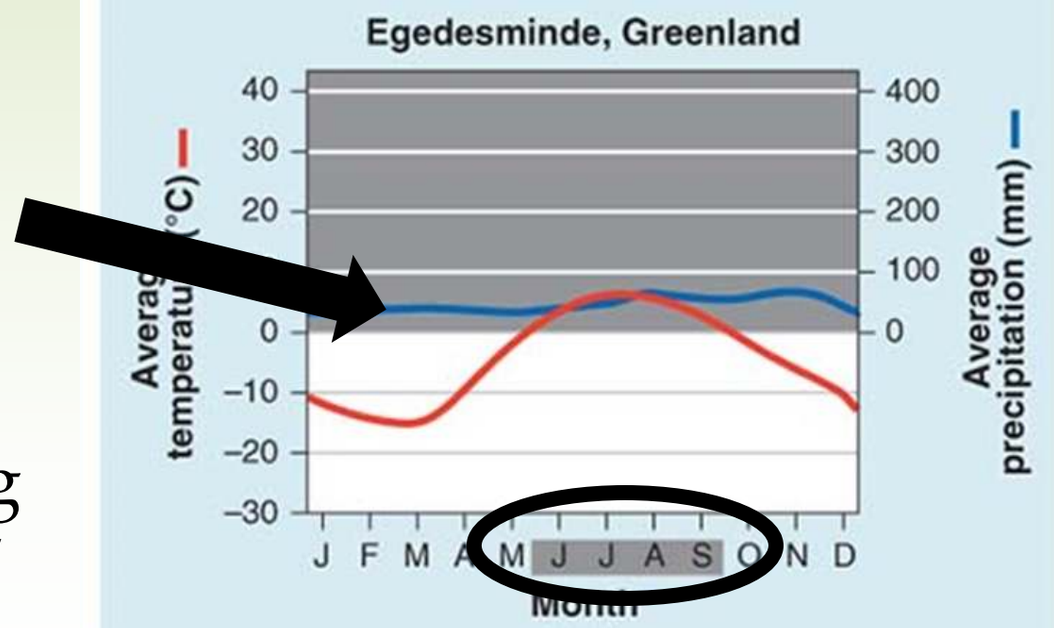
- Cold, *treeless* biome with *low-growing vegetation*. In winter, the soil is completely frozen.

- 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

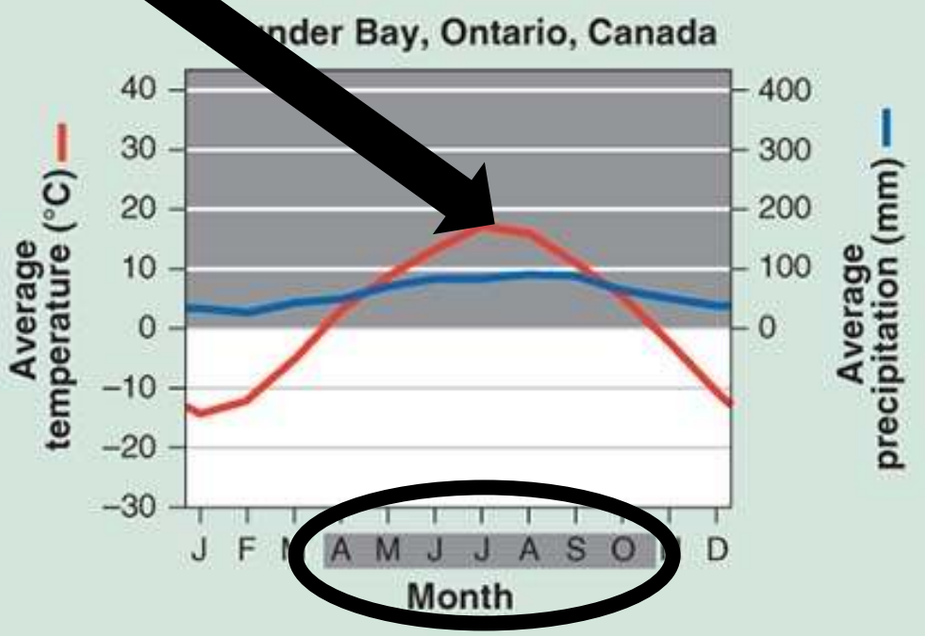
- Cold temperature *slow the rate of chemical reactions* so decomposition is slow resulting in *organic matter* in the soil, but *low levels of soil nutrients*



Tundra

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 then 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

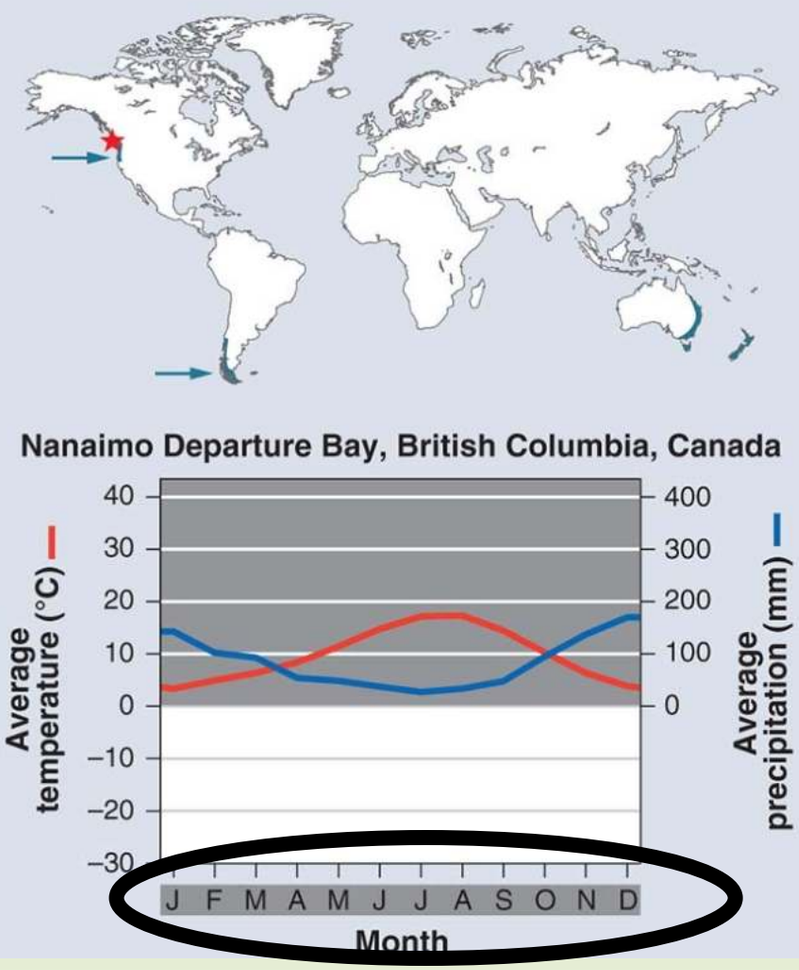
- *Moderate* temperatures and *high* precipitation typify the temperate rainforest.

- 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

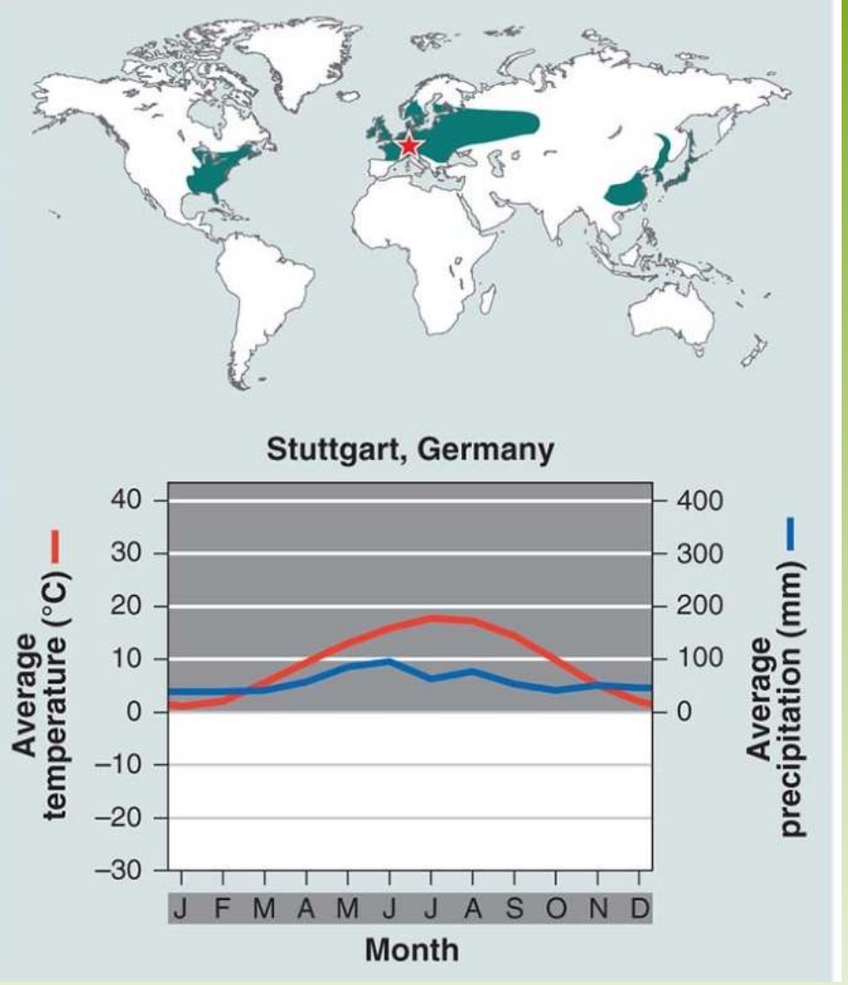
Chilliwalk River Provincial Park in British Columbia

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

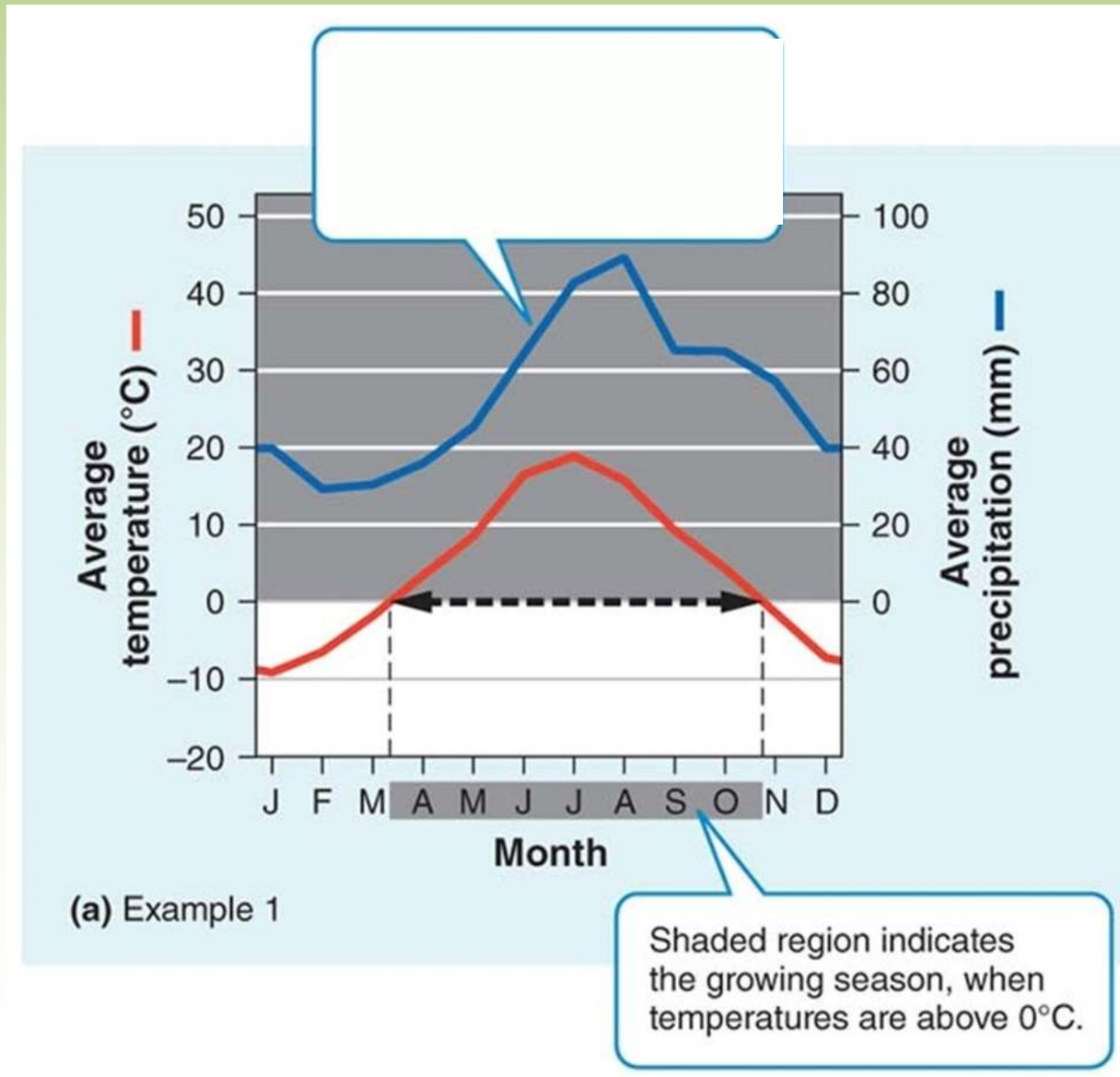
Temperate deciduous forest in the eastern United States

Agenda:

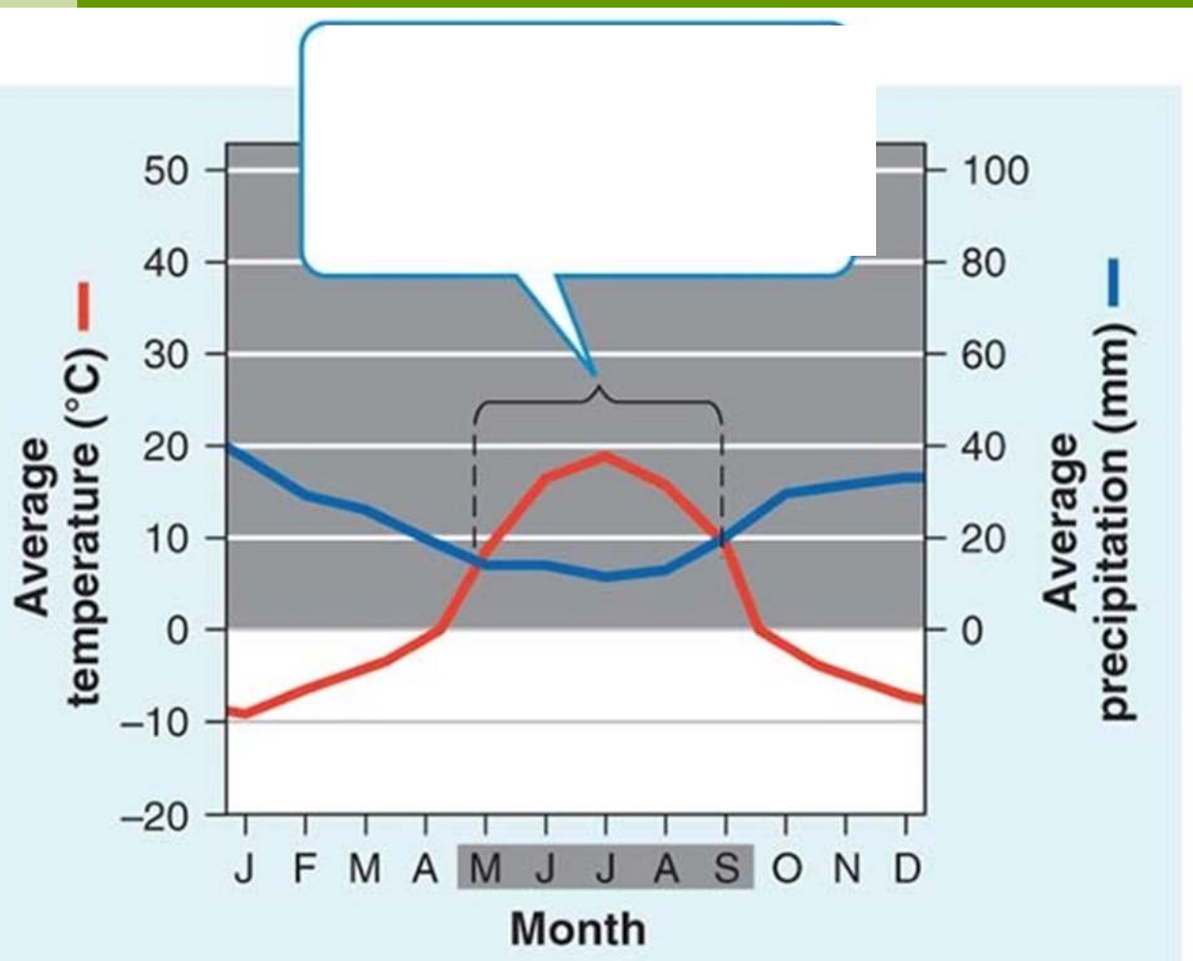
- Check pre-lab
- Review pre-lab answers
- Discuss lab procedure
- Ch. 4 notes

Bell Work

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



(a) Example 1



(b) Example 2

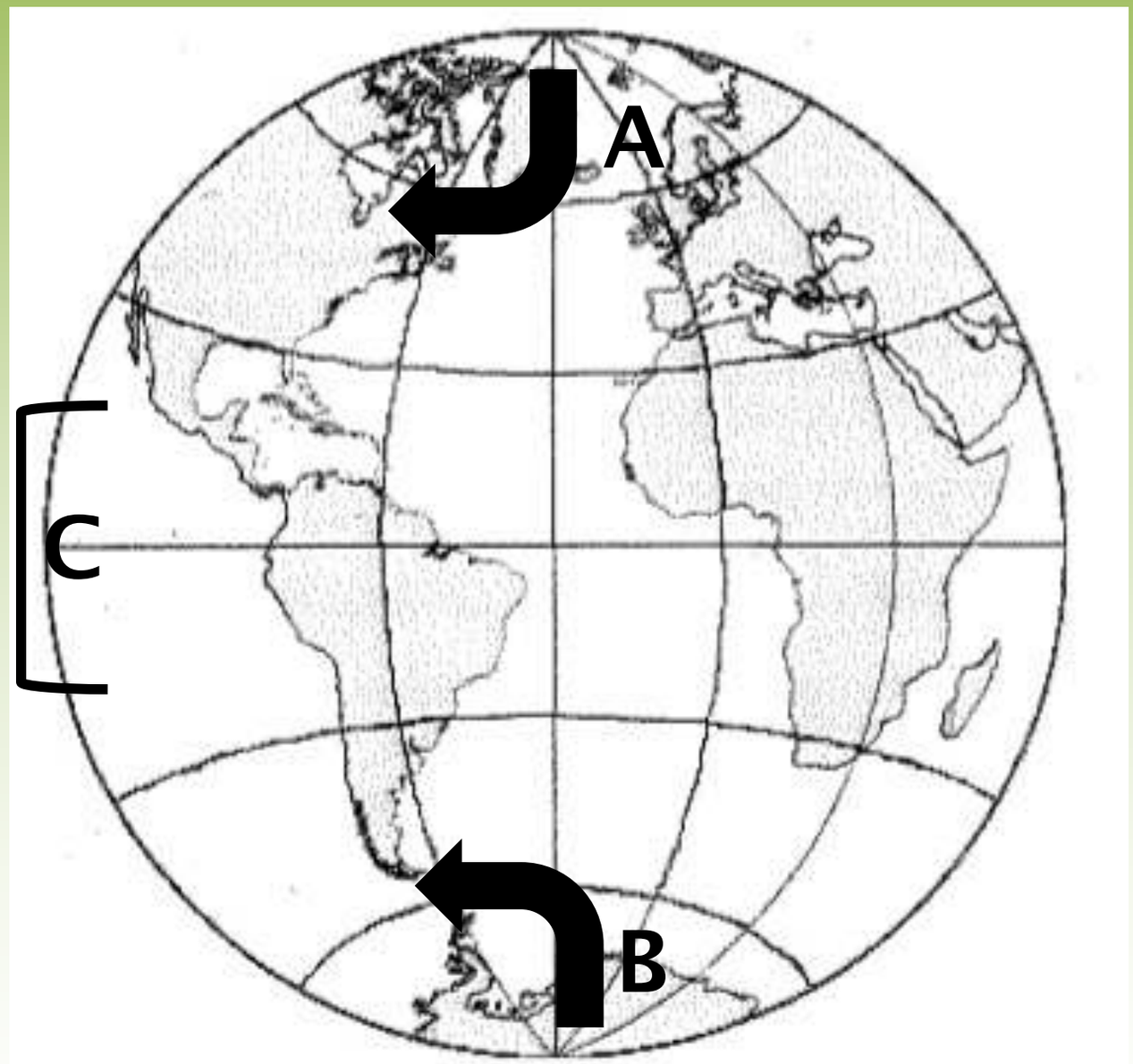
Prelab Questions

- 1. On the globe:

- a. Draw an arrow indicating the direction that the Coriolis effect would deflect an air mass moving from the North Pole towards the equator. Label the arrow “A”.

- b. Draw an arrow indicating the direction that the Coriolis effect would deflect an air mass moving from the South Pole toward the equator. Label the arrow “B”.

- c. Indicate the area(s) of the globe that are moving fastest due to the rotation of the earth on its axis. Label the area(s) “C”.



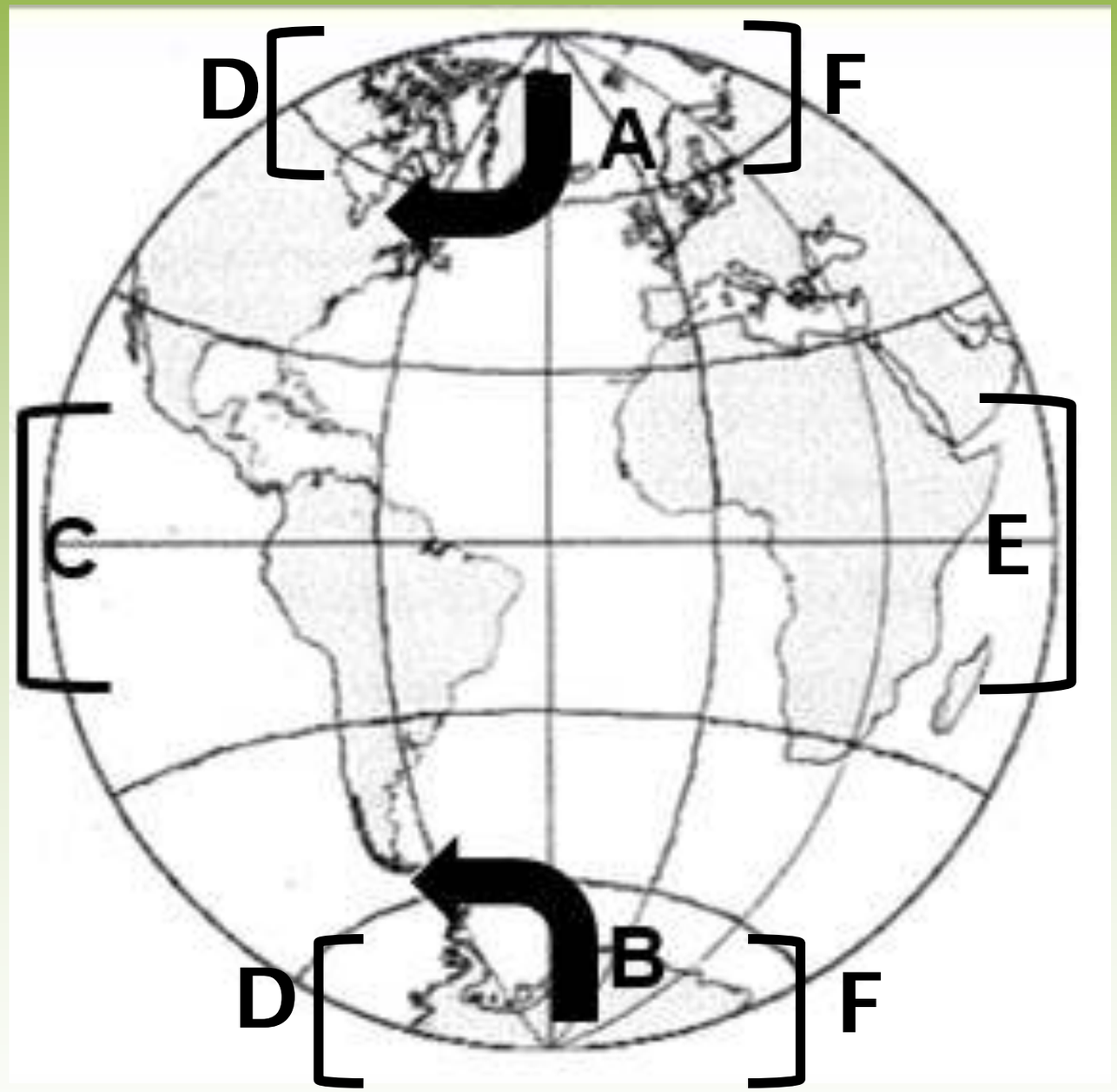
Prelab Questions

- 1. On the globe:

- d. Indicate the area(s) of the globe that are moving slowest due to the rotation of the earth on its axis. Label the area(s) “D”.

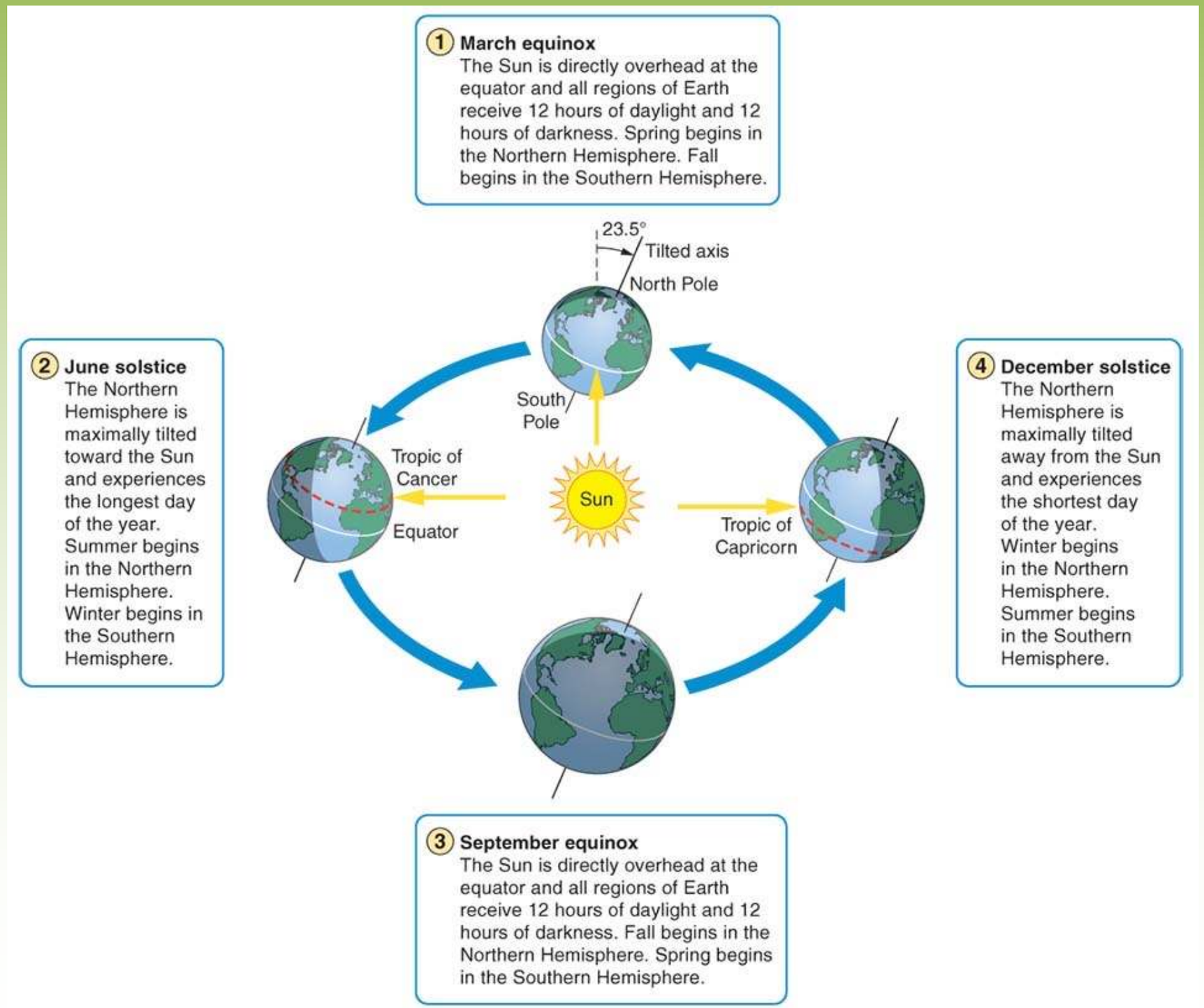
- e. Indicate the area(s) of the globe that typically receive more of the sun’s energy. Label the area(s) “E”.

- f. Indicate the area(s) of the globe that typically receive less of the sun’s energy. Label the area(s) “F”.



Prelab Questions

2. Describe the differences in the seasons between the Northern an Southern Hemispheres due to the tilt of the earth and its orbit around the sun.



Woodland/Shrubland

- Found on the coast of southern California, southern Australia, southern Africa and in the area surrounding the Mediterranean Sea.

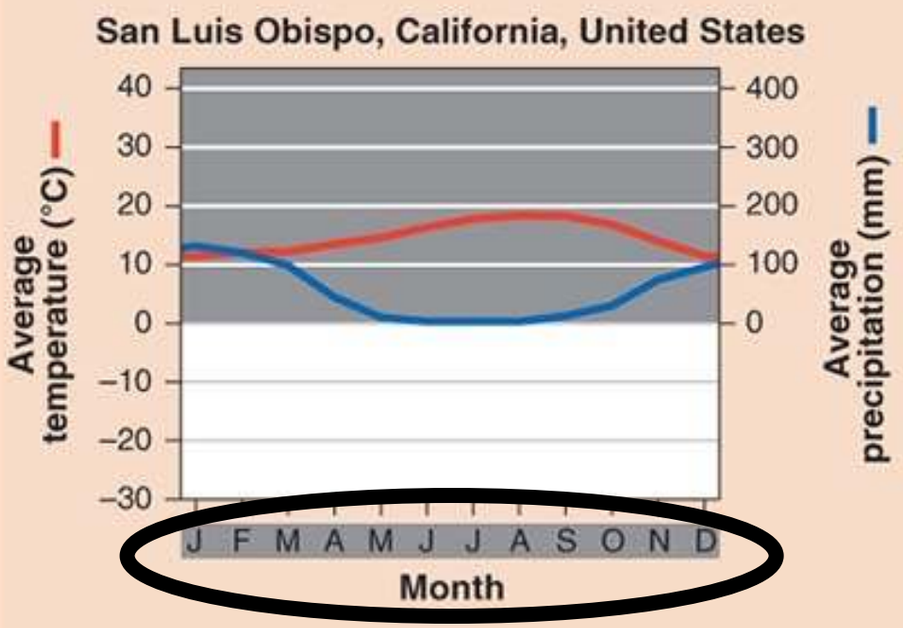
- *Hot, dry summers* and *mild, rainy winters* are characteristic of this biome.

- 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

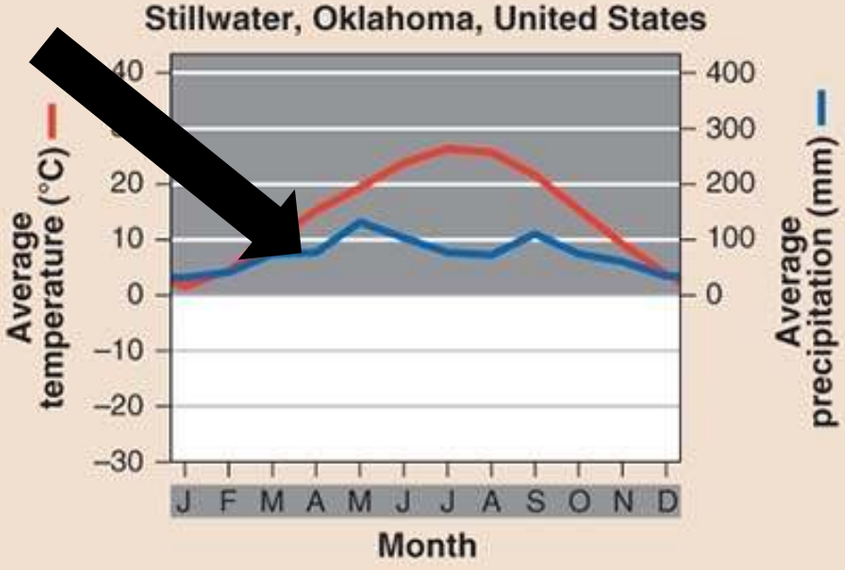


Woodland/Shrubland

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

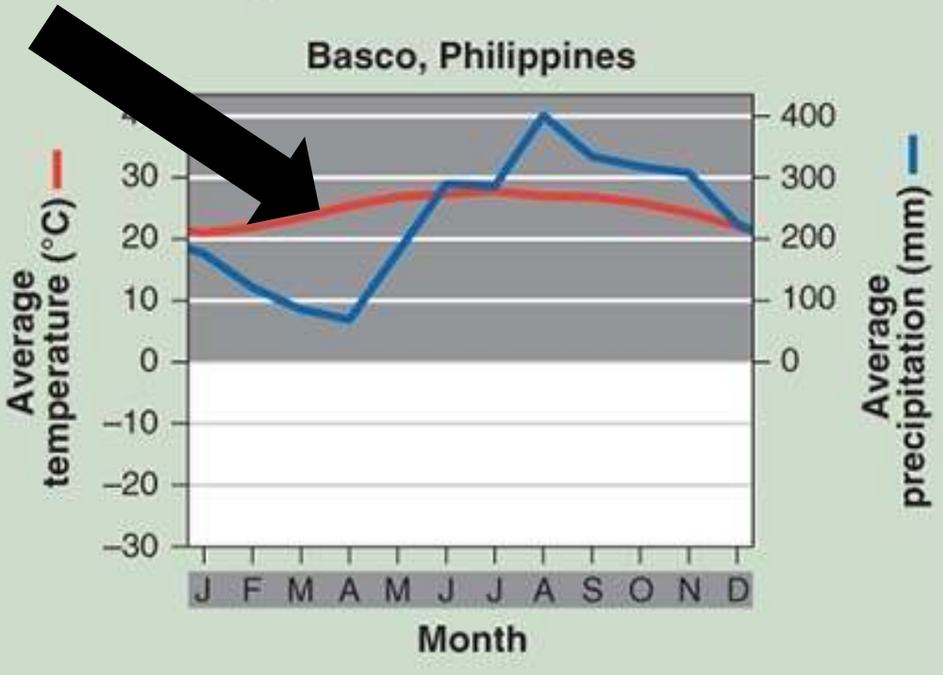


Temperate Grassland/Cold Desert

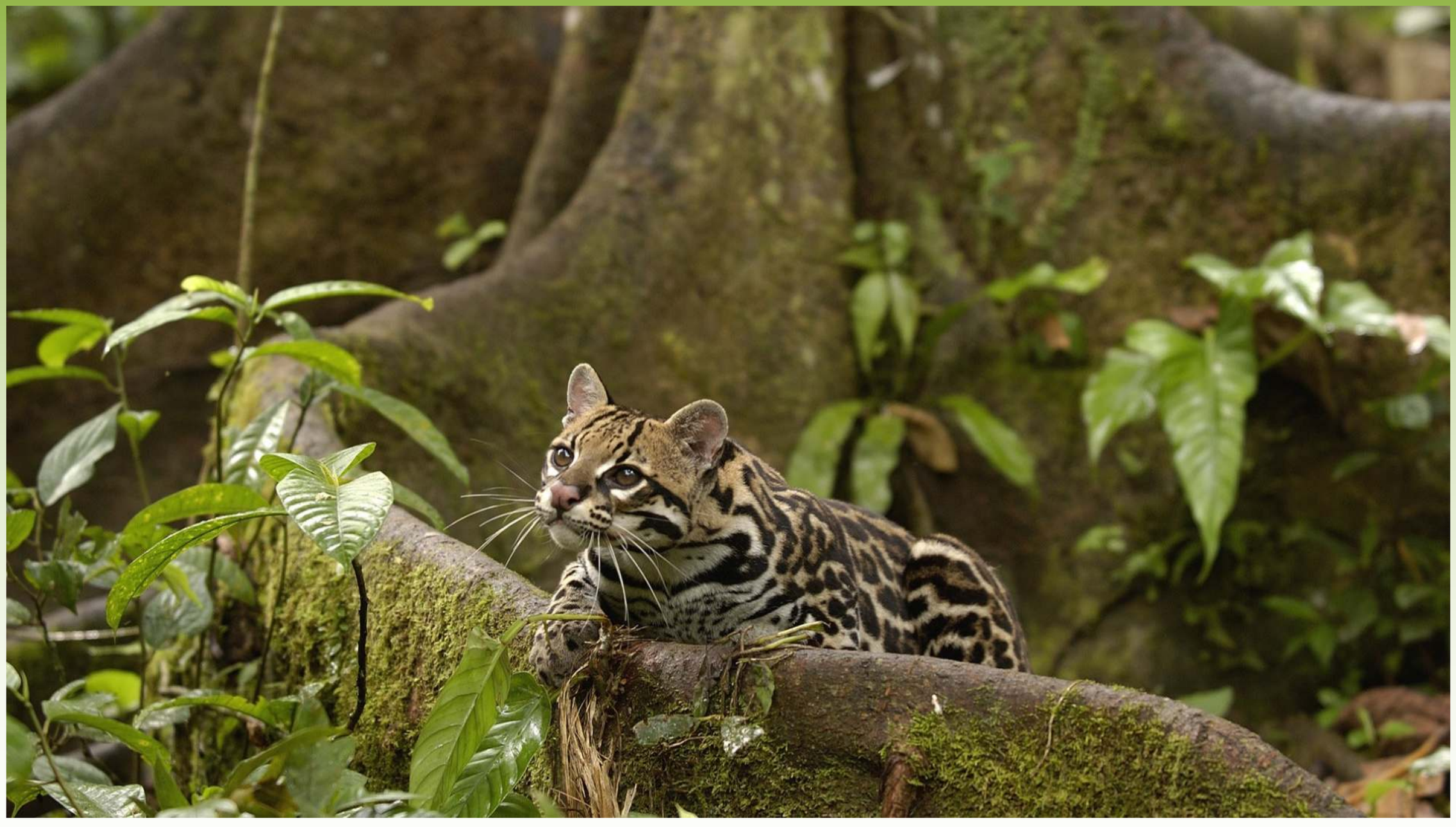
Tallgrass Prairie Nature Preserve in Osage County, Oklahoma

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

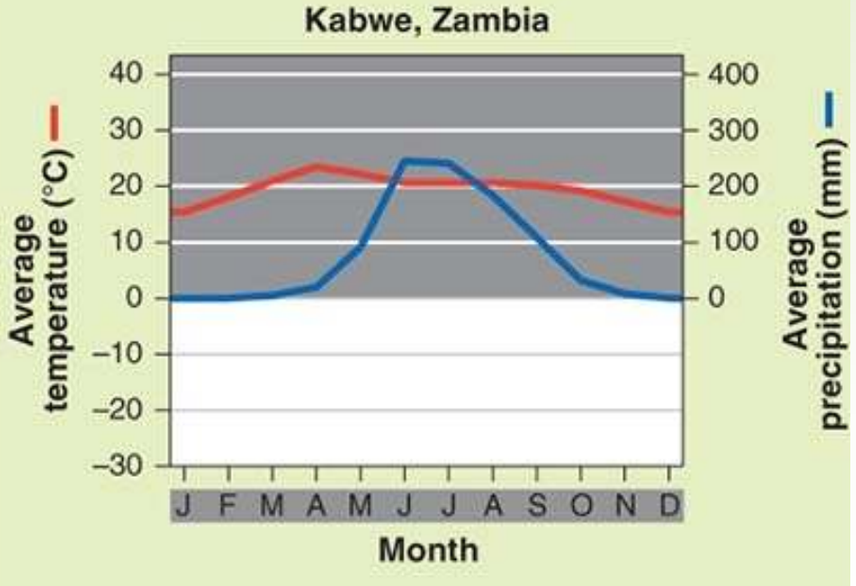
- *Warm temperatures* and *distinct wet and dry seasons* characterize this biome and are caused by the ITCZ

- **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

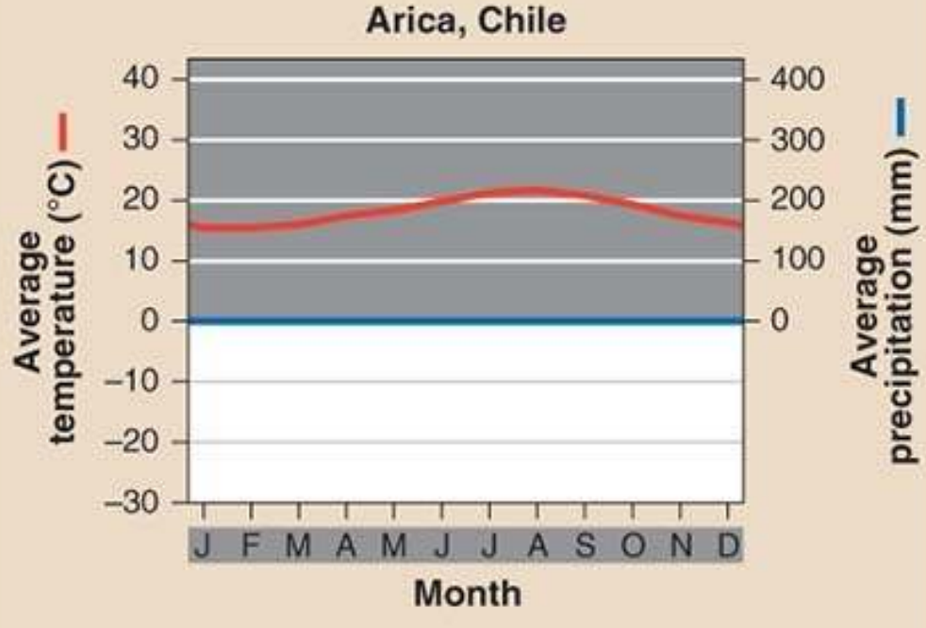
- This biome is found at 30° N and S with hot temperatures and *extremely dry conditions*.

- 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

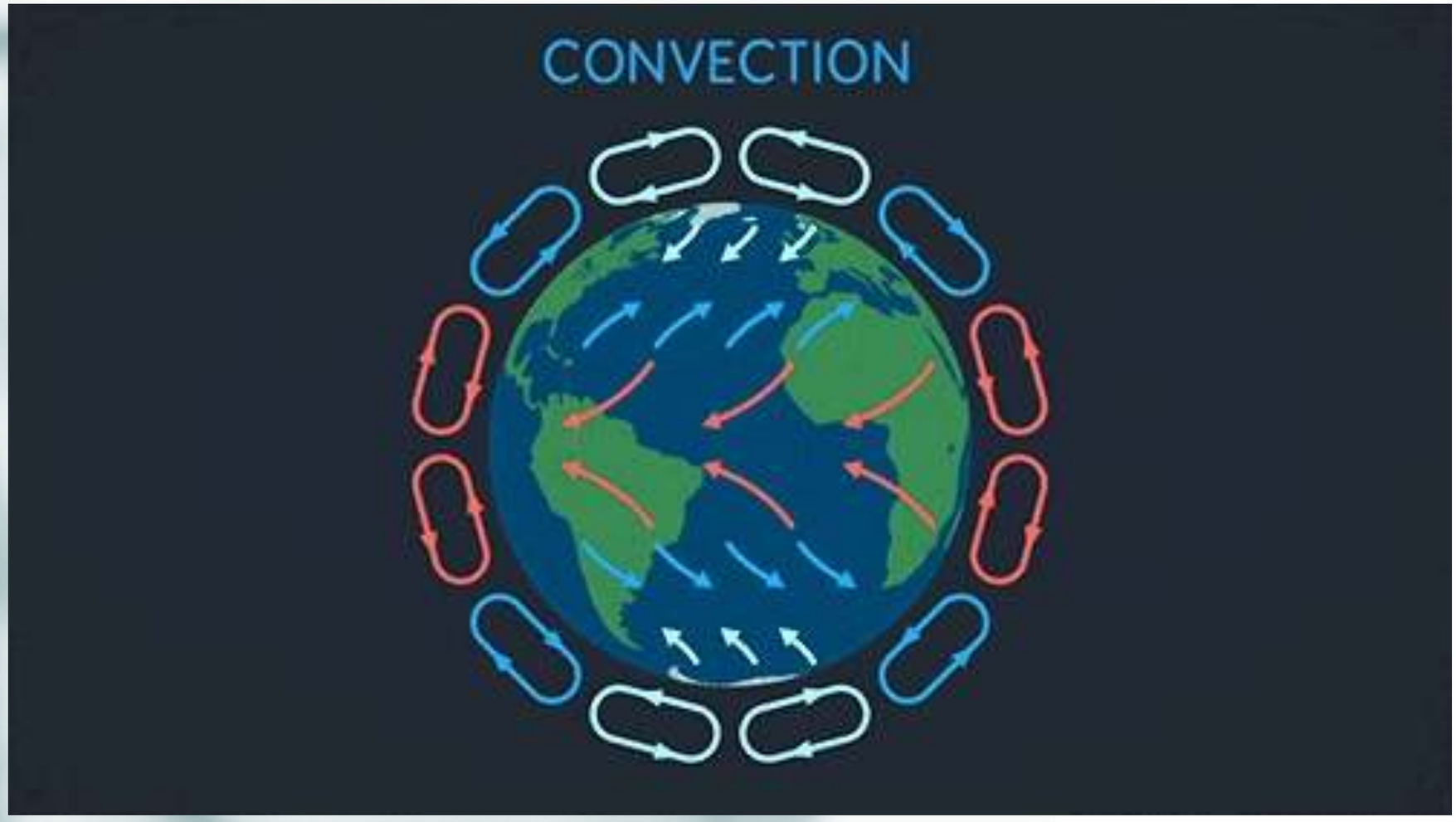
Mohave desert in Northern Arizona

Agenda:

- **LAB DAY!!!**
- **Class time to work on HW**

Bell Work

Finish Coriolis lab!!!



CORIOLIS EFFECT AND ATMOSPHERIC CIRCULATION

AP ENVIRONMENTAL SCIENCE

Lab Groups!


EVERY GROUP PROJECT
DOES 99% OF THE WORK
HAS NO IDEA WHAT'S GOING ON THE WHOLE TIME
SAYS HE'S GOING TO HELP BUT HE'S NOT
DISAPPEAR AT THE VERY BEGINNING AND DOESN'T SHOW UP AGAIN TIL THE VERY END
IN SCHOOL YOU HAVE EVER DONE
WeKnowMemes

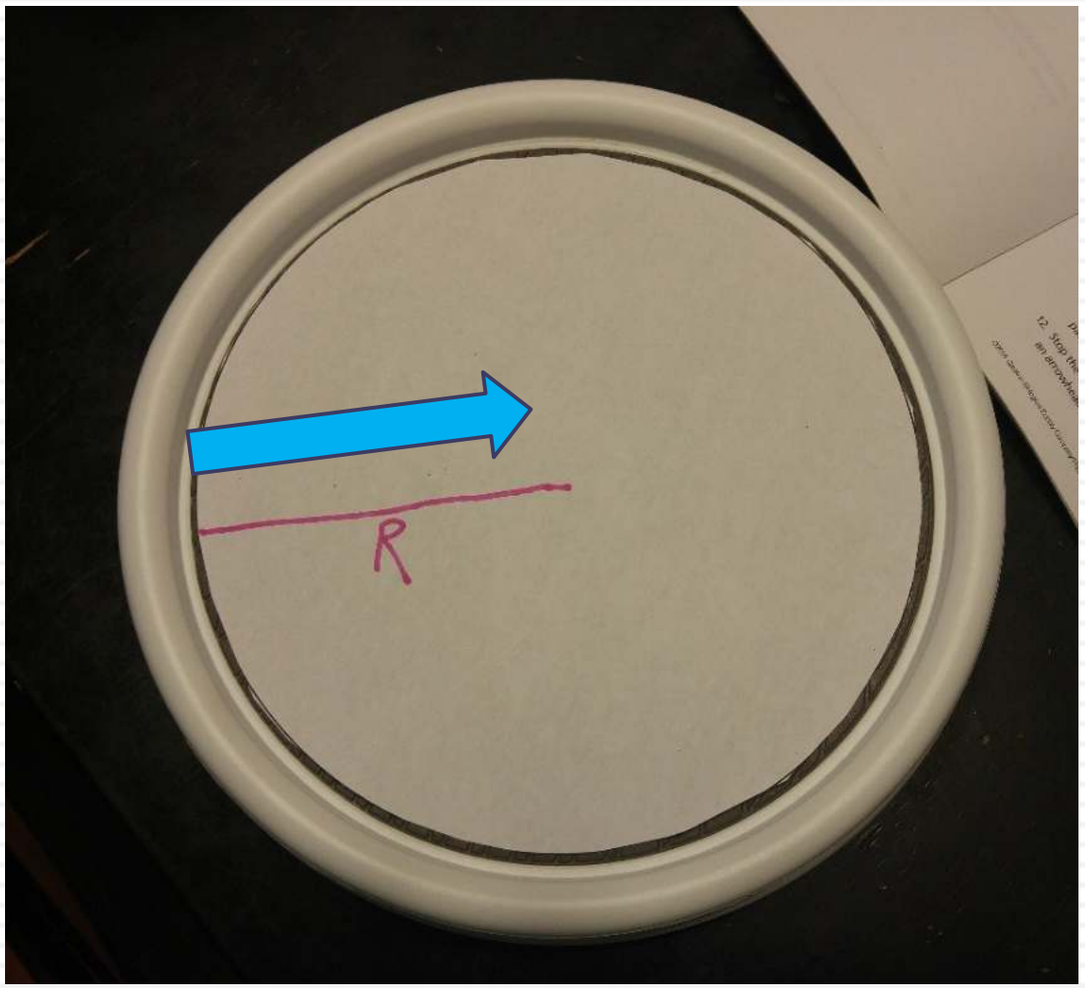
Materials per group:

- Turn table
- Turn table template
- 100 mL beaker X1
- 100 mL beaker with 80 mL ice water X1
- 100 mL beaker with warm water X1
- Blow up globe
- Dry erase marker
- Clorox wipes

Methods:

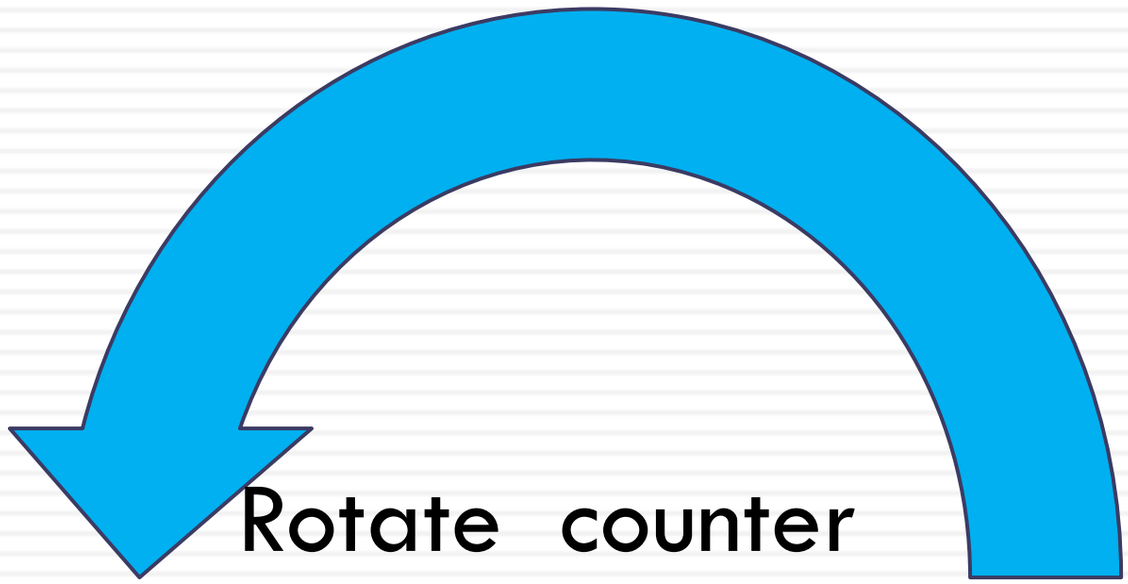
Not this kind!

- **Turntable:**
  1. Cut circle from template
  2. Place paper on turn table
  3. Hold ***stationary*** and draw a strait line from the ***edge of the turn table to the center*** and label “R” for reference line

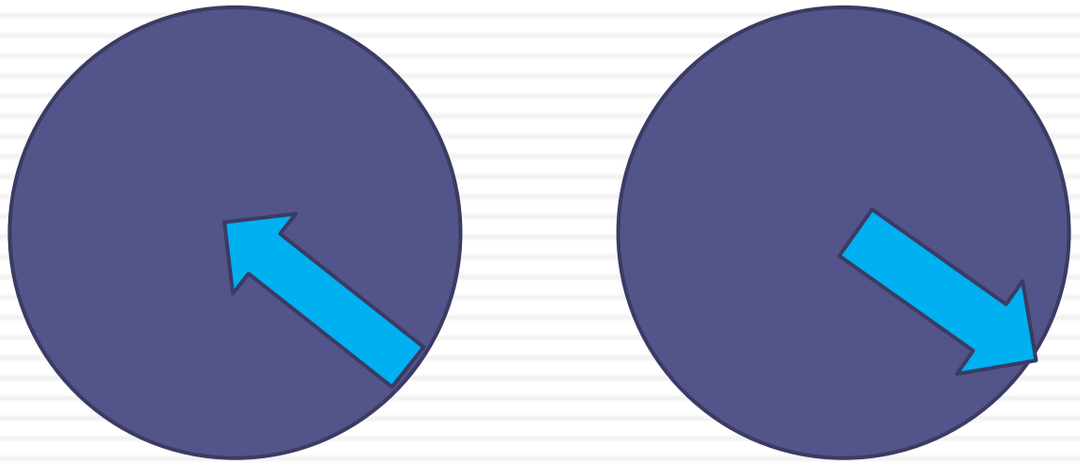


Methods

- **Turntable:**
  4. Do the same thing while the turn table is being rotated ***counter clockwise***
  5. Label this line “1CCW” for trial one counter clockwise
  6. Repeat but draw the line from center to edge and label next line “2CCW” for trial 2 counter clockwise
  7. Draw an arrow head at the end of each line for directional reference



Rotate counter clockwise!!!

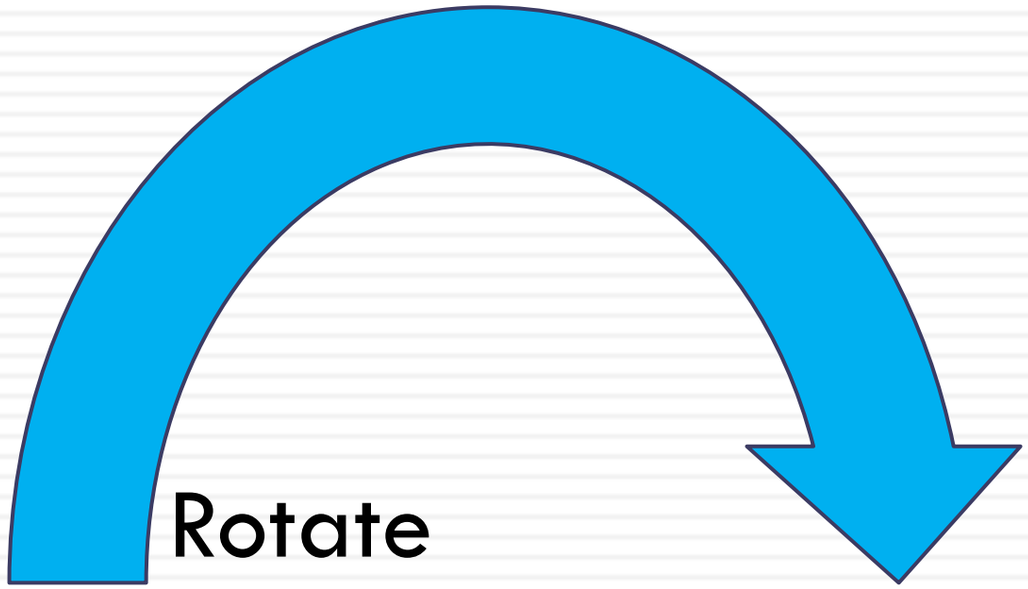


1 CCW - draw line from edge to center

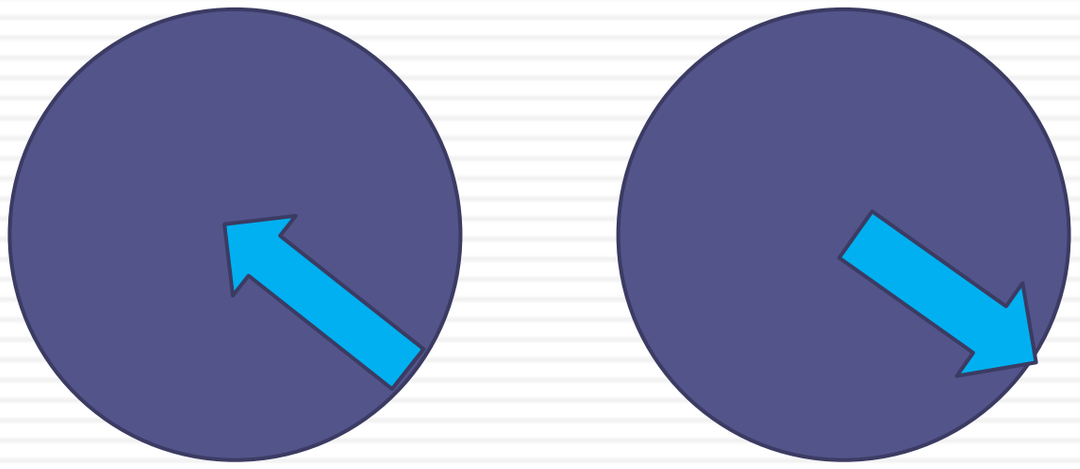
2 CCW – draw line from center to edge

Methods:

- **Turntable:**
  8. Repeat the entire procedure ***two more*** times while rotating the turn table ***clockwise***
  9. Label the next 2 lines “1CW” for trial 1(edge to center) clockwise and “2CW” for trial 2 clockwise (center to edge)
  10. Draw an arrow head at the end of each line for directional reference
  11. ***Save your template*** (for answers to lab questions #1 and 2)



Rotate clockwise!!!

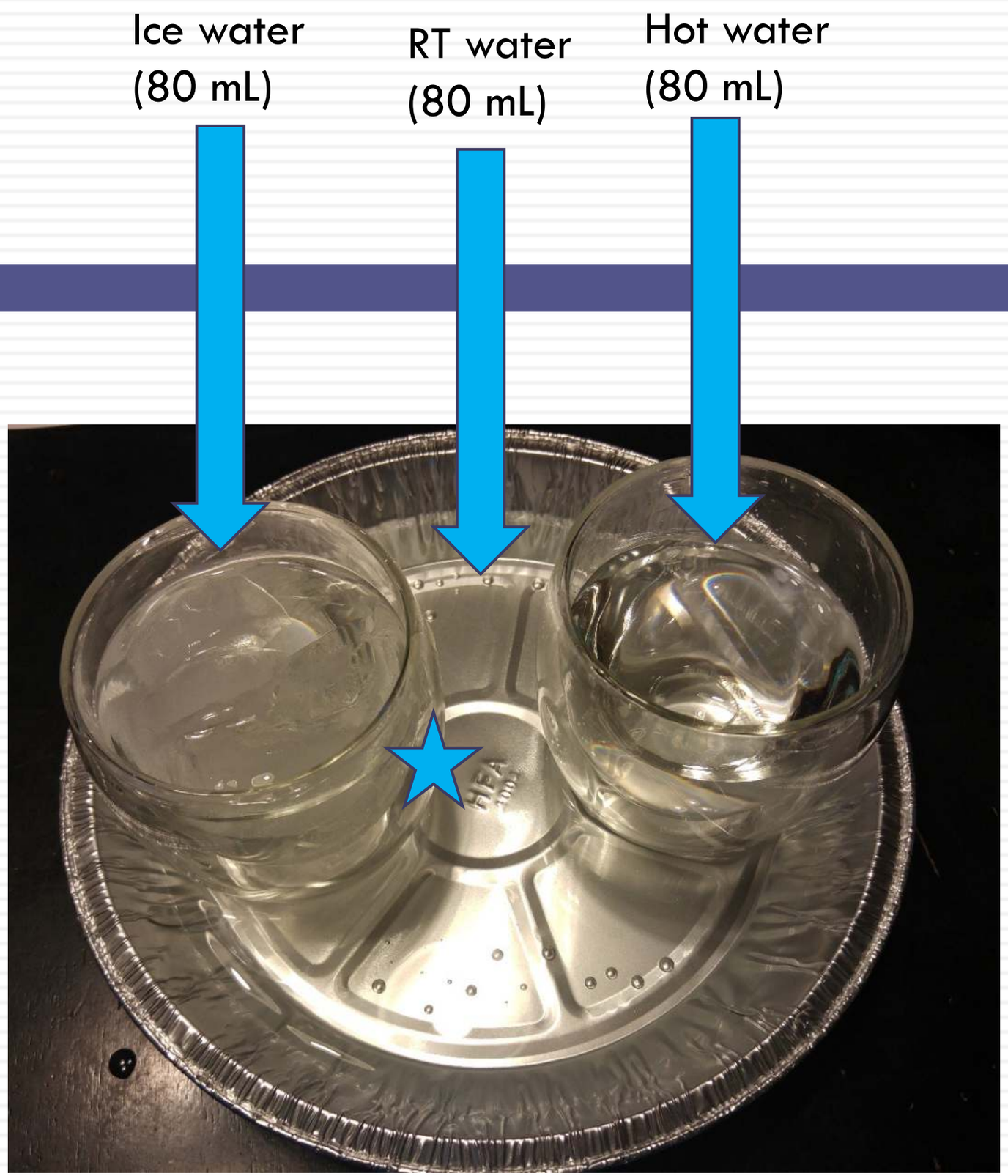


1 CW - draw line from edge to center

2 CW – draw line from center to edge

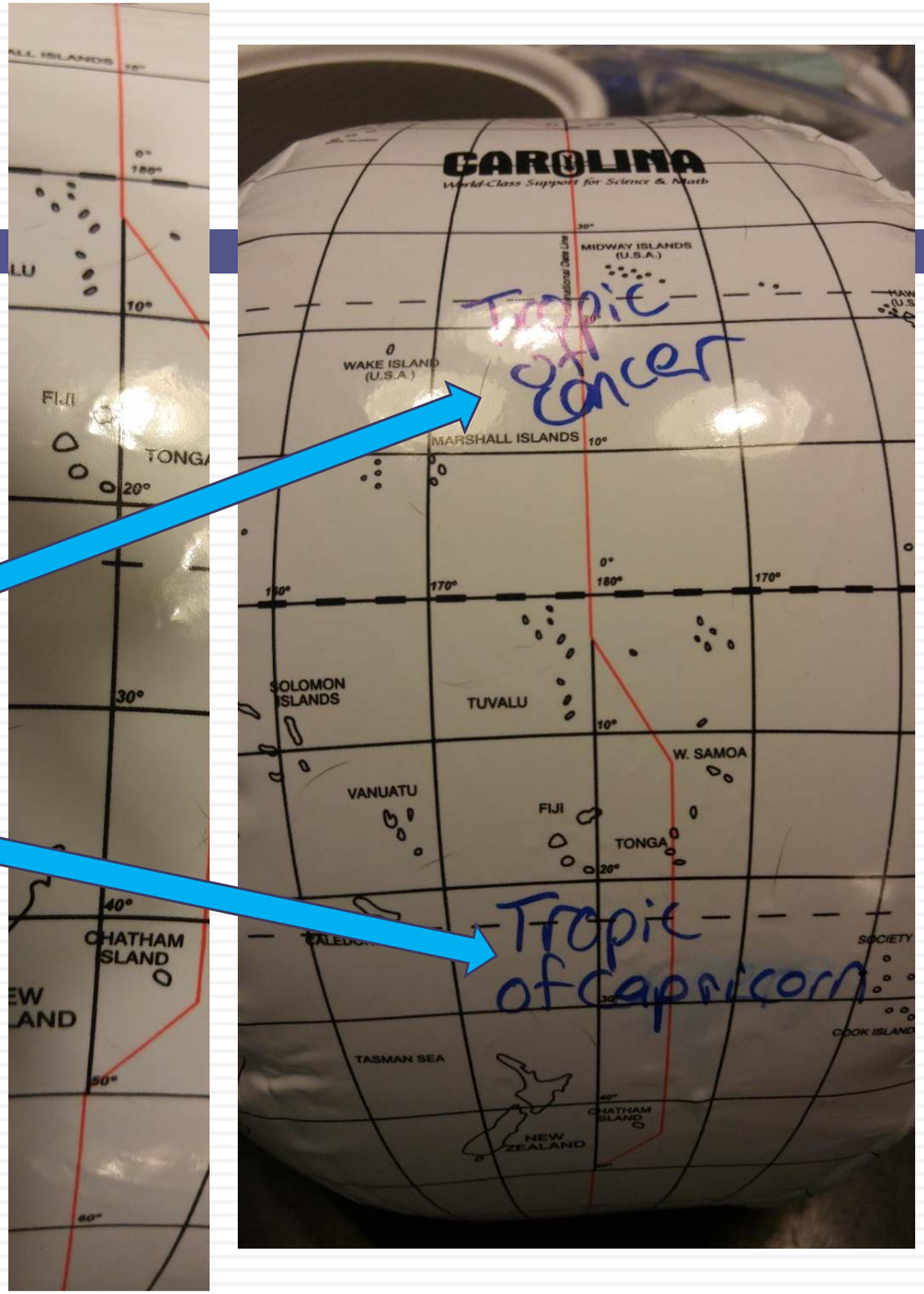
Methods:

- **Fluid Convection:**
  1. Fill the empty beaker with 80 mL of ***room temperature water*** and add it to the aluminum ***pan***
  2. Place the ***beaker of ice water*** on ***one side of the pan***
  3. Place the ***beaker of hot water*** on the ***other side of the pan***
  4. Place ***1 – 2 drops of chilled food coloring*** in the water ***in the pan*** at the ***base of the beaker of ice water***
  5. ***Observe the movement of the food coloring and observe the convection currents*** (record in lab questions #3 – 6)



Methods:

- **Globe:**
  1. Locate the following lines on the globe:
     a. ***Tropic of Cancer*** (23.5° N)
     b. ***Tropic of Capricorn*** (23.5° S)
     c. ***Artic Circle*** (66.5° N)
     d. ***Antarctic Circle*** (66.5° S)

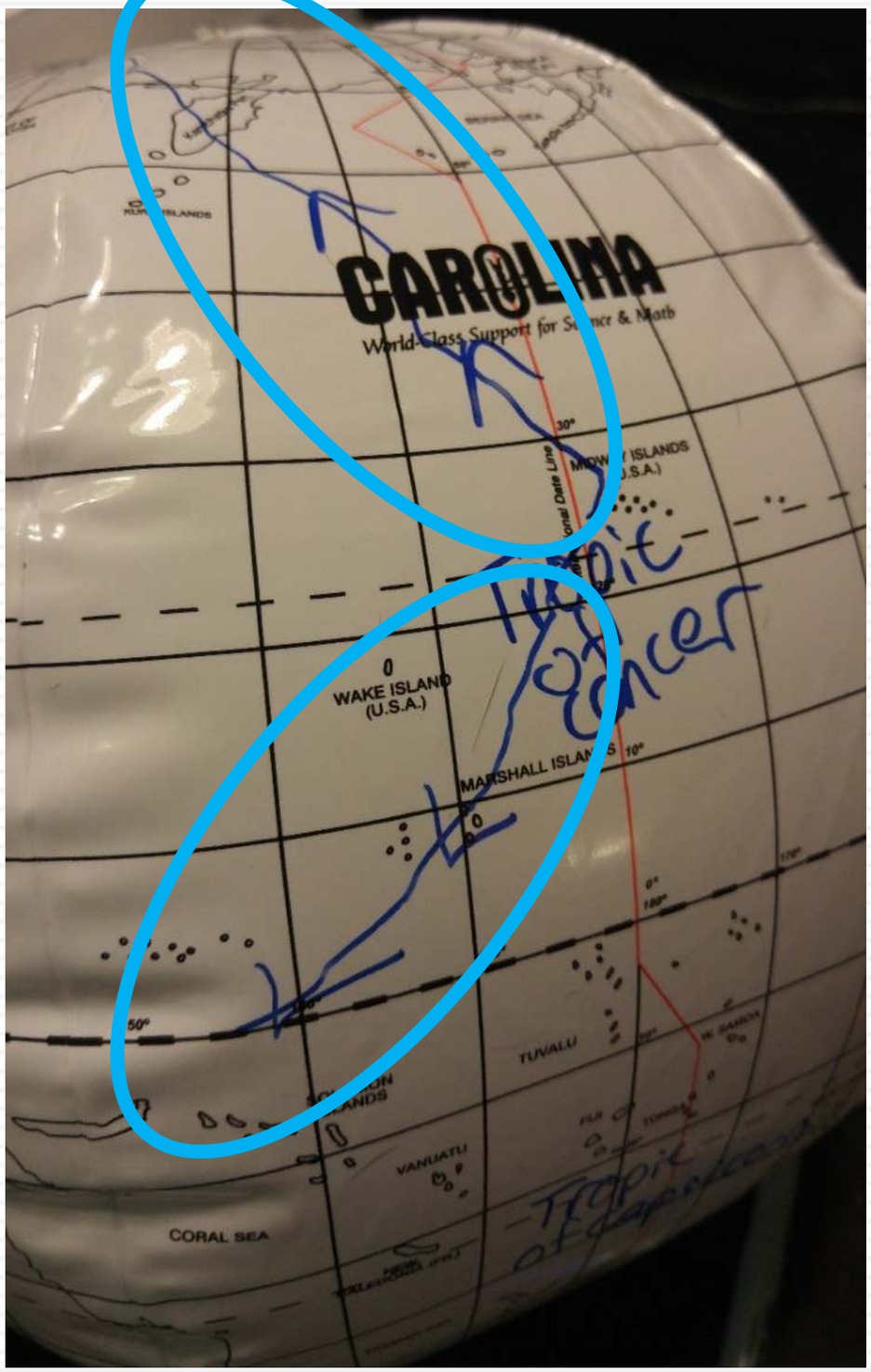


Methods:

USE DRY ERASE MARKERS!!!!!

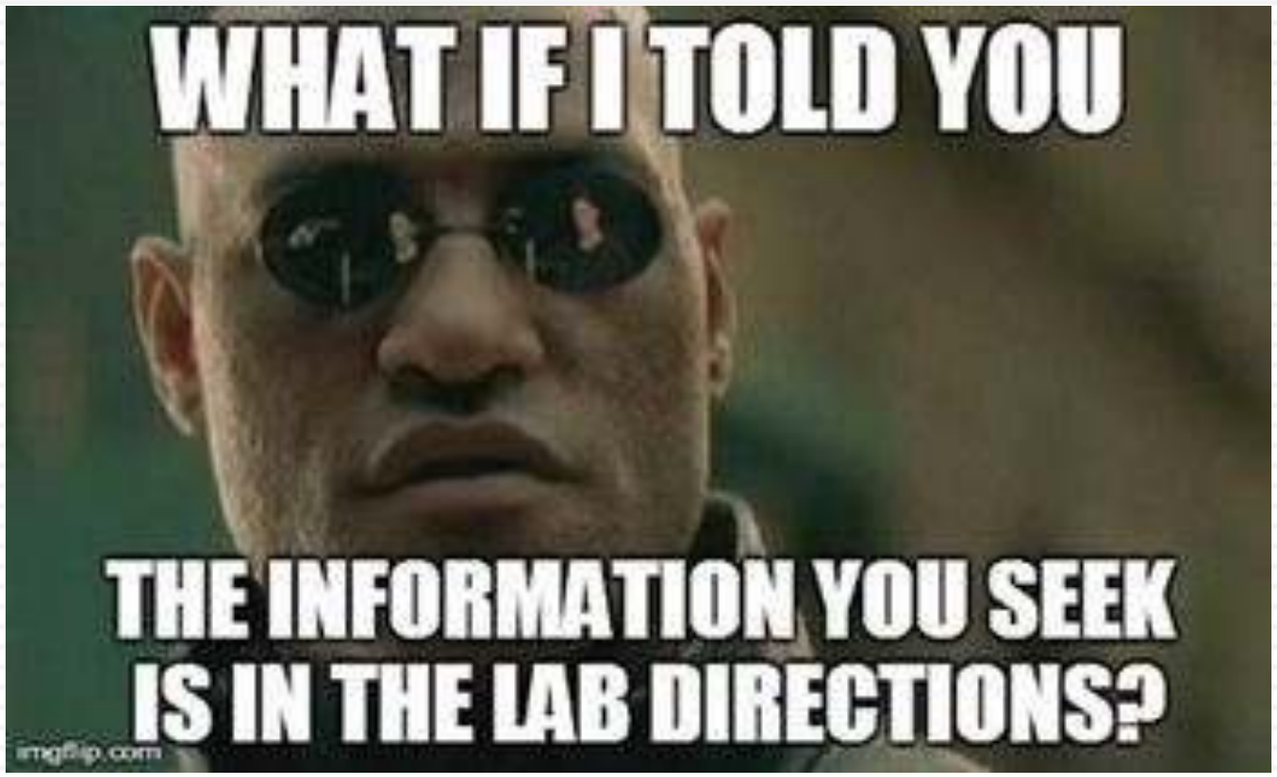
Rotate counter clockwise!!

- **Globe:**
  2. Rotate ***counter clockwise*** and draw a line from the ***tropic of cancer*** to the ***artic circle***
  3. Rotate ***counter clockwis***e and draw a line from the ***tropic of cancer*** to the ***equator***
  4. Rotate ***counter clockwis***e and draw a line from the ***tropic of Capricorn*** to the ***equator***
  5. Rotate ***counter clockwis***e and draw a line from the ***tropic of cancer*** to the ***Antarctic circle***
  6. Rotate ***counter clockwis***e and draw a line from the ***South Pole*** to the ***Antarctic circle***
  7. ***Answer Lab question #7***
  8. Use a Clorox wipe to clean off the globe



Methods:

- **Wrap up:**
  1. Clean up your area and return equipment where you got it!
  2. You will have the remaining class time to work on the lab questions and discussion questions
  3. There is ***NO*** data table and ***NO*** graphs or this lab!!!



Aquatic Biomes

- Categorized by *salinity*, *depth*, and *water flow*

- Two broad categories:

1. **<u>Freshwater biomes</u>**: streams, rivers, lakes, and wetlands

2. **<u>Saltwater biomes</u>**: shallow marine areas such as estuaries and coral reefs as well as the open ocean

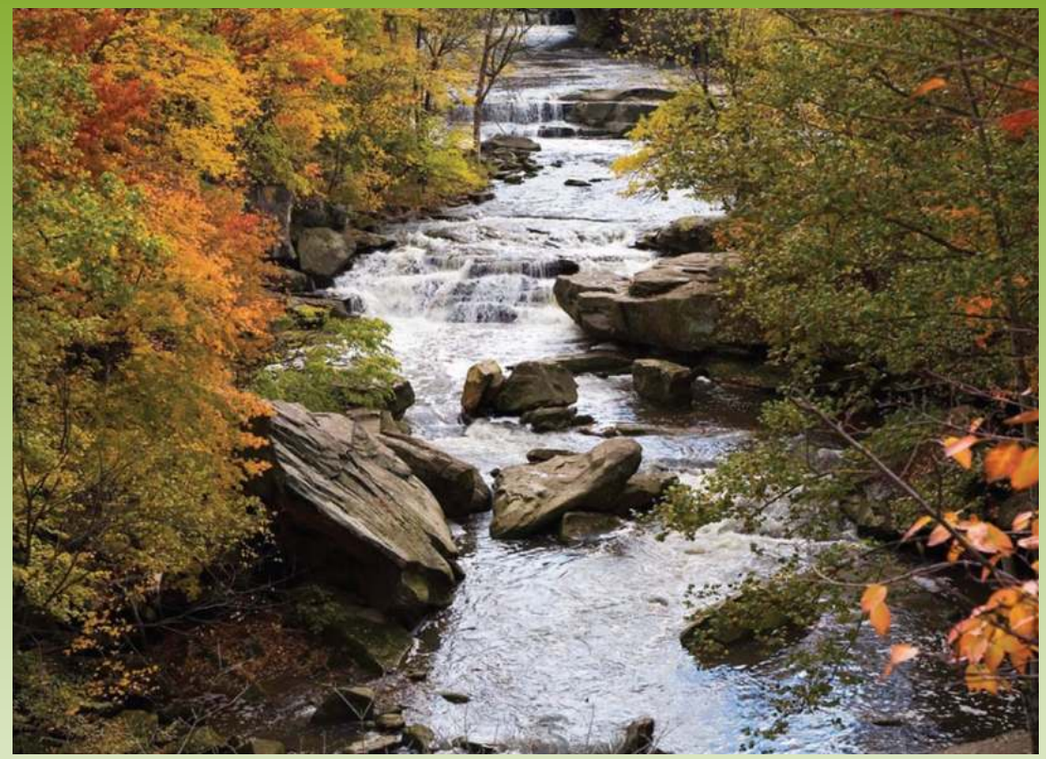
- *Temperature* is an important factor in determining which species can live in a particular aquatic habitat, but is not used as a *determining factor* for biome categorization

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

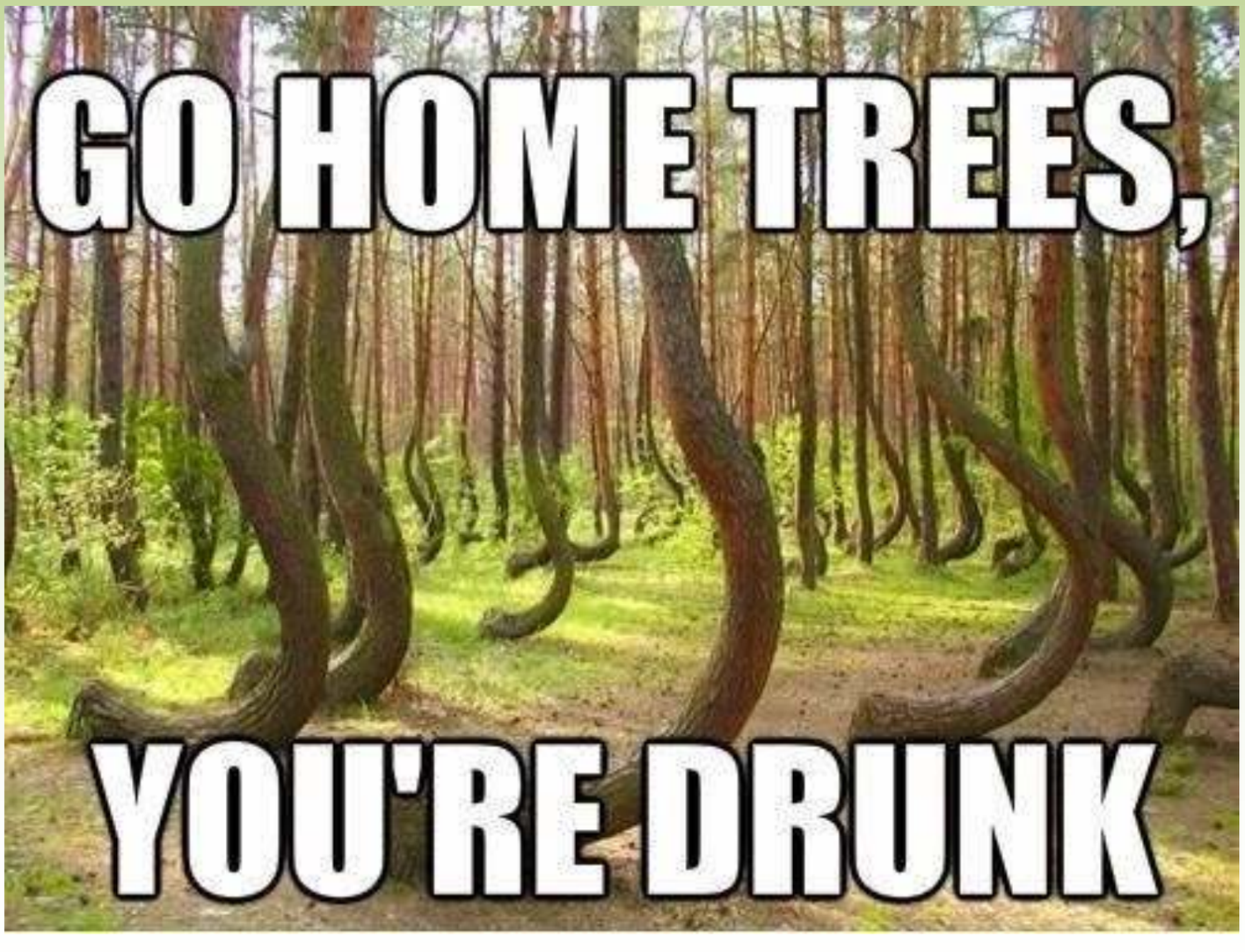
- *Standing water* that some of which is *too deep* to support emergent vegetation.

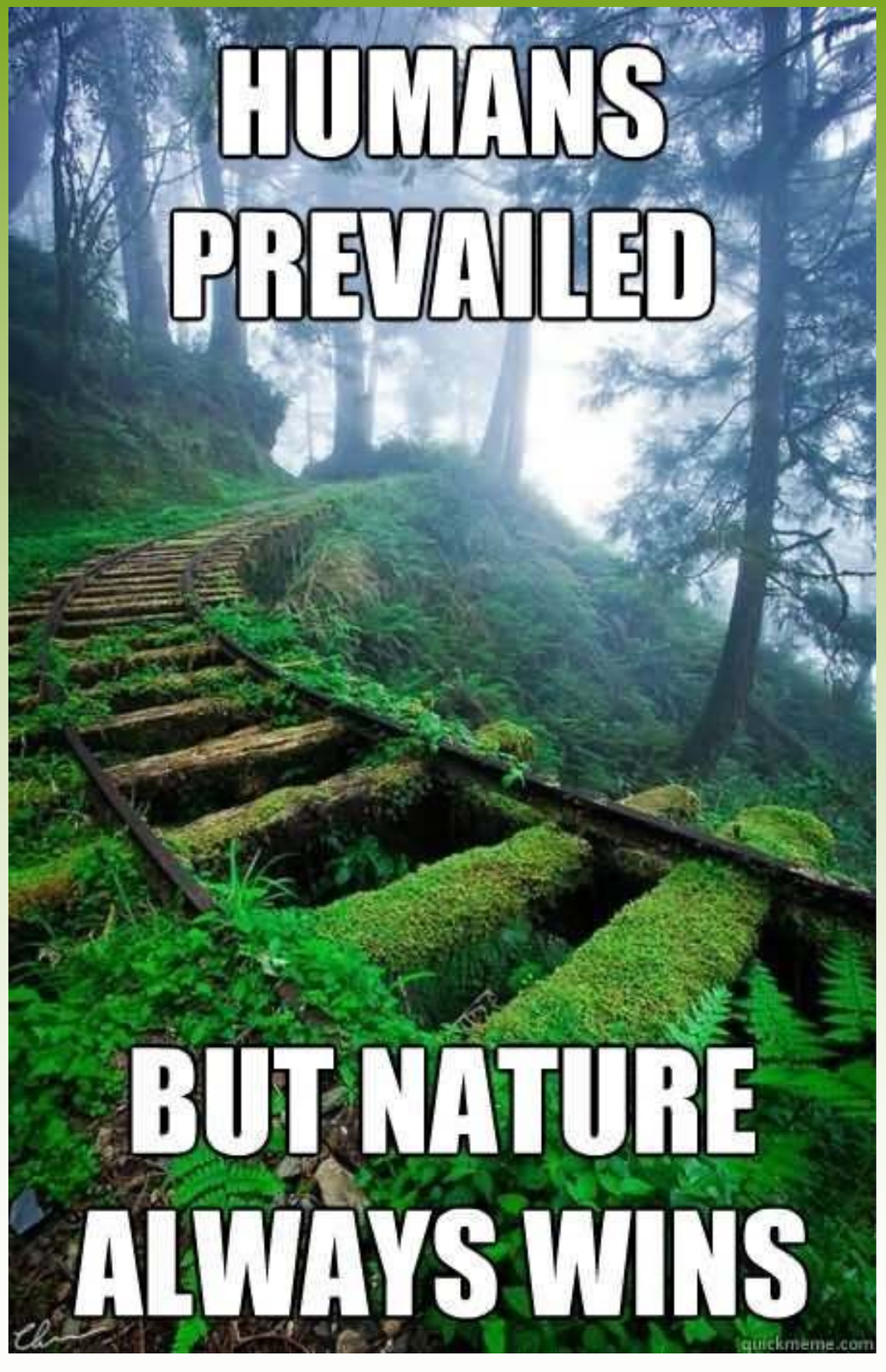
- Lakes are *large*r than ponds but there is *no clear point* at which a pond is considered large enough to be called a lake.

- Lakes and ponds can be divided into several *distinct zones*

Agenda:

- Ch. 4 notes
- Class time to work on the lab (due Monday)





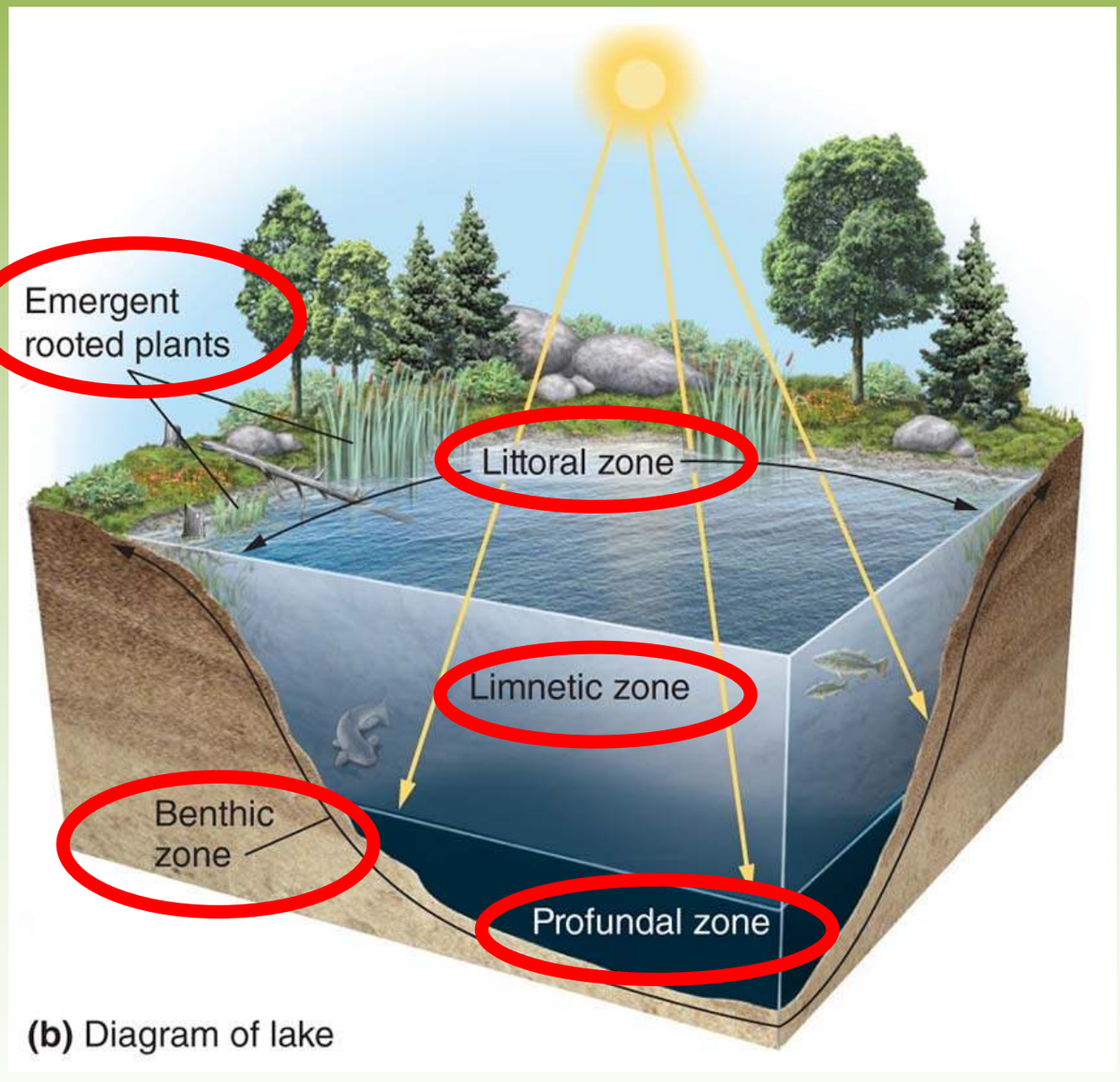
Lakes and Ponds

- **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.*

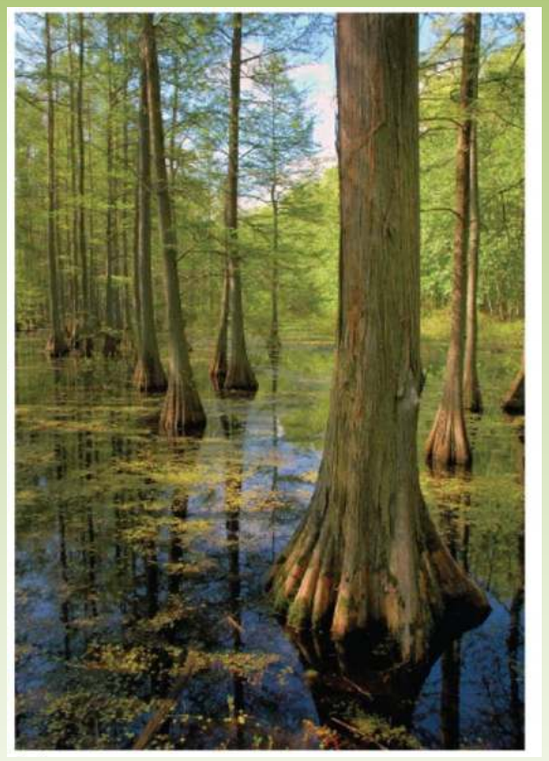
- **Profundal zone-** the zone where *sunlight cannot penetrate* and therefore *producers cannot survive.*

- **Benthic zone-** the *muddy bottom* of a lake or bond 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. **<u>Swamps</u>** – wetlands that contain emergent trees

2. **<u>Marshes</u>** – wetlands that contain non-woody vegetation

3. **<u>Bogs</u>** – 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

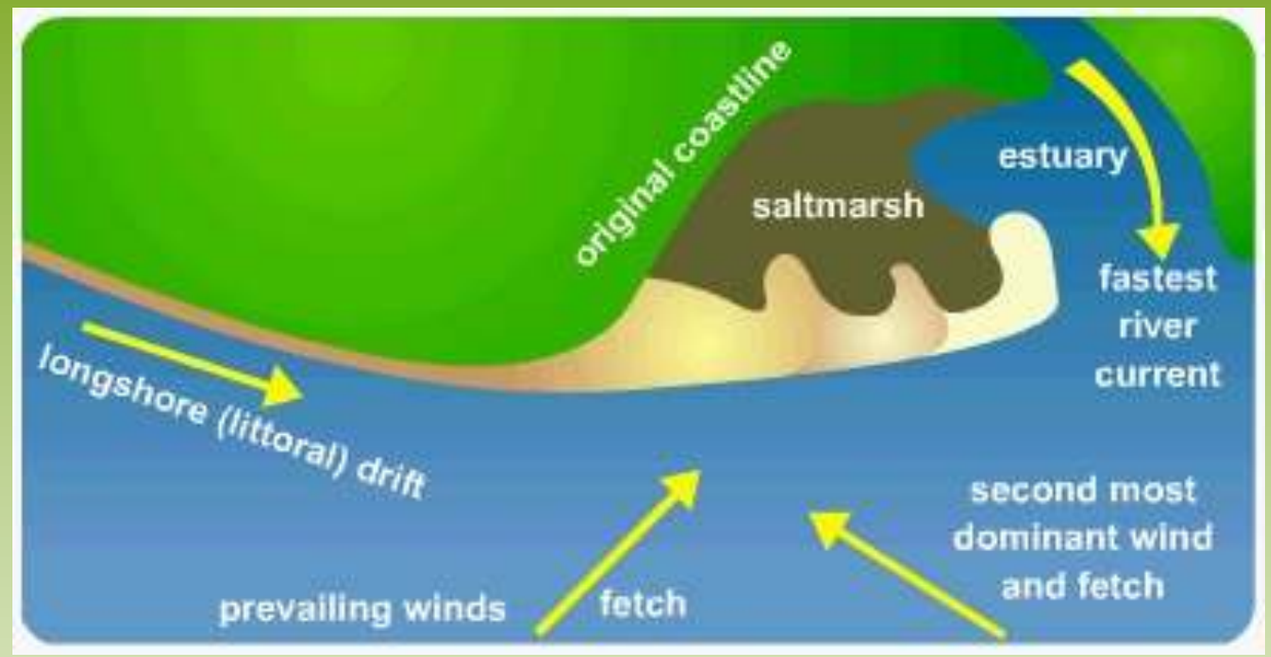
- Many *bird species* depend on wetlands during *breeding* or migration

- 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.



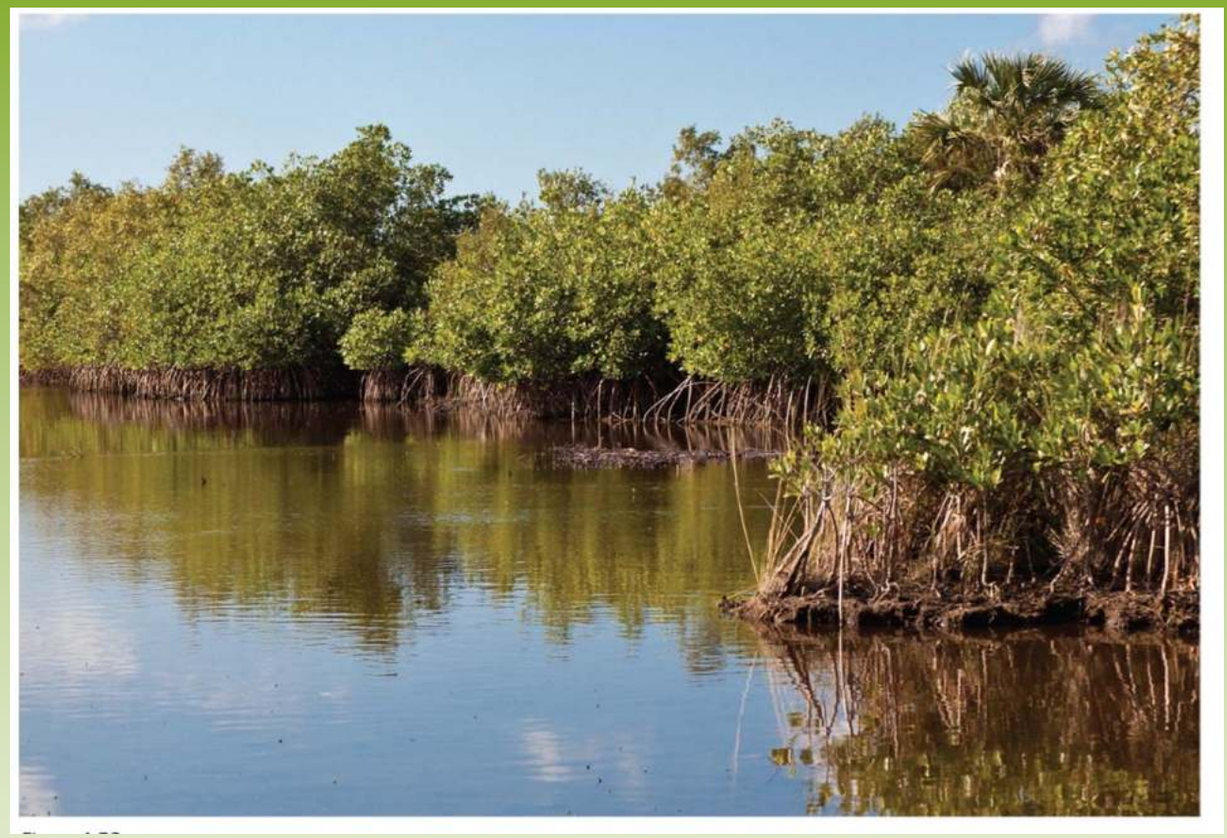
- Many are found in *estuaries*, which are areas along the coast where *salt water mixes with fresh water from rivers*

- Freshwater contains *nutrient-rich organic material* creating abundant plant life in salt marshes which *filter contaminants* out of the water

Figure 4.31
Environmental Science for AP®
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 an low ti*de.

- 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.

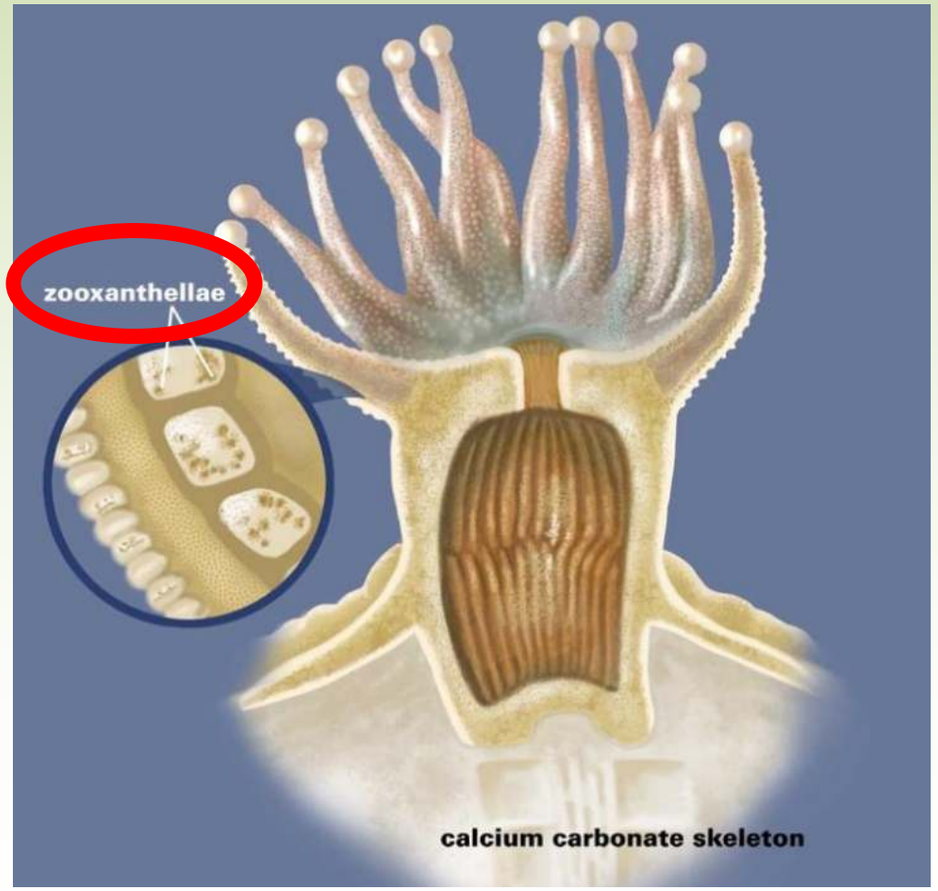
- Home to a wide range of *well adapted organisms* such as barnacles, sponges, mussels, crabs, and starfish

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 (**<u>zooxanthellae</u>**) that *lives in their tissues*



- Corals *release* CO^2 and algae *use* CO^2 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*.

.

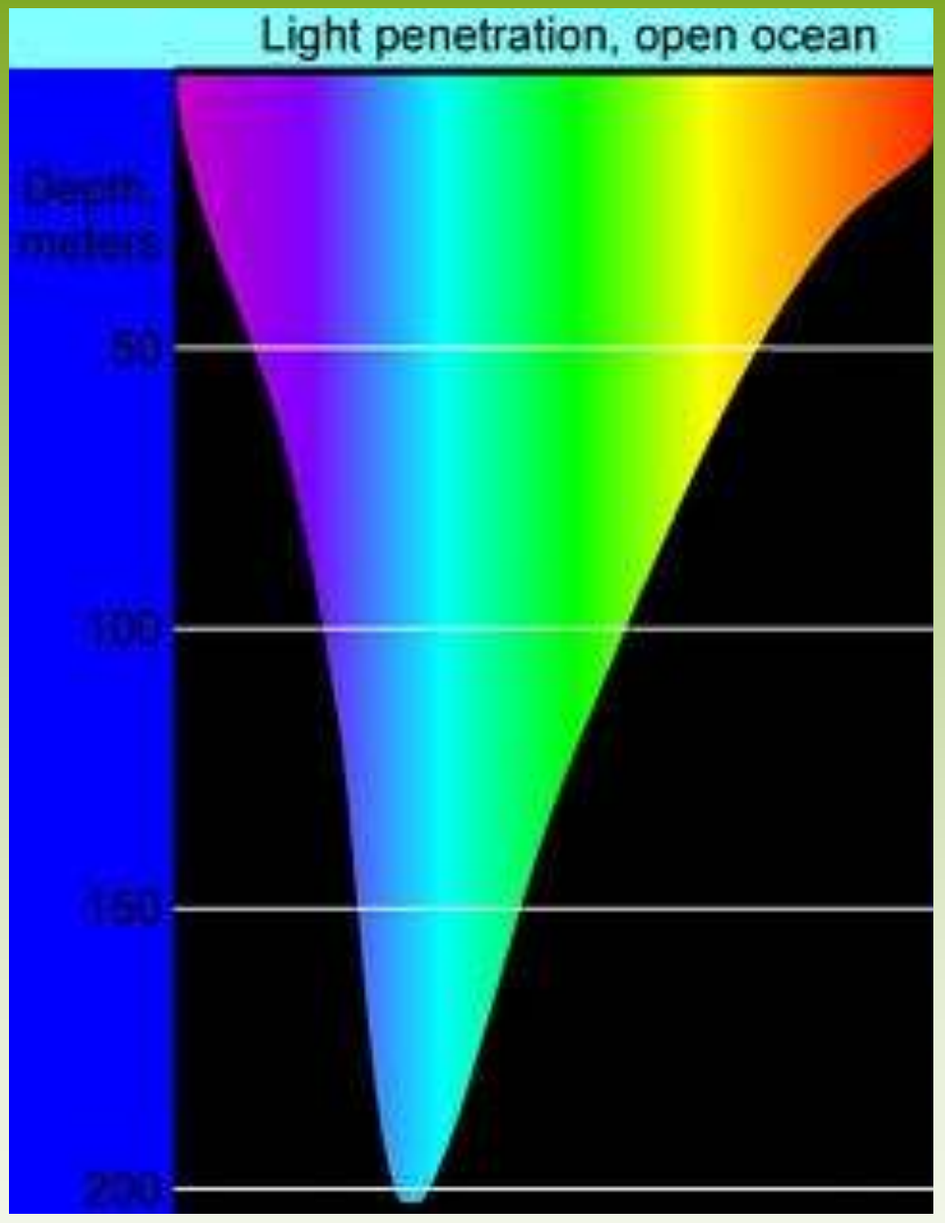
Coral Reefs

- **<u>Coral bleaching-</u>** 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*.

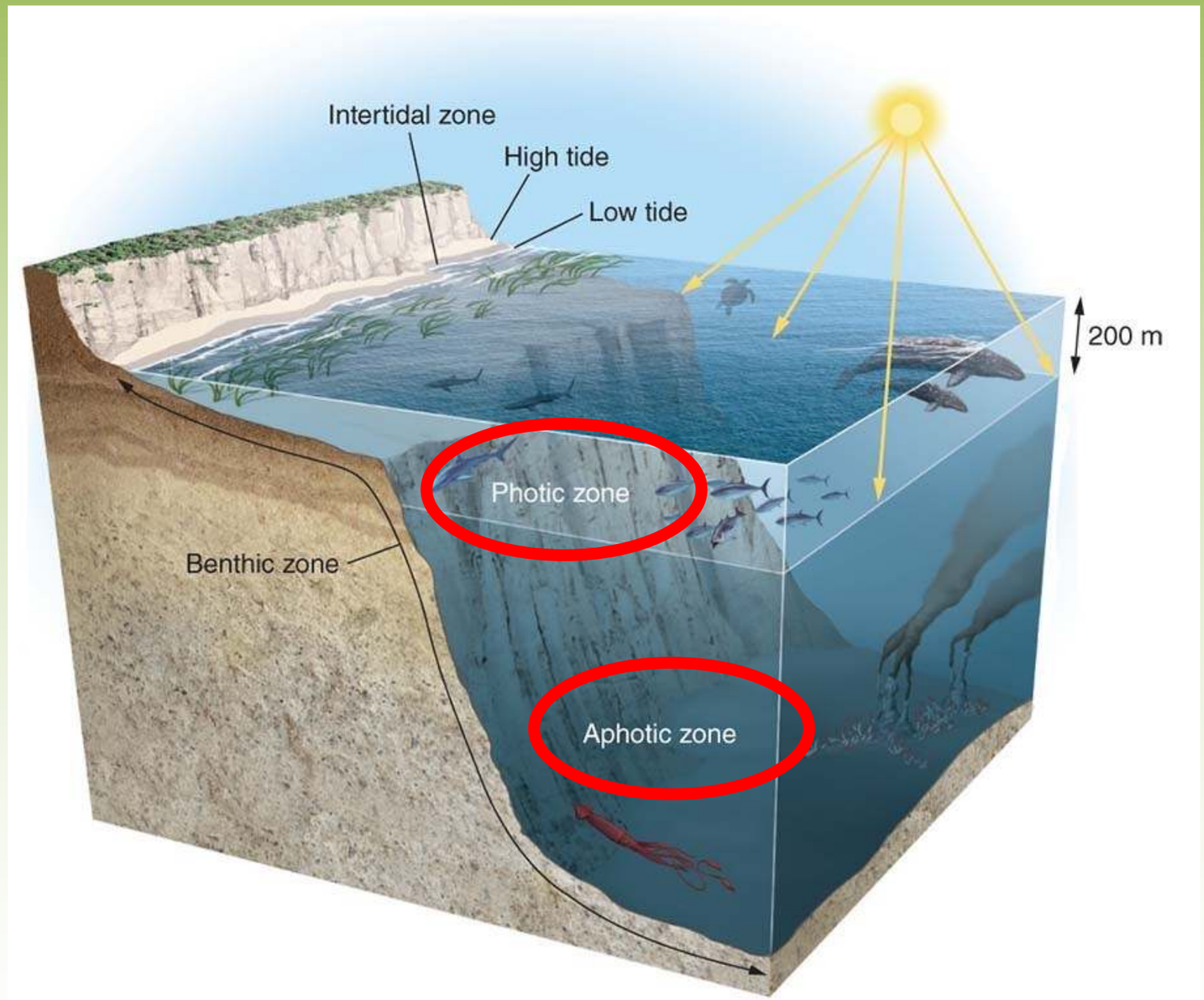
- Generally does not exceed 200 m (650 ft)



The Open Ocean

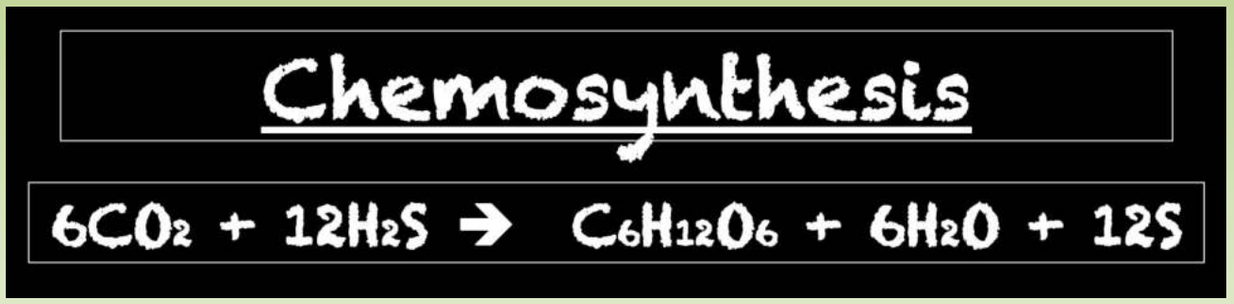
- **<u>Photic zone-</u>** the zone that receives enough *light to allow photosynthesis* to occur.

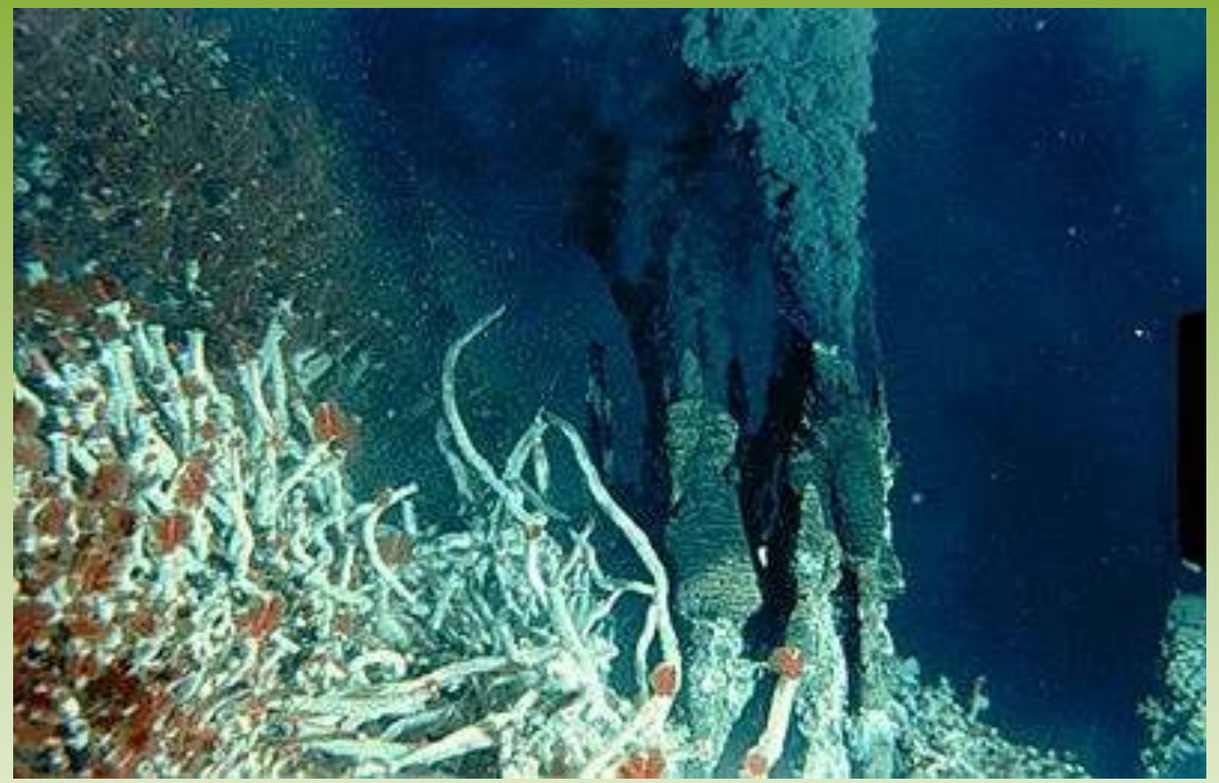
- **<u>Aphotic zone-</u>** the deeper water that *lacks sufficient light for photosynthesis*.



The Open Ocean

- **<u>Chemosynthesis-</u>** 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*

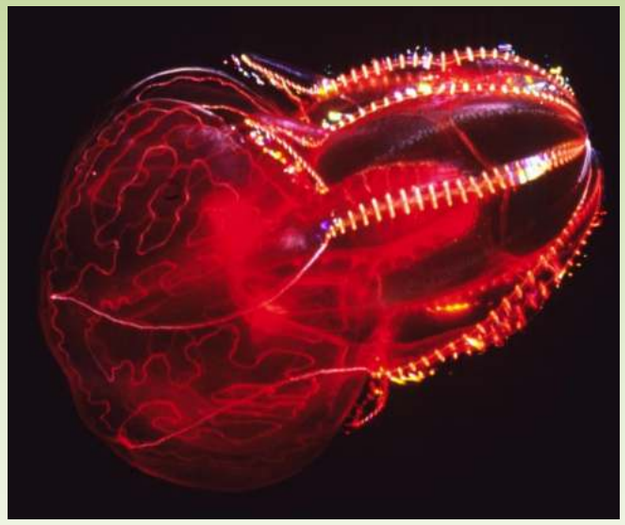


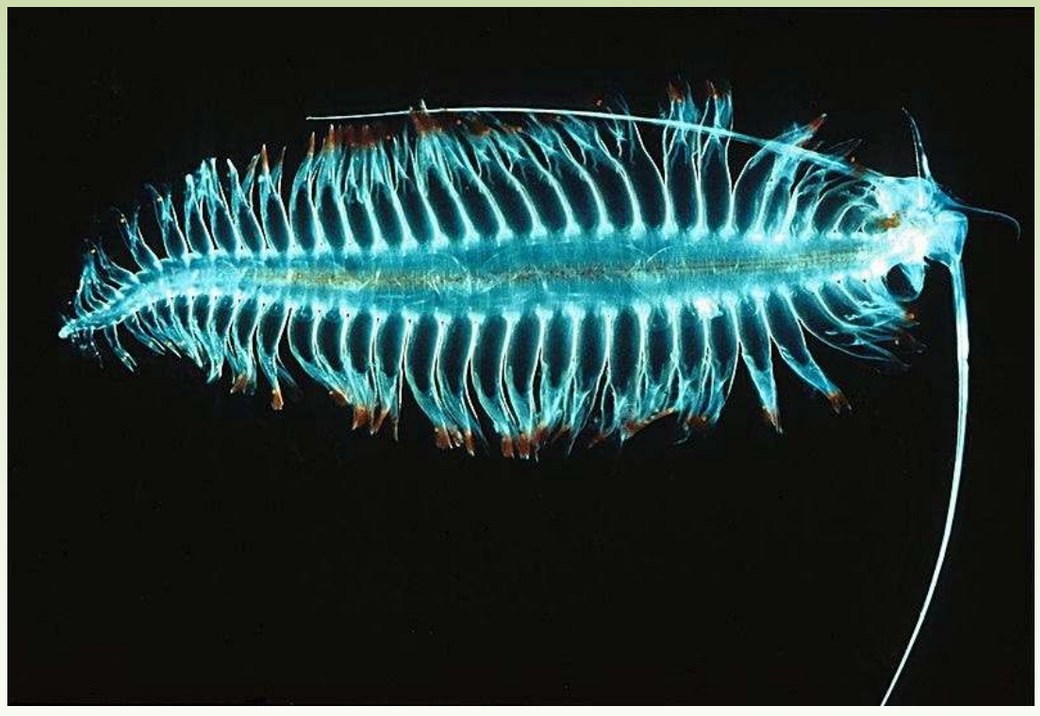


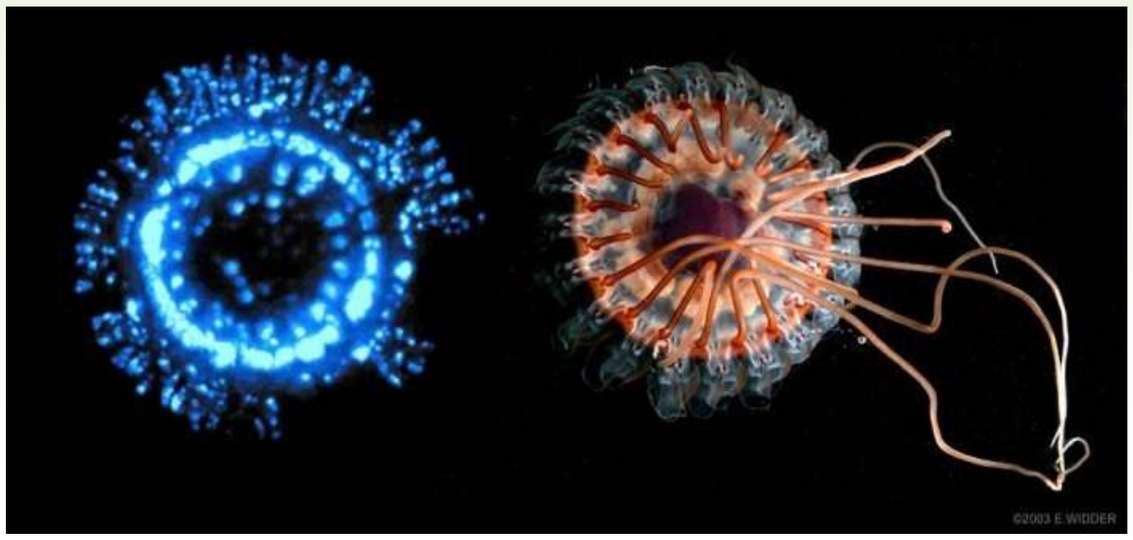
The Open Ocean

- The *aphotic zone* also contains a variety of organisms that can produce their *own light*

- A phenomenon called **<u>bioluminescence</u>** to help feed themselves in dark waters








ITS OVER
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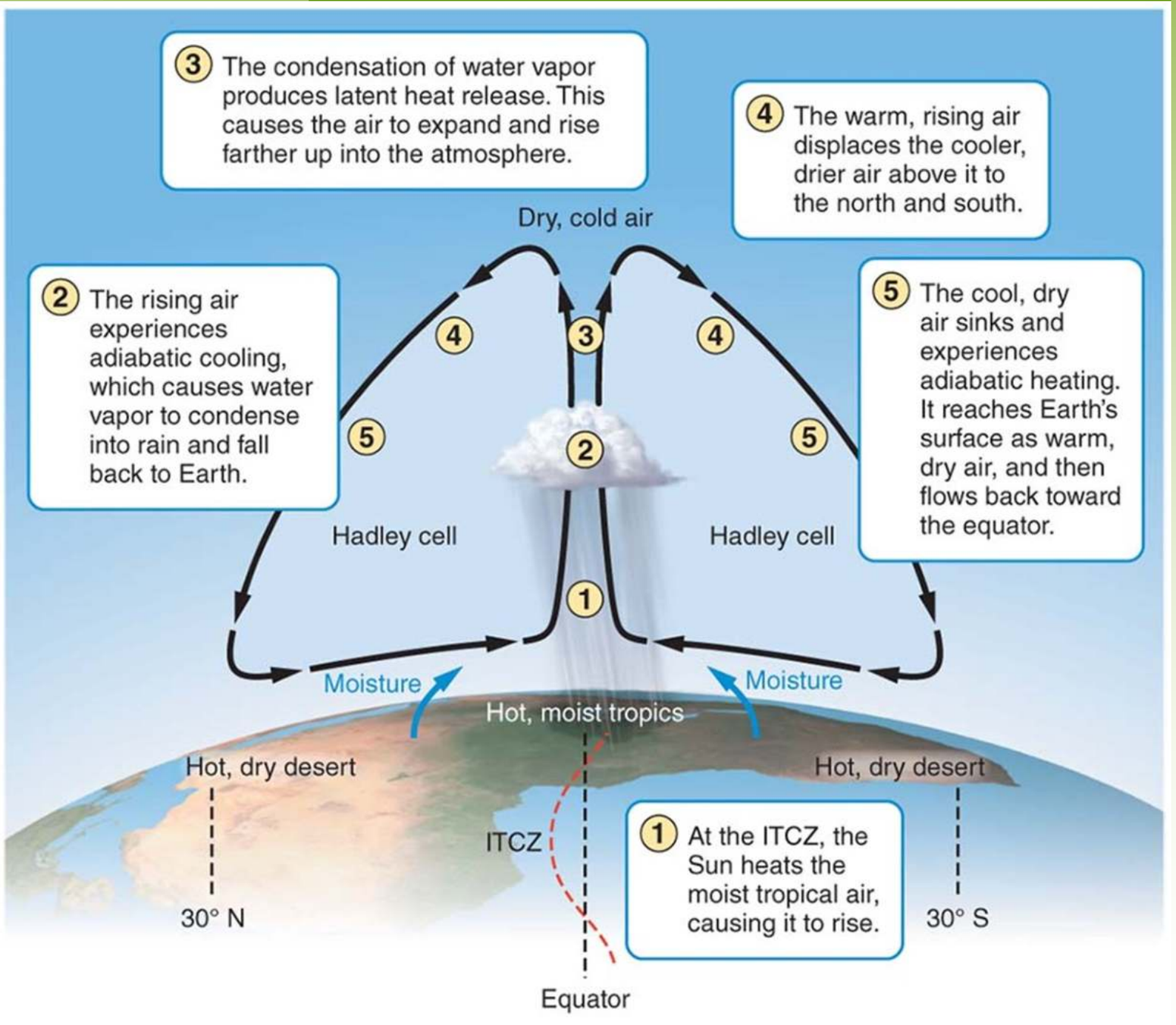
CHAPTER 4 REVIEW GAME!!!

Agenda:

- Collect Labbie Doos
- Continue Ch. 4 notes

Describe the air movement in a Hadley cell



Formation of Convection Currents

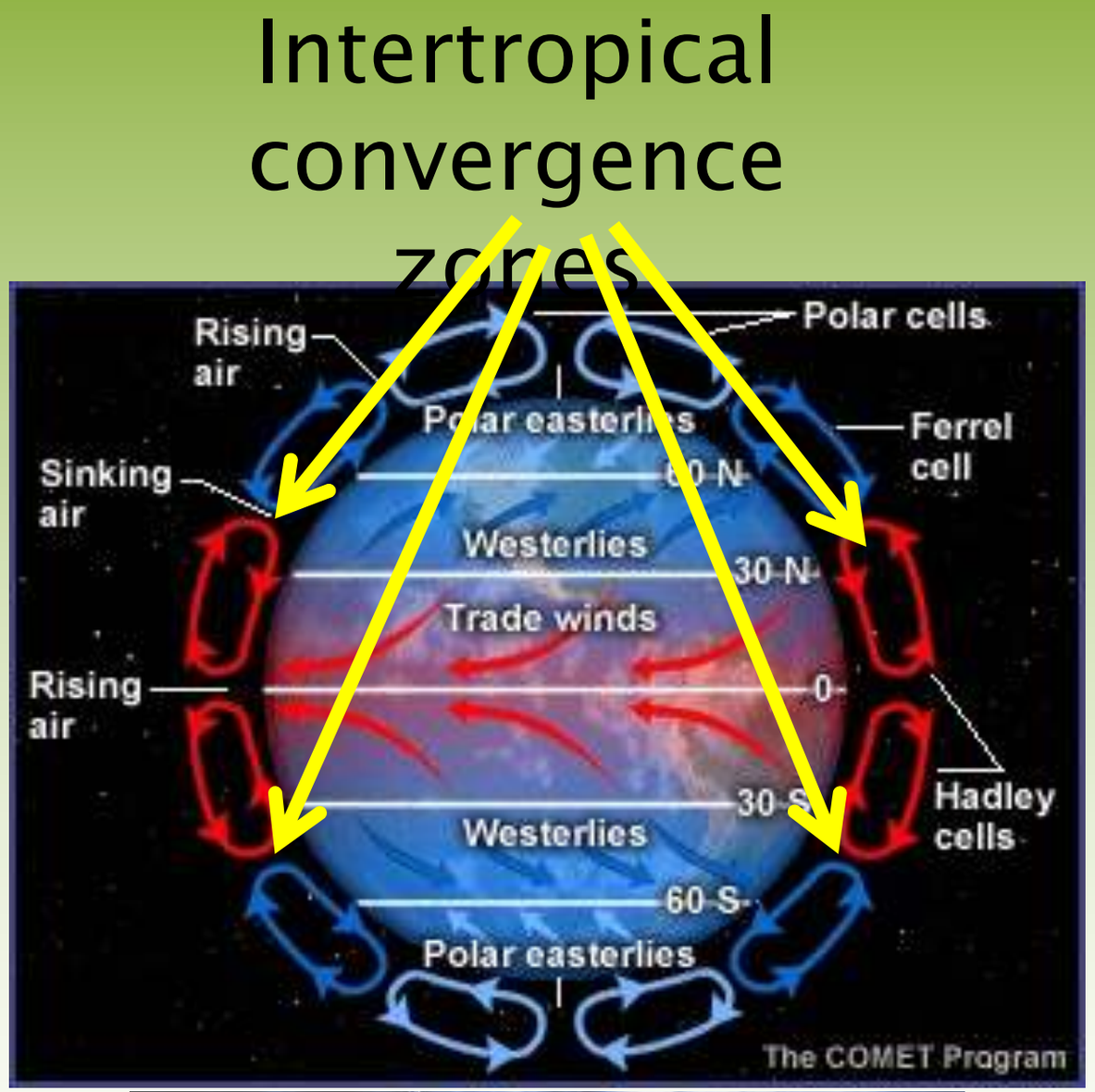
- The area of earth that receives the most intense sunlight, where the ascending branches of the two Hadley cells converge is called the **<u>intertropical convergence zone (ITCZ)</u>**

- Typified by intense thunderstorm activity

- *Latitude of the ITCZ moves north and south* of the equator

- Due to the *tilted axis of Erath's rotation,* the area receiving the most sunlight shifts between 23.5° N and 23.5° S

- Explains the seasonal patterns of precipitation in the tropics



Agenda:

- Class time to work on labbie doo and prepare for vocab quiz tomorrow

Bell Work:

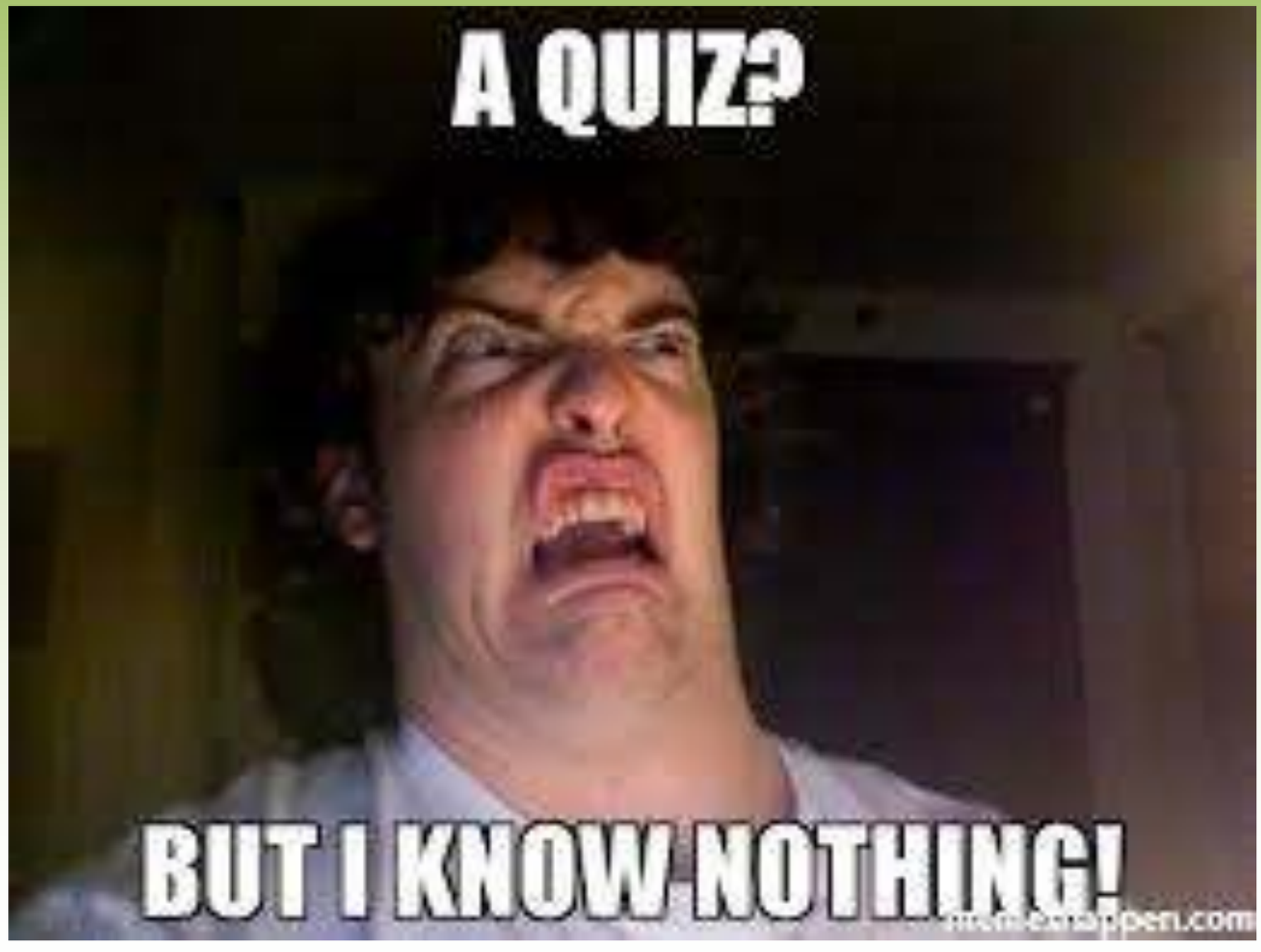
- Continue working on lab

Agenda:

- Ch. 4 Vocab quiz
- Ch. 4 lecture

Bell Work:

- Spend 5 minutes reviewing your vocab. for the quiz!



THE ORIGINAL PENNYWISE!!!

Agenda:

- Collect Labbie Doos
- Ch. 4 lecture

Bell Work:

- What is the ENSO?