

# Chapter 4

# Ecosystems and Communities

Dr. Bertolotti

# Essential Question

**How do abiotic and biotic factors shape ecosystems?**

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**What factors determine  
global climate?**

# Weather vs. climate

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- **Weather** is the day-to-day conditions of Earth's atmosphere at a particular time and place. Example, today it is sunny but yesterday it was thunder storming.
- **Climate** refers to the average, year-to-year conditions of temperature and precipitation in a particular region.

# Factors that affect climate

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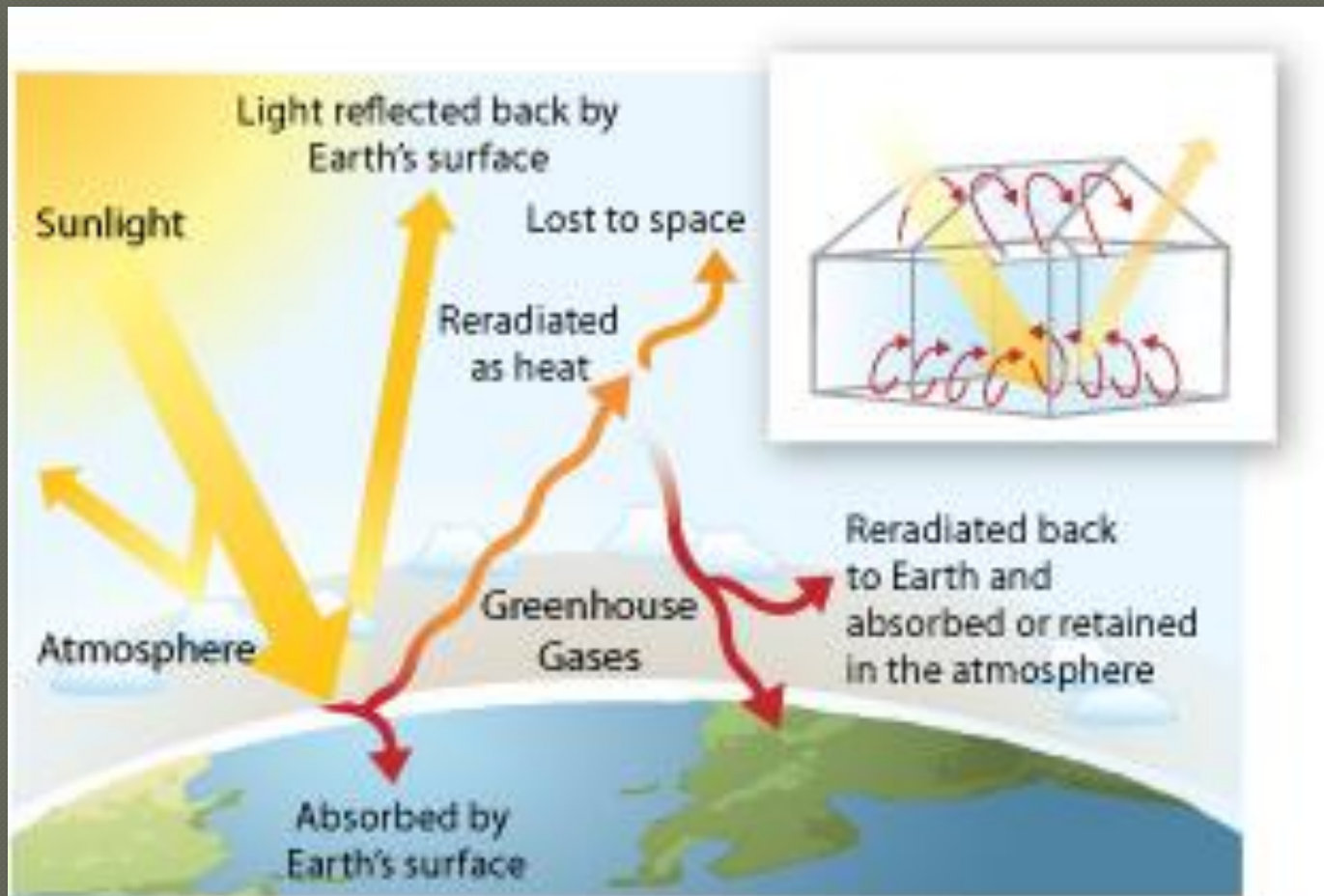
- Global climate is shaped by many factors, including solar energy trapped in the biosphere, latitude, and the transport of heat by winds and ocean currents.

# The Greenhouse Effect

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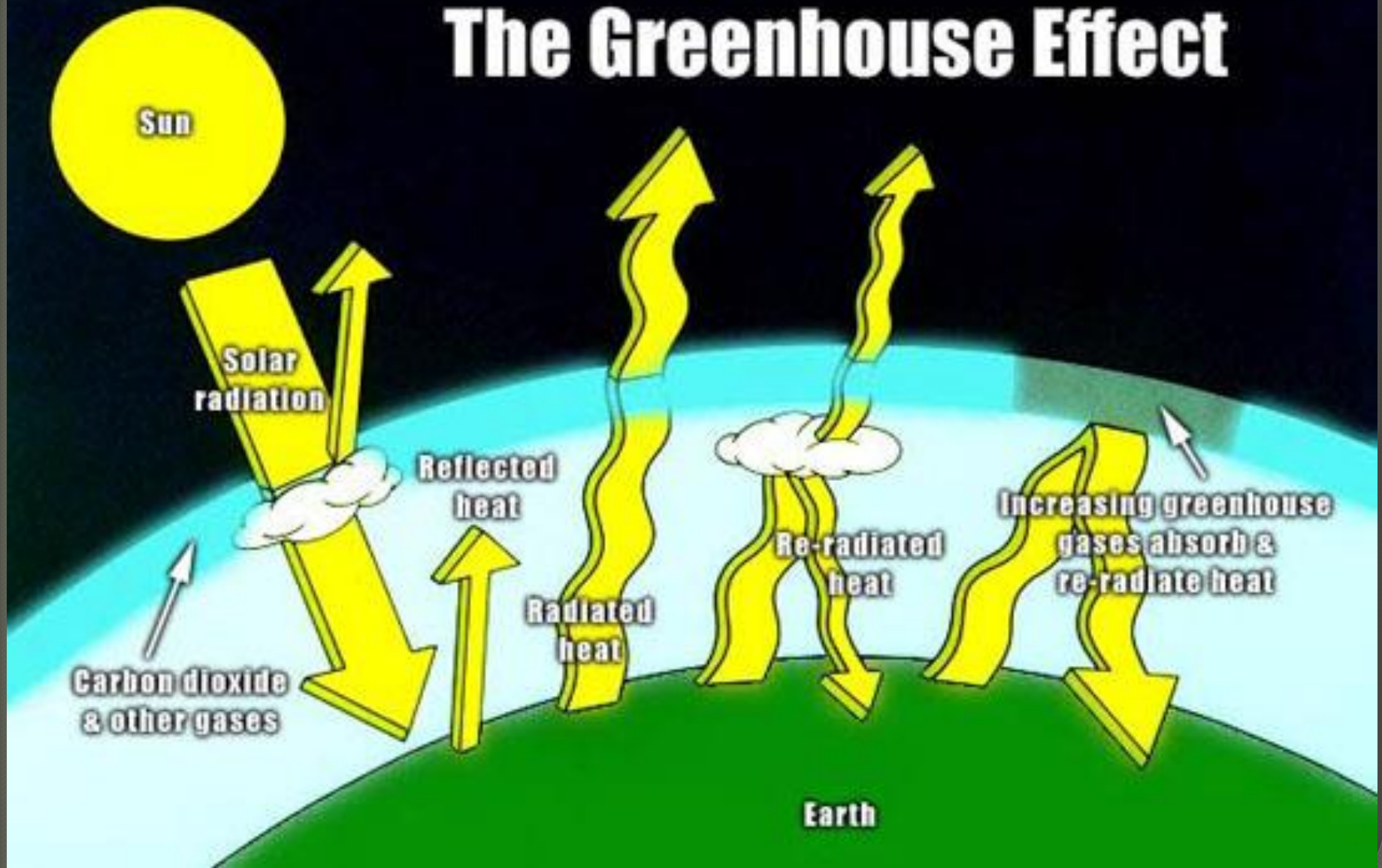
- Carbon dioxide, methane, water vapor, and a few other atmospheric gases trap heat energy and maintain Earth's temperature range by trapping the heat energy of sunlight inside the Earth's atmosphere
- The natural situation in which heat is retained by this layer of greenhouse gases is called the **greenhouse effect**
  - The balance between heat that stays in the biosphere and heat lost to space determines Earth's average temperature.
  - Without the greenhouse effect, Earth would be about 30°C cooler than it is today.

# The Greenhouse Effect





# The Greenhouse Effect





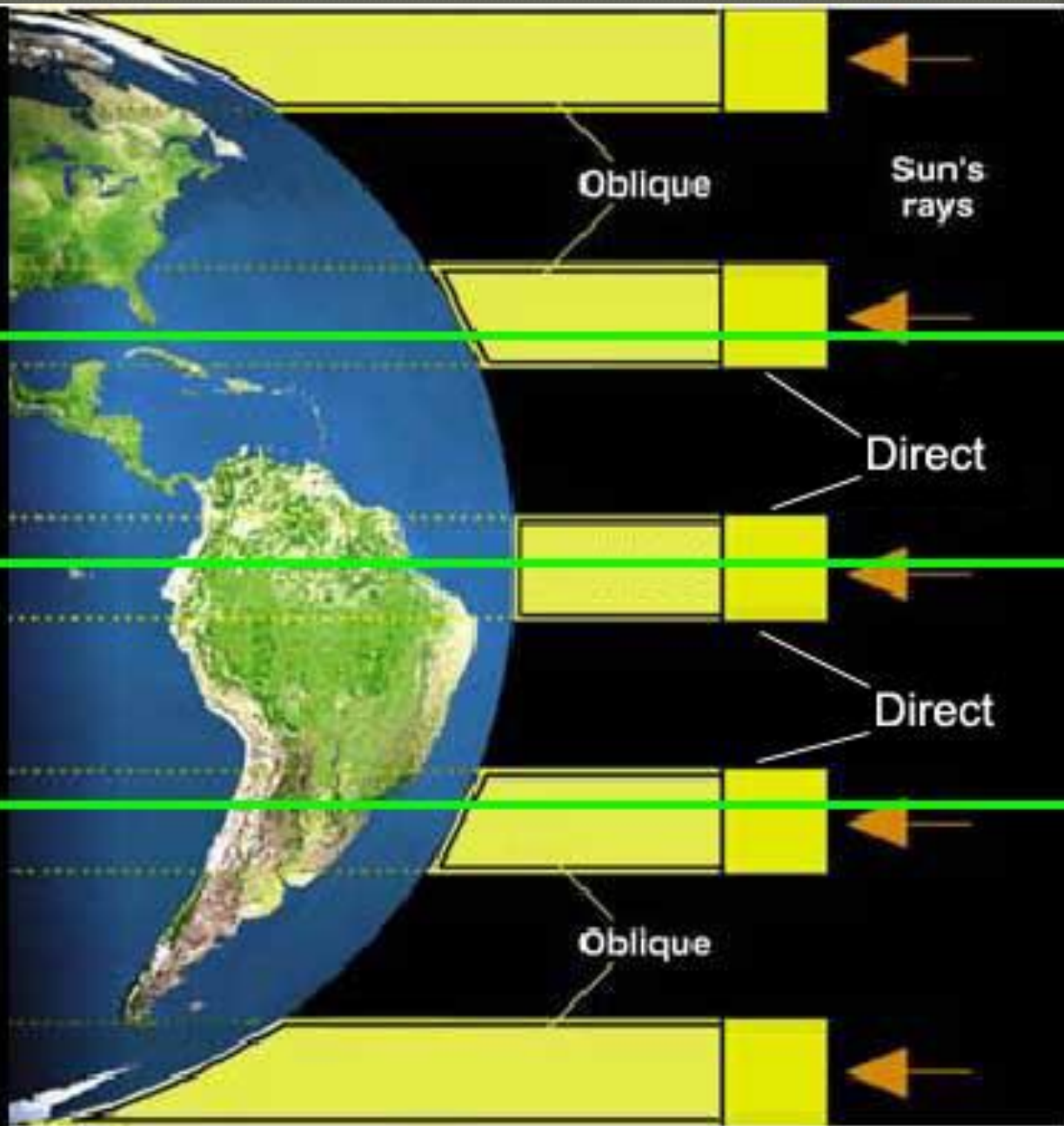
- Because the Earth is spherical that is tilted on an axis, solar radiation strikes different part of the Earth's surface at an angle that varies throughout the year.
- Differences in latitude and therefore the angle of heating results in the creation of 3 main climate zones: polar, temperate, and tropical.
  - **Polar zones** are cold zones where the sun strikes at a very low angle, ex. North and South poles
  - **Temperate zones**: sits between the polar zones and the tropics and experience various seasons
  - **Tropical zone**: is near the equator and receives nearly direct sunlight all year around

Tropic of Cancer



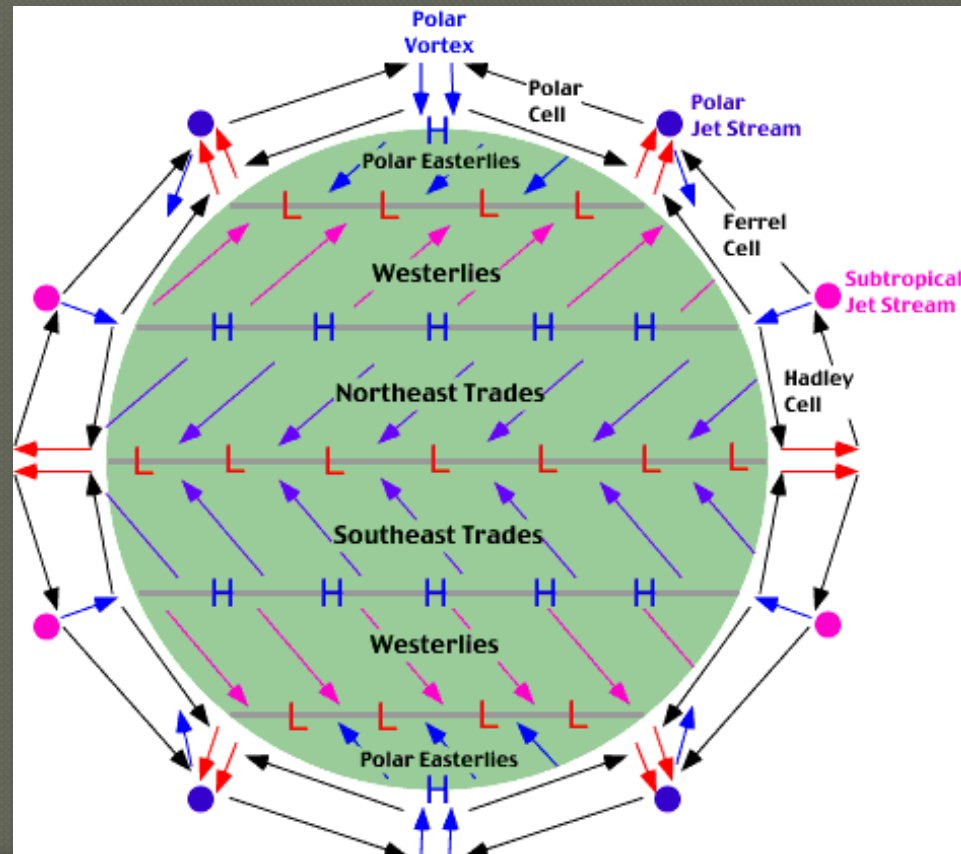
Equator

Tropic of Capricorn



# Heat transport in the Biosphere

- The unequal distribution of heat across the globe creates wind and ocean currents, which transport heat and moisture.



# QUESTION AND ANSWER

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**What factors determine  
global climate?**

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**How does competition shape  
communities?**

# What shapes an ecosystem?

- Ecosystems are influenced by 2 factors:
  - 1. biological influences on organisms called **biotic factors** such as plants and animals; and
  - 2. physical or non-living factors called **abiotic factors** such as soil, wind, etc.
- **Tolerance:** the ability to survive and reproduce under a range of environmental circumstances
- **Habitat:** the place where an organism lives
- **Niche:** is the full range of physical and biological conditions in which an organism lives and the way in which the organism uses those conditions.
  - No 2 species can share the same niche in the same habitat
- **Resource** refers to any necessity of life such as food, water, etc.



# Abiotic vs. Biotic Factors

- **Abiotic**- “non-living” components
  - examples: temperature, light, water, nutrients, boats
- **Biotic**- “living” species
  - examples: sea turtle, sea grass, coral, fish, humans



# Community Interactions

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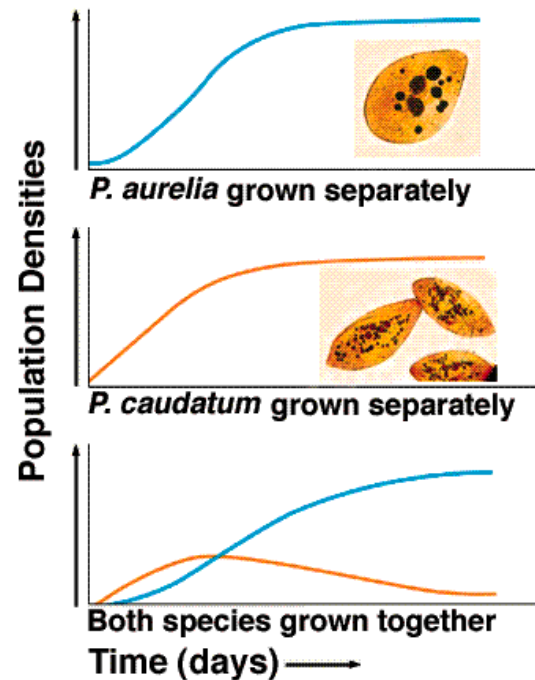
- Community interactions such as competition and predation and various forms of symbiosis can powerfully affect an ecosystem
  - **COMPETITION.** This occurs when organisms of the same or different species attempt to use an ecological resource in the same place at the same time.
  - The **competitive exclusion principle** states that no 2 species can occupy the same niche in the same habitat at the same time.
  - **PREDATION:** An interaction in which one organism captures and feeds on another organism.
    - Example: dragonflies and mosquitoes

# How competition effects ecosystems

- Sometimes two species will compete.
- No two species can occupy the exact same niche (job) for a long period time.
- Only one species wins. This is called **competitive exclusion.**

Sylvia S Mader, Biology, 6th edition. © 1998 The McGraw-Hill Companies, Inc. All rights reserved.

## Competition Between Two Laboratory Populations of *Paramecium*



# What if no one wins?

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- In some species interactions, neither species wins.
- This results in close, long term associations within an ecosystem called **symbiotic** relationships.

● **SYMBIOSIS:** Any relationship in which 2 species live closely together.

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- The 3 main classes are:
  - **1. Mutualism:** both species benefit from the relationship.
    - Example: the pollination of flowers by bees and birds
  - **2. Commensalism:** one member of the association benefits and the other is neither helped nor harmed.  
Example: barnacles on a whale and crabs and jellyfish
  - **3. Parasitism:** one organism lives on or inside another organism and harms it. The parasite obtains all or parts of its nutritional needs.
    - Example: tapeworms, ticks and fleas on dogs.



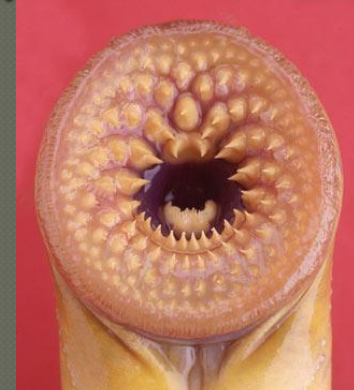
# 3 Kinds Symbiotic Relationships

- ⦿ += helped
- ⦿ - = harmed
- ⦿ 0 = neither

⦿ Parasitism (+/-)

⦿ Commensalism (+/0)

⦿ Mutualism (+/+)





# QUESTION AND ANSWER

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**How does competition shape  
communities?**

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**How do communities change  
over time?**

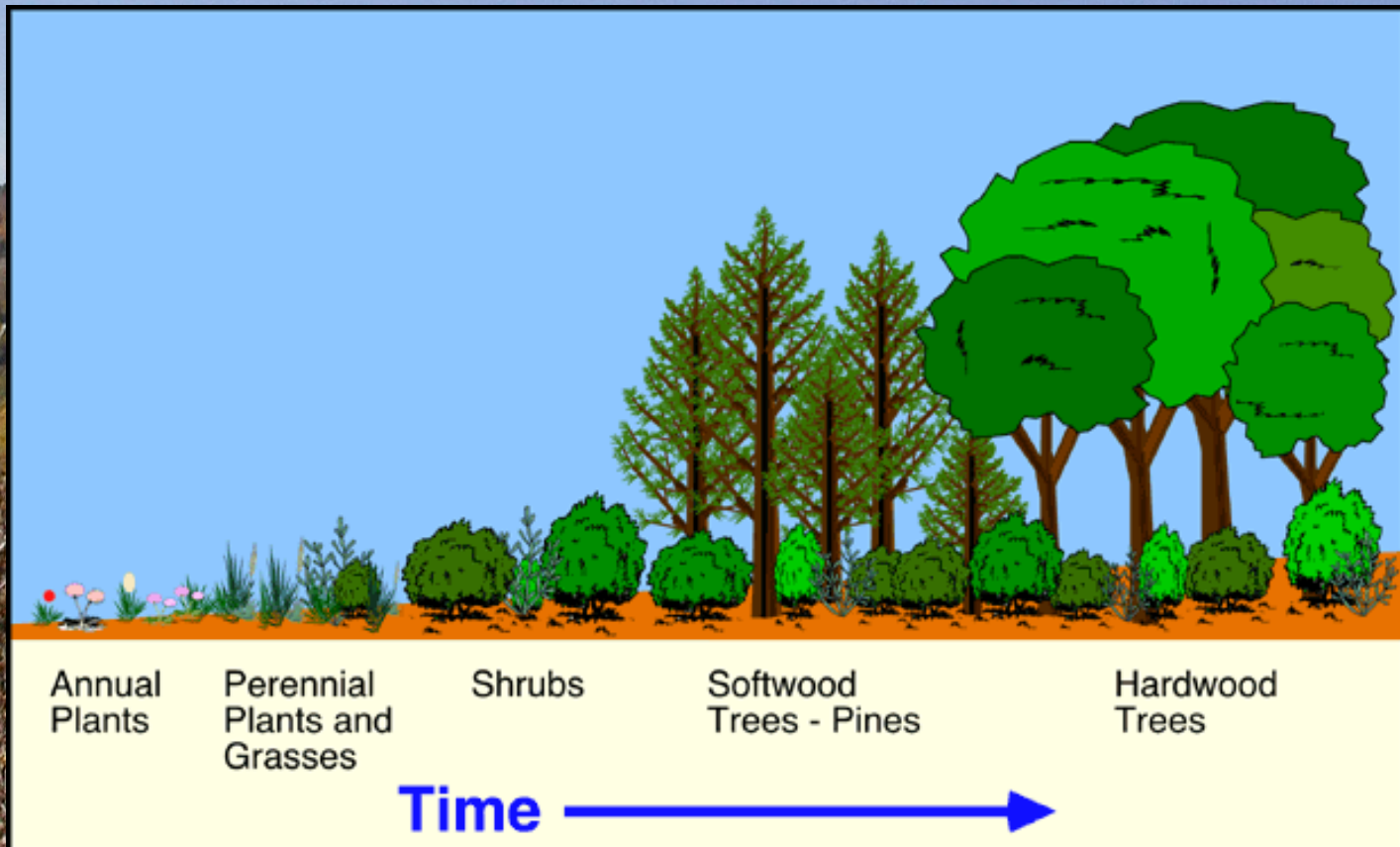
# Ecological Succession

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- Ecosystems are constantly changing in response to natural and human disturbances. As an ecosystem changes, older inhabitants gradually die out and new organisms move in, causing further changes in the community.
- The series of predictable changes that occurs in a community over time is called **ecological succession.**

# Changing Ecosystems

- Changes are a natural part of any ecosystem.
- **Succession:** regular development of an ecosystem which leads to gradual replacing of species in a community by others.





○ **Primary succession** occurs on surfaces where no soil exists. Example, surfaces formed from volcanic eruptions.

- The first species to populate the area is called **pioneer species**.
- Examples of pioneer species, include: Algae, mosses, bacteria, fungi, and lichens
- Pioneer species usually have the ability to live in harsh environments where other species cannot survive. These organisms are able to quickly colonize recently disturbed areas through rapid reproduction. They are well-adapted to dispersing their young to new locations.
- Pioneer species often slightly change the environments that they colonize. In some instances pioneer species such as lichens and plants break apart rock and add organic matter to soil. This frequently makes it easier for new organisms to enter the environment, survive and outcompete the pioneer species. Thus, organisms in the next stage of ecological succession eventually take over the habitat from the pioneer species

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- ◎ **Secondary succession** is a succession following a disturbance that destroys a community without destroying the soil. Usually, the ecosystem is restored to its former glory. Example, after wildfires.



# Ecosystem Stability

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- Does succession ever end?
  - Succession in a given area always proceeds through the same stages to produce a specific and stable climax community
  - Secondary succession in healthy ecosystems following natural disturbances often reproduces the original climax community.
  - Ecosystems may or may not recover from extensive human-caused disturbances.
- **Stability** - ability of an ecosystem to resist change when a disturbance occurs.
  - Biodiversity tends to promote stability.

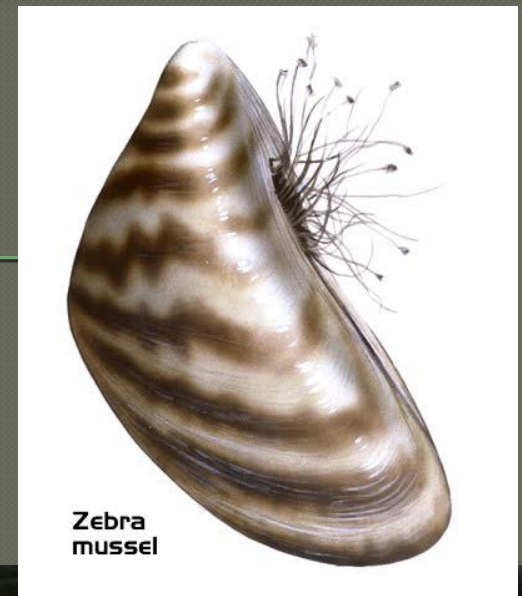
# Ecosystem Stability

- Keystone species- species that are crucial to the stability of an ecosystem.
  - If members of a keystone species die, then the entire ecosystem can collapse.
- i.e. sea otters- keep sea urchins in check, which would take over the kelp beds without the otters



# Ecosystem Stability

- **Invasive/non-native/introduced species** destroy ecosystems.
- They are species that are brought by humans accidentally or purposefully from other places and take hold
- They multiply unchecked due to lack of predators in new place they are moved to.
- Ex: Asian longhorn beetle, Zebra mussels





# QUESTION AND ANSWER

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**How do communities change  
over time?**

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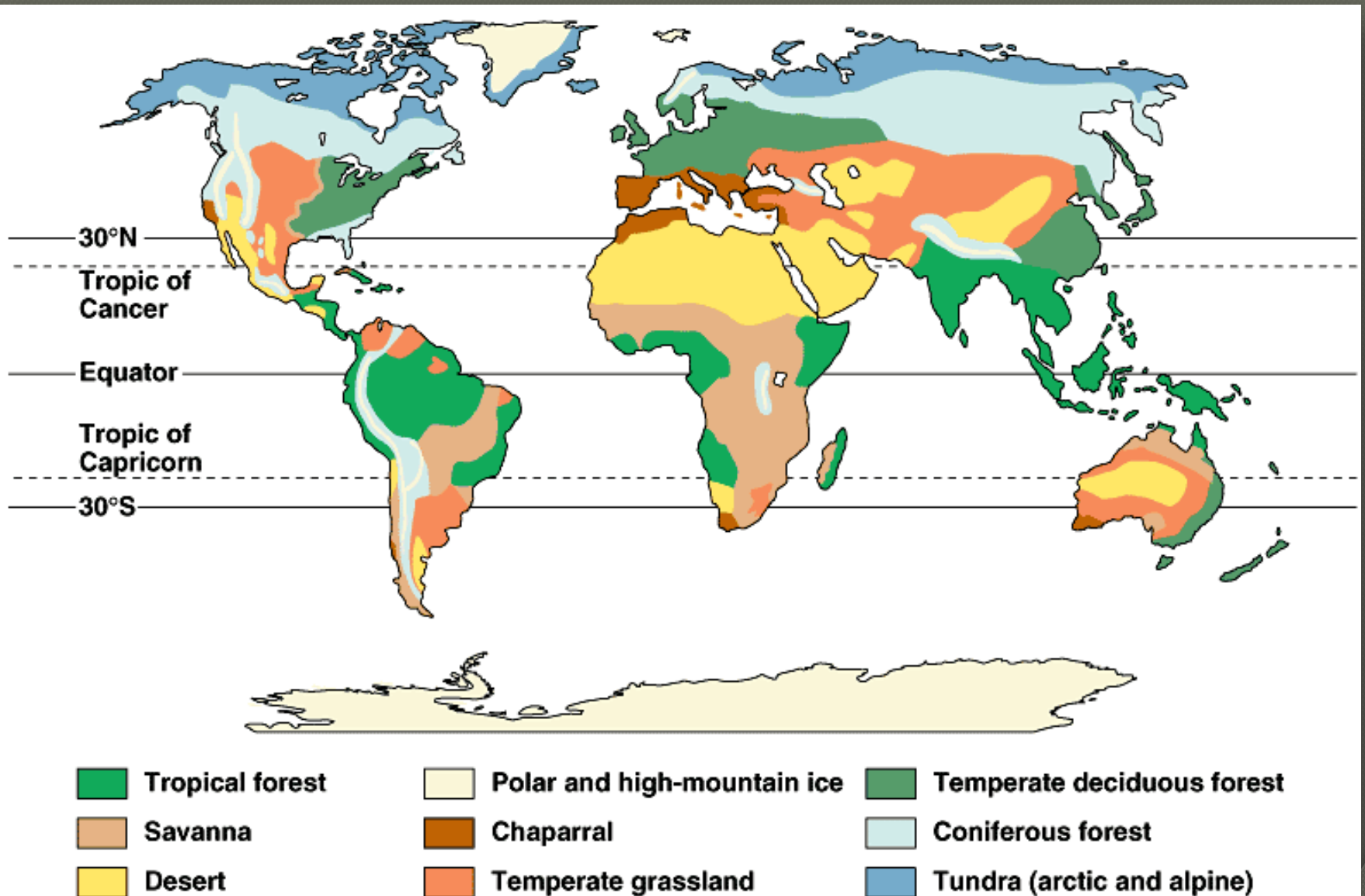
**What abiotic and biotic  
factors characterize  
biomes?**

# 4-4 Biomes

- **Tolerance:** the ability of plants and animals to survive and reproduce under conditions that differ from their optimal conditions.
- **Microclimate:** the climate in a small area that differs from the climate around it
- There are **10 different biomes** including:
  - tropical rain forest,
  - tropical dry forest,
  - tropical savanna,
  - desert,
  - temperate grassland,
  - temperate woodland and shrubland,
  - temperate forest,
  - northwestern coniferous forest,
  - boreal forest,
  - tundra



# Earth's land ecosystems



**high biodiversity**

# Tropical rainforest



**lots of rain, lots of sunlight, always warm  
many plants & animals**



**mid biodiversity**

# Savanna

**dry season/wet season, always warm  
frequent fires in dry season  
many herbivores**





**low biodiversity**

**Desert**



**very dry, hot in day & cold at night**  
**very few plants & only small animals:**  
**reptiles, insects, rodents, birds**

# Temperate Grassland (Midwest U.S.)

**mid biodiversity**



**dry season/wet season, cold winters/hot summers  
frequent fires in dry season  
many herbivores**



# Temperate Deciduous Forest

**high biodiversity**

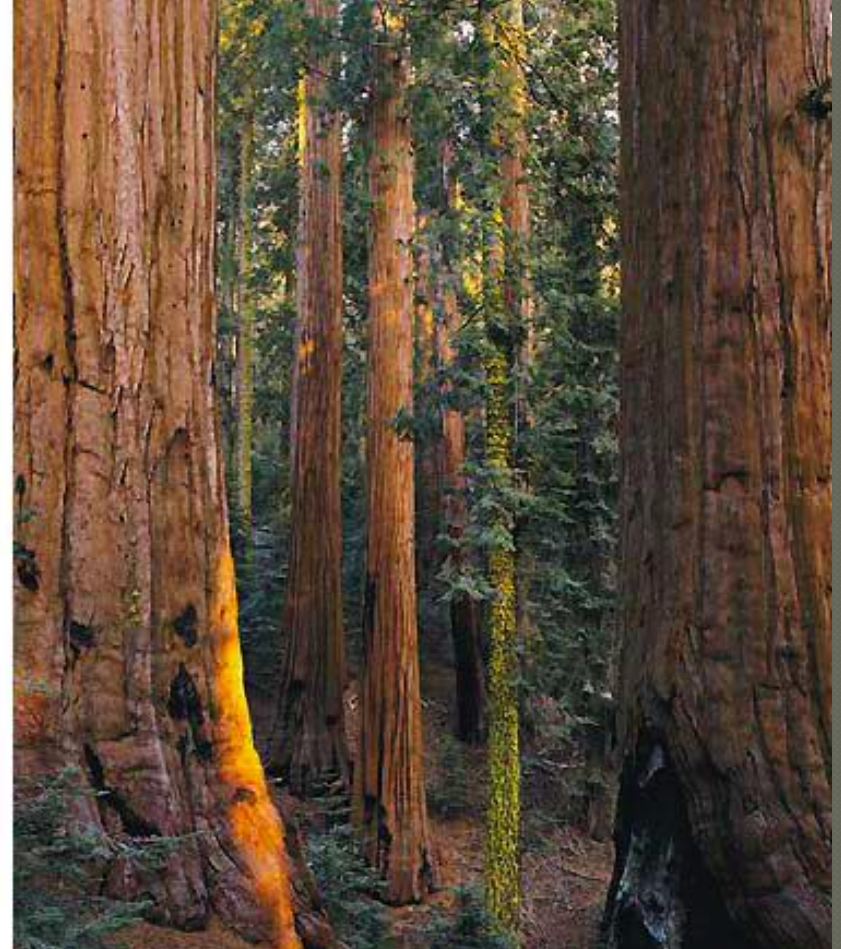


**4 seasons: warm summer with rains, cold winter with snow  
deciduous trees, many mammals, insects, birds, etc.**



# Coniferous Forest (Taiga)

mid biodiversity

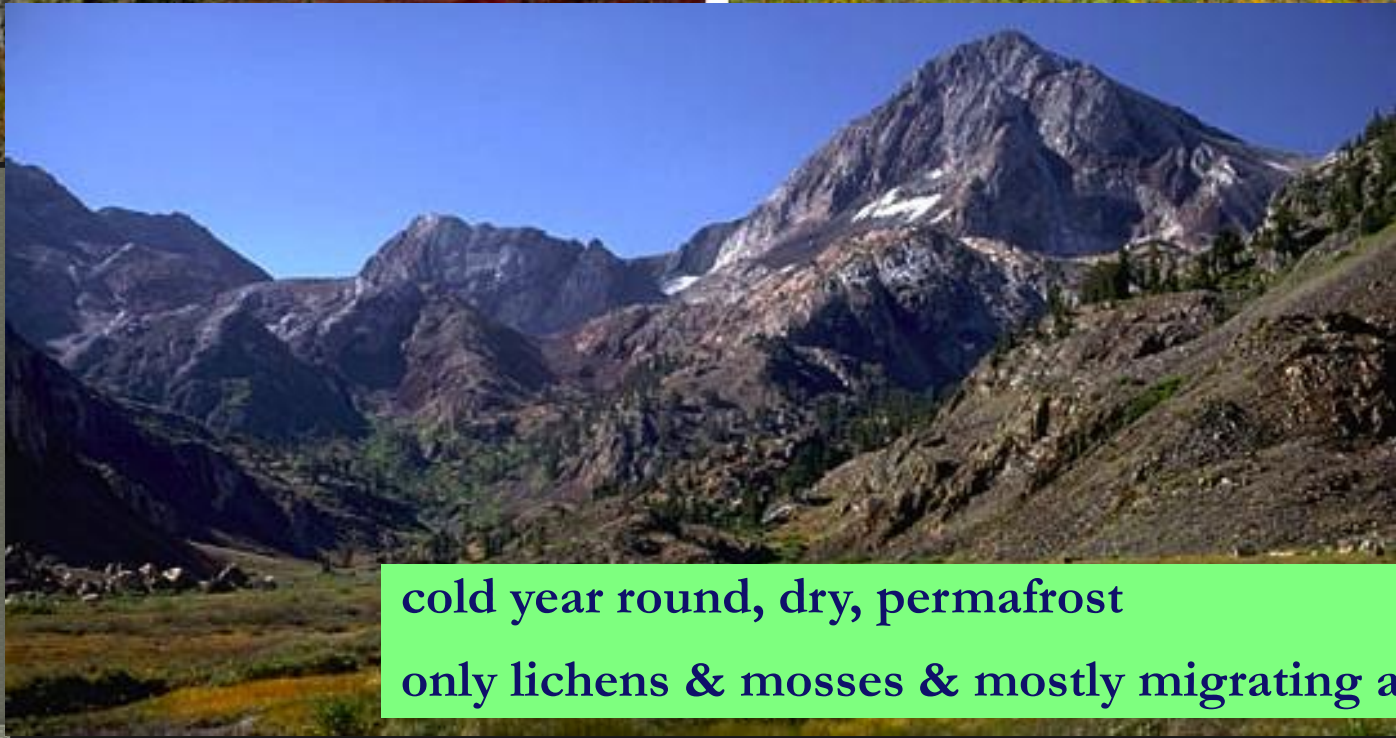


northern forest, drier, cooler  
evergreens, mammals, birds, insects, etc.



**low biodiversity**

**Tundra**



**cold year round, dry, permafrost**

**only lichens & mosses & mostly migrating animals**

# QUESTION AND ANSWER

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**What abiotic and biotic  
factors characterize  
biomes?**

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**What factors affect life in aquatic ecosystems?**



# 4-5 Aquatic Ecosystems

- Aquatic ecosystems are determined primarily by the depth, flow, temperature, and chemistry of the overlying water.
- Water depth strongly influences aquatic life because sunlight penetrates only a relatively short distance through water
  - The zone near the surface where photosynthesis can take place is the **photic zone**.
  - Contains **plankton**- a free floating organism
    - 2 main types of plankton
    - **1. phytoplankton** is a unicellular algae (producer)
    - **2. zooplankton** is an animal plankton (consumer of phytoplankton)
  - The zone below the photic zone that is dark is the **aphotic zone** where photosynthesis cannot occur

- ◉ **Wetland** is an ecosystem in which water either covers the soil or is present at or near the surface of the soil ex. Florida Everglades
- ◉ **Estuaries** are wetlands formed where rivers meet the sea
- ◉ **Salt marshes** are temperate-zone estuaries dominated by salt-tolerant grasses above the low-tide line, and seagrass under water.
- ◉ **Mangrove swamps** are coastal wetlands that are widespread across tropical regions

# Marine Ecosystems Vocabulary

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- **Photic zone:** the thin surface layer where algae and producers can engage in photosynthesis as sunlight penetrates this area
- **Aphotic zone:** is found below the photic zone and is permanently dark. Chemosynthetic autotrophs are the only producers capable of surviving here.
- **Kelp Forests:** are named from the dominant organism- the kelp.

# QUESTION AND ANSWER

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**What factors affect life in  
aquatic ecosystems?**

# Essential Question

**How do abiotic and biotic factors shape ecosystems?**