Ecology

Ch 4-6

Ecology

- Study of the interactions between living things and their environment

- The interdependence of organisms can be organized into levels and changes in one level can have impacts on other levels

Levels of Organization in Ecology

1. Biosphere – thin volume of Earth and its atmosphere that supports life
2. Ecosystem – all living and nonliving parts of a particular place

3. Community – all interacting organisms living in a area

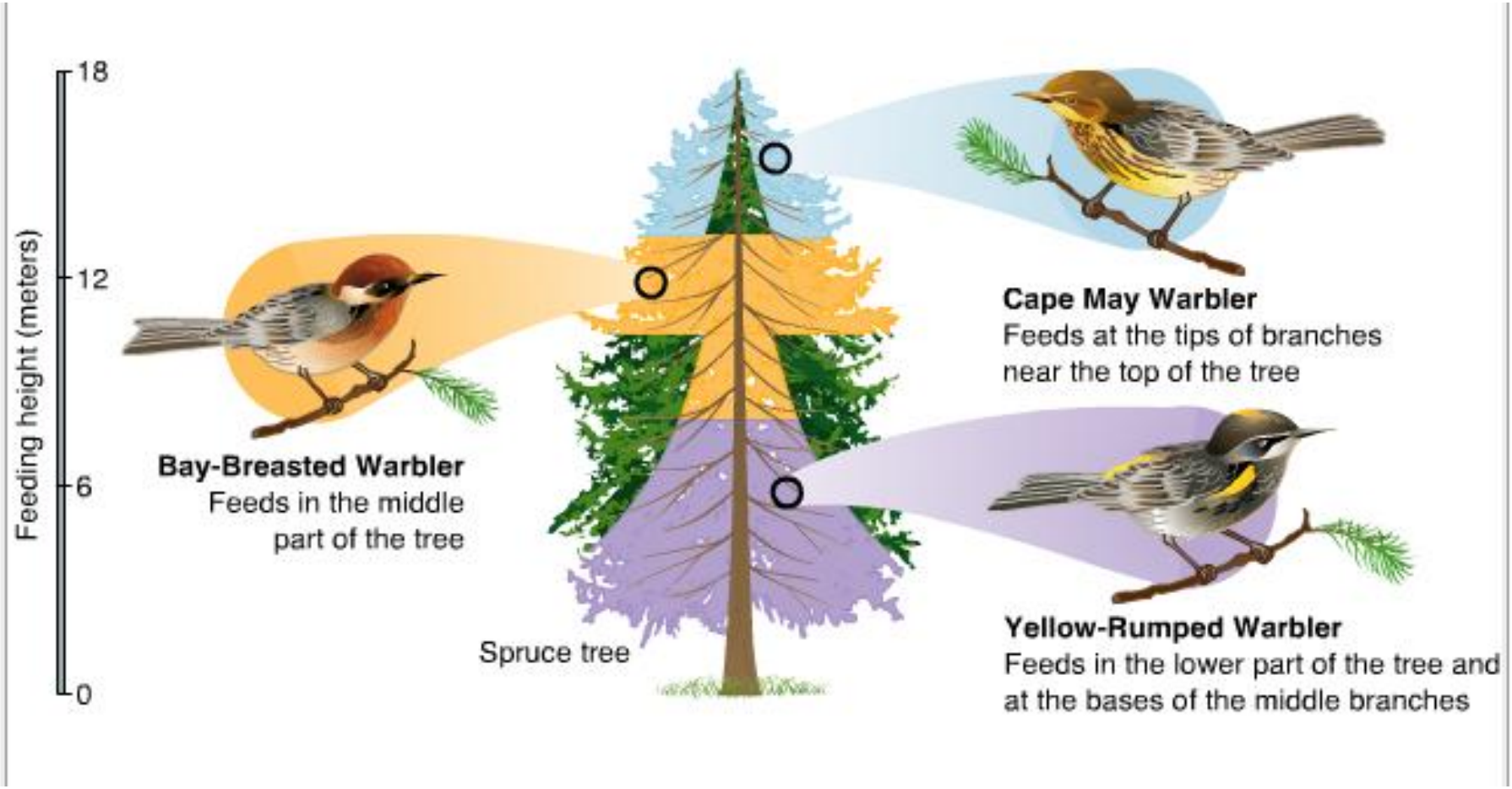
4. Population – all members of a species living in one place at one time

5. Organism – one living thing in a population

Ecosystem/Organism

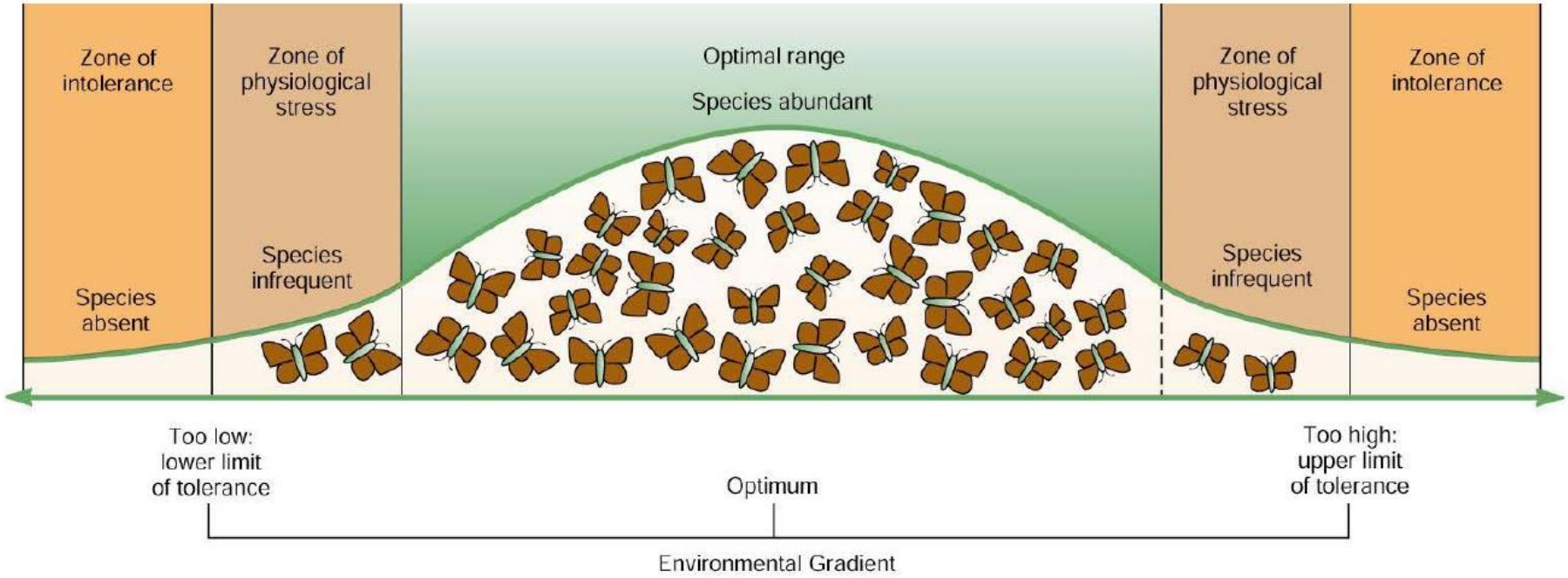
- Within an ecosystem, the two types of environmental factors are:
  - Biotic = living
    - Ex) bacteria, protists, fungi, plants, and animals
  - Abiotic = nonliving
    - Ex) rocks/soil, air, sun, water

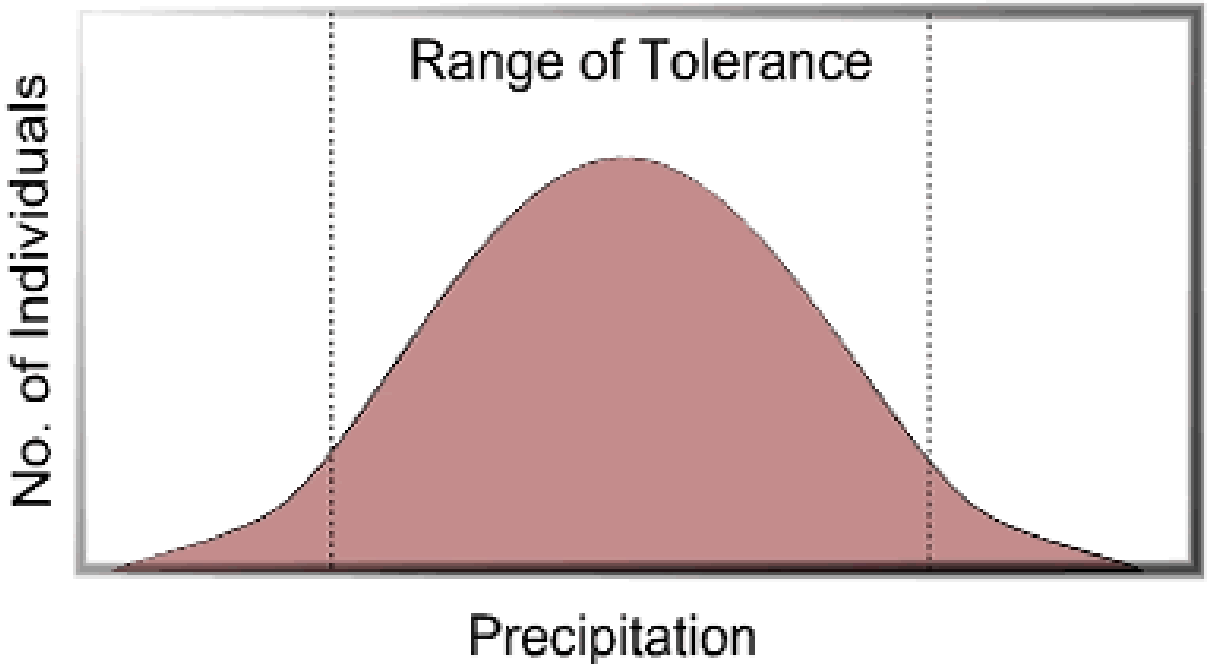
- Habitat = place where organism lives
- Niche = organism’s role in the environment
- Species can live in the same habitat but not share the same niche due to competition for resources


Feeding height (meters)
18
12
6
0
Bay-Breasted Warbler
Feeds in the middle part of the tree
Spruce tree
Cape May Warbler
Feeds at the tips of branches near the top of the tree
Yellow-Rumped Warbler
Feeds in the lower part of the tree and at the bases of the middle branches

Organism's Response to Changing Environments:

- Tolerance curve – graph of performance versus an environmental variable
  - Ex) If a fish's water gets too hot or too cold, then they will slow down then eventually die
- Acclimation – adjustment to an abiotic factor
  - Ex) increase in red blood cells when you go up in altitude
- Migration – moving to another more favorable habitat


Zone of intolerance
Species absent
Zone of physiological stress
Species infrequent
Optimal range
Species abundant
Zone of physiological stress
Species infrequent
Zone of intolerance
Species absent
Too low: lower limit of tolerance
Optimum
Too high: upper limit of tolerance
Environmental Gradient

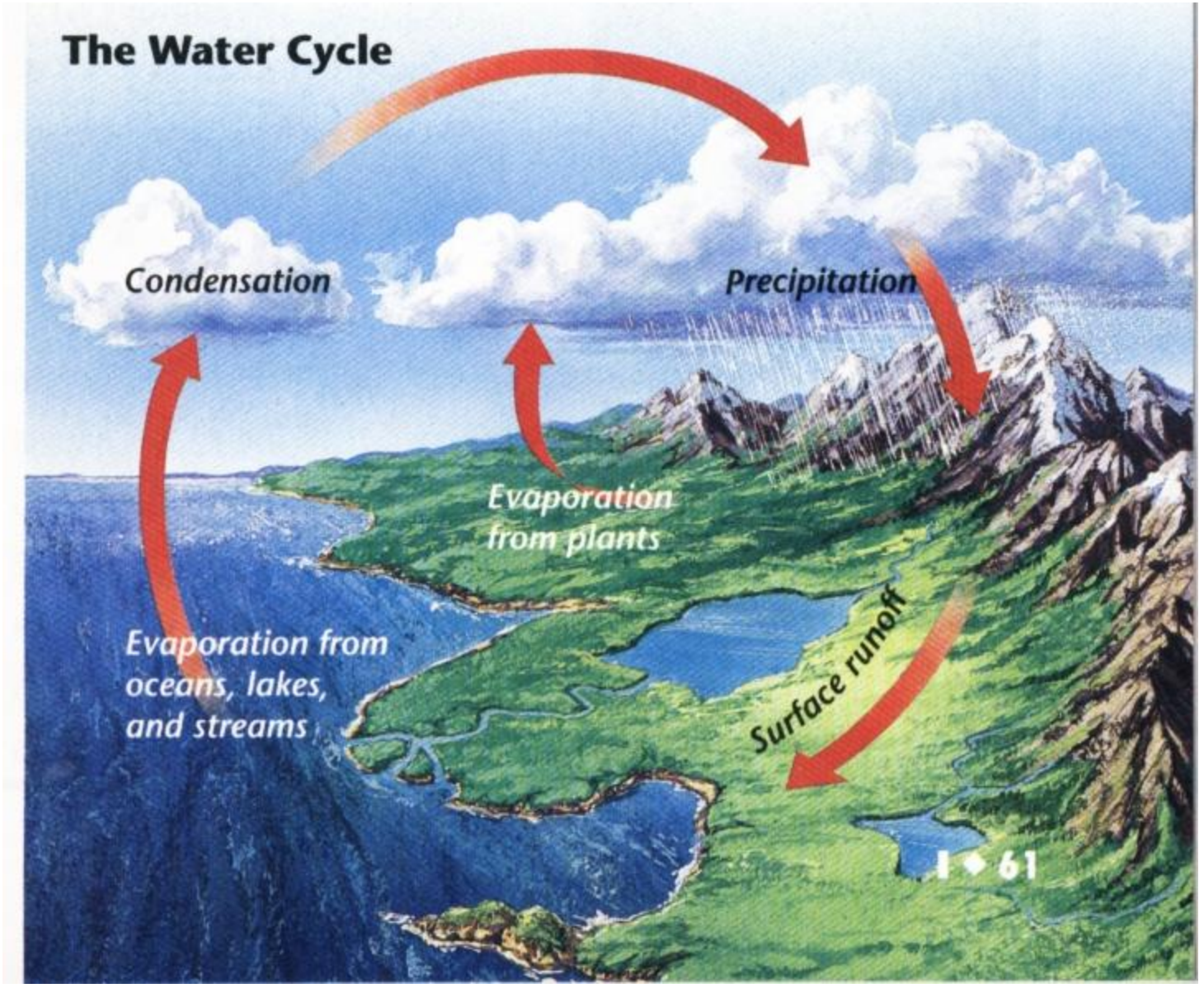

Range of Tolerance
No. of Individuals
Precipitation

Nutrient Cycles

- Why is it important to recycle nutrients such as C, O, N, P, and water?
  - Matter (elements and compounds) must be put back into the ground (recycled) in order for organisms to be able to use them again
  - Necessary for life to continue

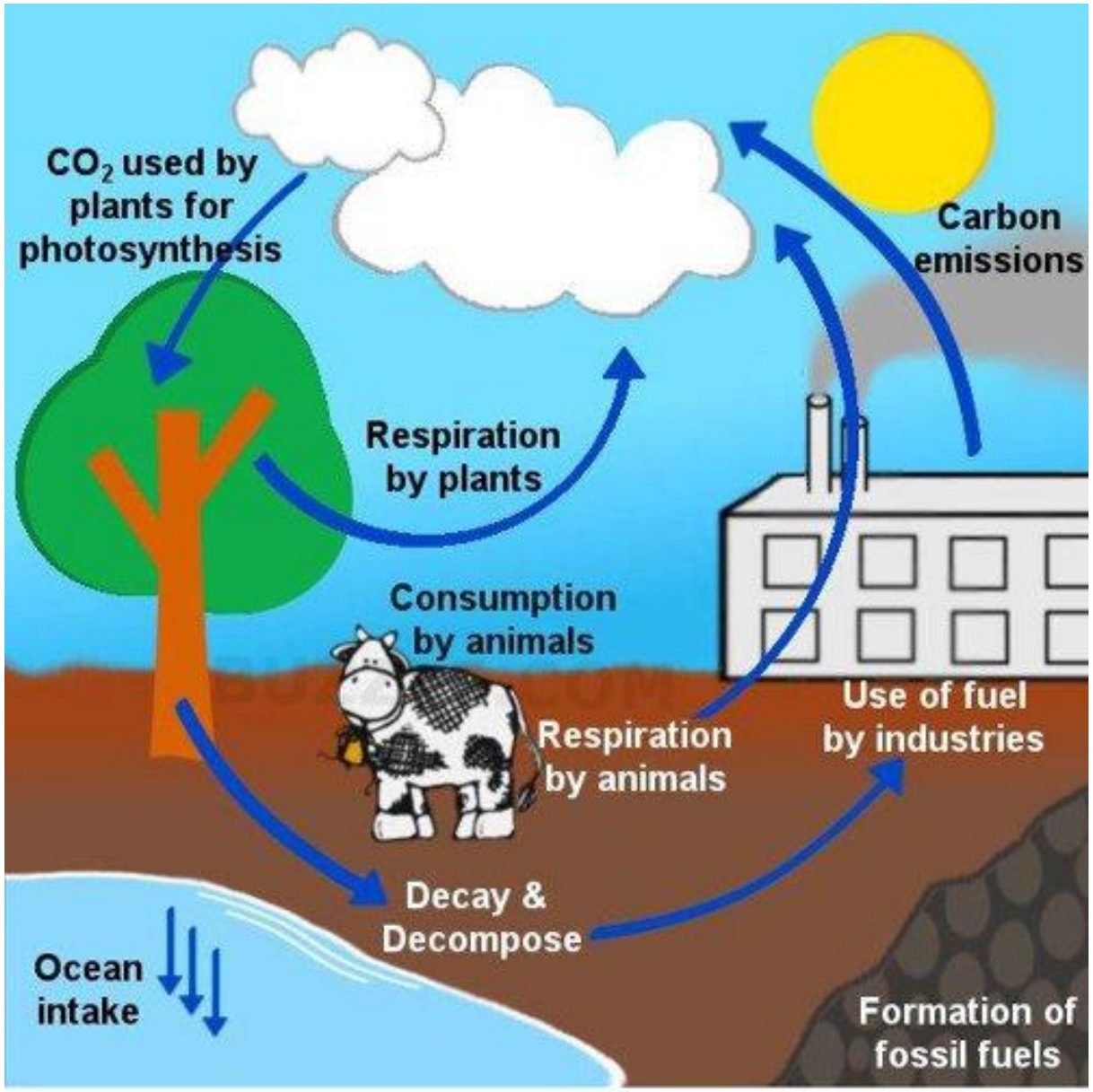
Water Cycle

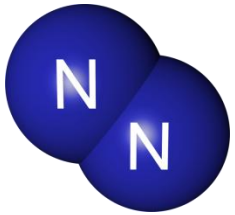
- Circulates freshwater between the earth's surface and the atmosphere.
  - The water cools to form clouds (condensation) and **water vapor** which then creates **precipitation** (rain, snow, sleet, hail)
  - **Runoff** moves water from the mountains to the rivers, lakes, streams, and groundwater
  - The sun provides heat to start **evaporation** of water molecules from Earth's surface
  - Plants also release water into the atmosphere by the process of **transpiration**


The Water Cycle
Condensation
Precipitation
Evaporation from plants
Evaporation from oceans, lakes, and streams
Surface runoff
61

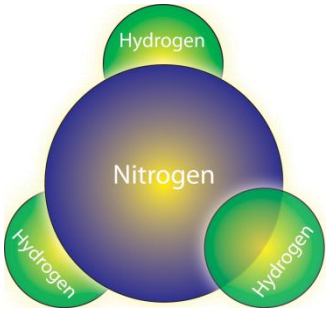
Carbon Cycle

- The cycling of carbon between carbon dioxide and organic molecules
  - Plants take in carbon dioxide through **photosynthesis**
  - Carbon also passes to other organisms through the food chain or web
  - It the returns to the atmosphere and the Earth through **respiration**, **waste** or **decomposition** after death
  - Coal and other **fossil fuels** can form from decomposing organic matter and burning it off, which called **combustion**

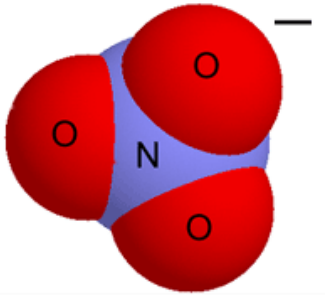

CO_2 used by plants for photosynthesis
Carbon emissions
Respiration by plants
Consumption by animals
Respiration by animals
Use of fuel by industries
Decay & Decompose
Ocean intake
Formation of fossil fuels
Illustrated by Zainab Jam

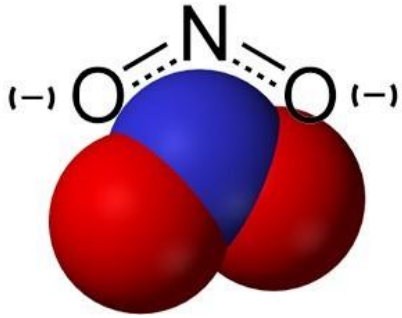


Nitrogen Cycle

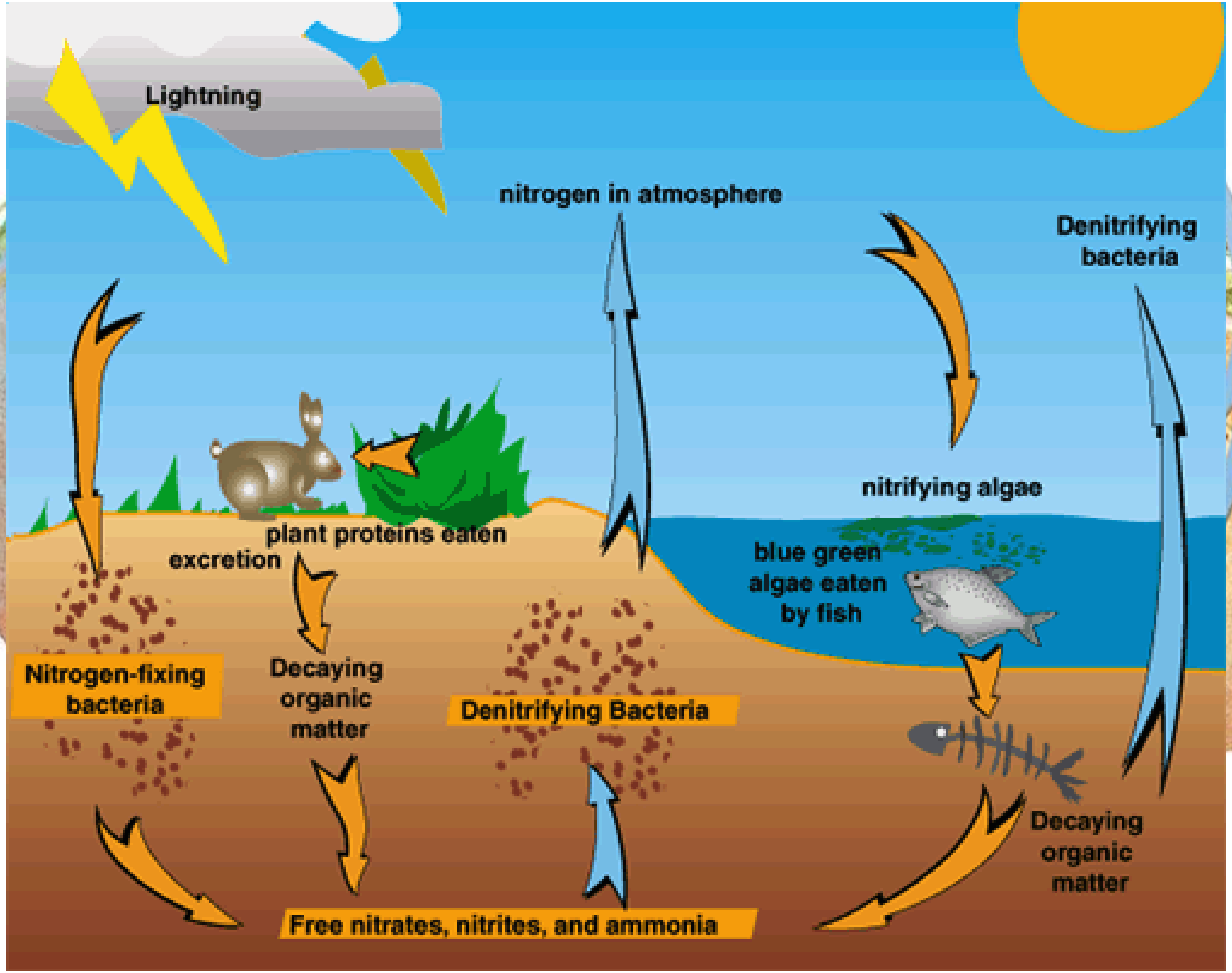


- The conversion of nitrogen gas into other nitrogen forms so that plants and animals may use it
  - **Nitrogen fixation** converts nitrogen gas into another form of nitrogen (ammonia) by bacteria in the soil and plant roots and by blue green algae in the ocean
  - **Waste and death/decomposition** also release ammonia into the ground
  - Ammonia then changes into another nitrogen form that **plants** can now use (nitrate and nitrite) with the help of more bacteria



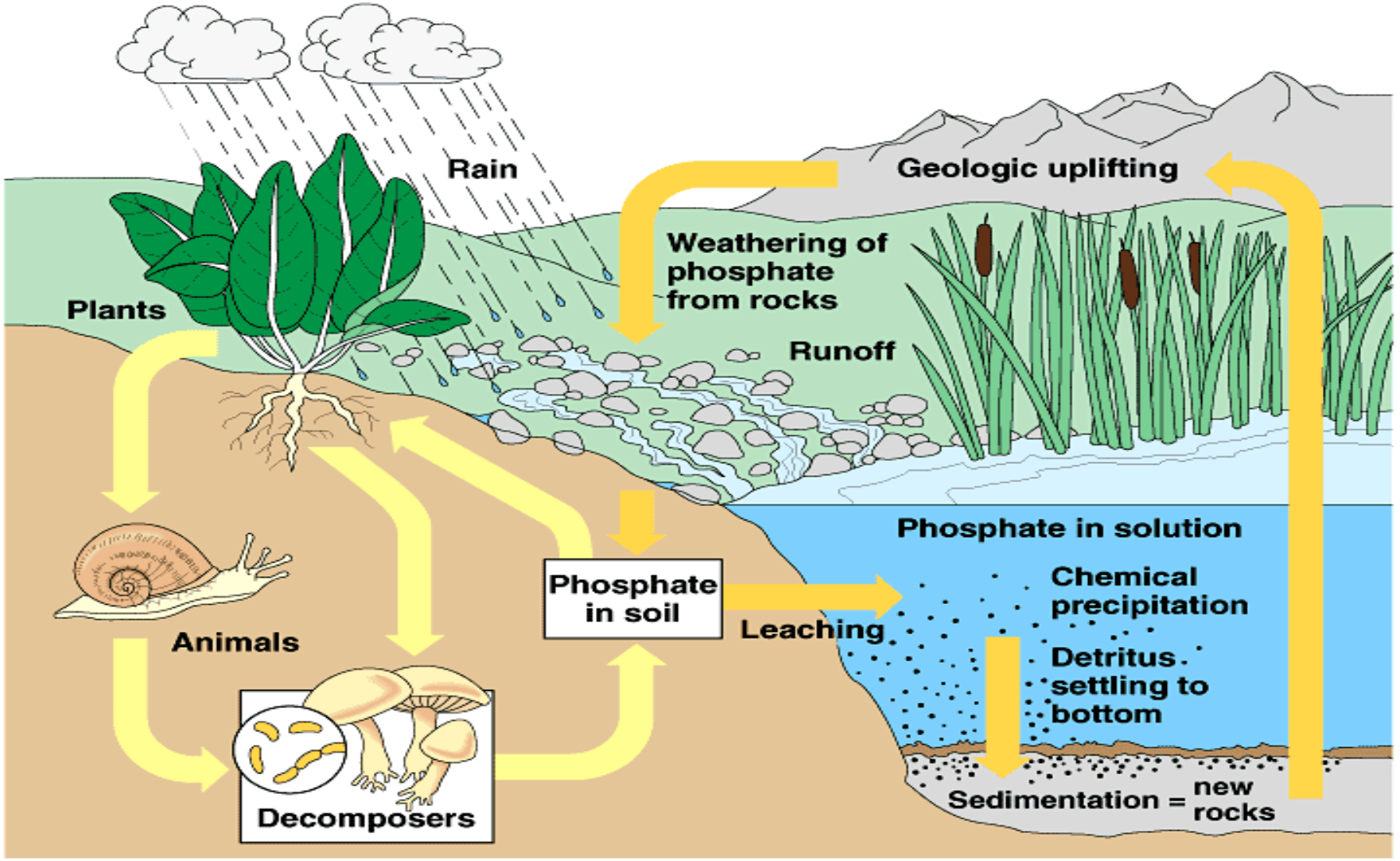


- **Lightening** and the addition of **fertilizer** are the final ways usable nitrogen gets into the soil
- The nitrogen passes to **animals** through the food chain
- The bacteria then convert nitrate and nitrite into nitrogen gas again (**denitrification**) and is released back into the atmosphere


Lightning
nitrogen in atmosphere
Denitrifying bacteria
nitrifying algae
plant proteins eaten
excretion
blue green algae eaten by fish
Nitrogen-fixing bacteria
Decaying organic matter
Denitrifying Bacteria
Decaying organic matter
Free nitrates, nitrites, and ammonia

Phosphorous Cycle

- Cycling of phosphorous from rocks to the food chain
  - Phosphorous is introduced into the soil and water through the breakdown of rocks (**weathering**)
  - **Plants and fungus** absorb the phosphorous from the soil
  - The phosphorous then moves through the food chain to **animals**
  - It then returns to the soil as **waste or decomposed material**



Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

Energy Flow

- Food chain = linear feeding relationship from one trophic level to the next
- Trophic level = organism's position in the food chain or web
- Food web = feeding relationship with several interconnected food chains

Energy Flow

- 4 parts: producers, primary consumers, secondary consumers, tertiary consumers
- Sun is the ultimate source of energy

- Only 10% of the energy from one trophic level gets passed to the level above
  - Reason: some energy is lost as heat, organisms need energy to live, and not all organisms get eaten

Community

Community

- Remember: Species can share a habitat, but not a niche because of competition for resources
- One species will win out and the other will be forced to find another resource or they will die off (natural selection)

- **Natural selection** = organisms with traits better suited for an environment will survive and reproduce while other organisms die off

- Passing the beneficial trait to offspring creates an **adaptation**

- Variation in traits occurs from: DNA mutations, independent assortment, and random fertilization

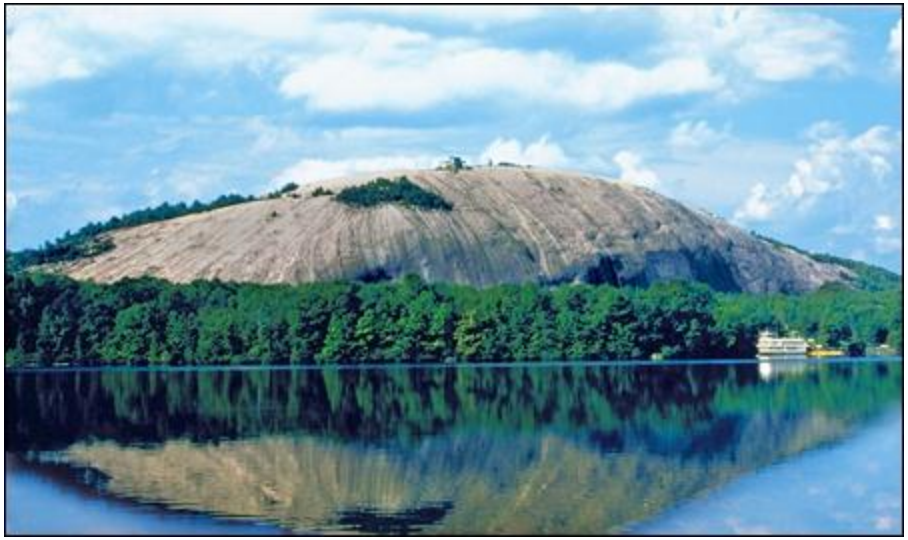
Succession

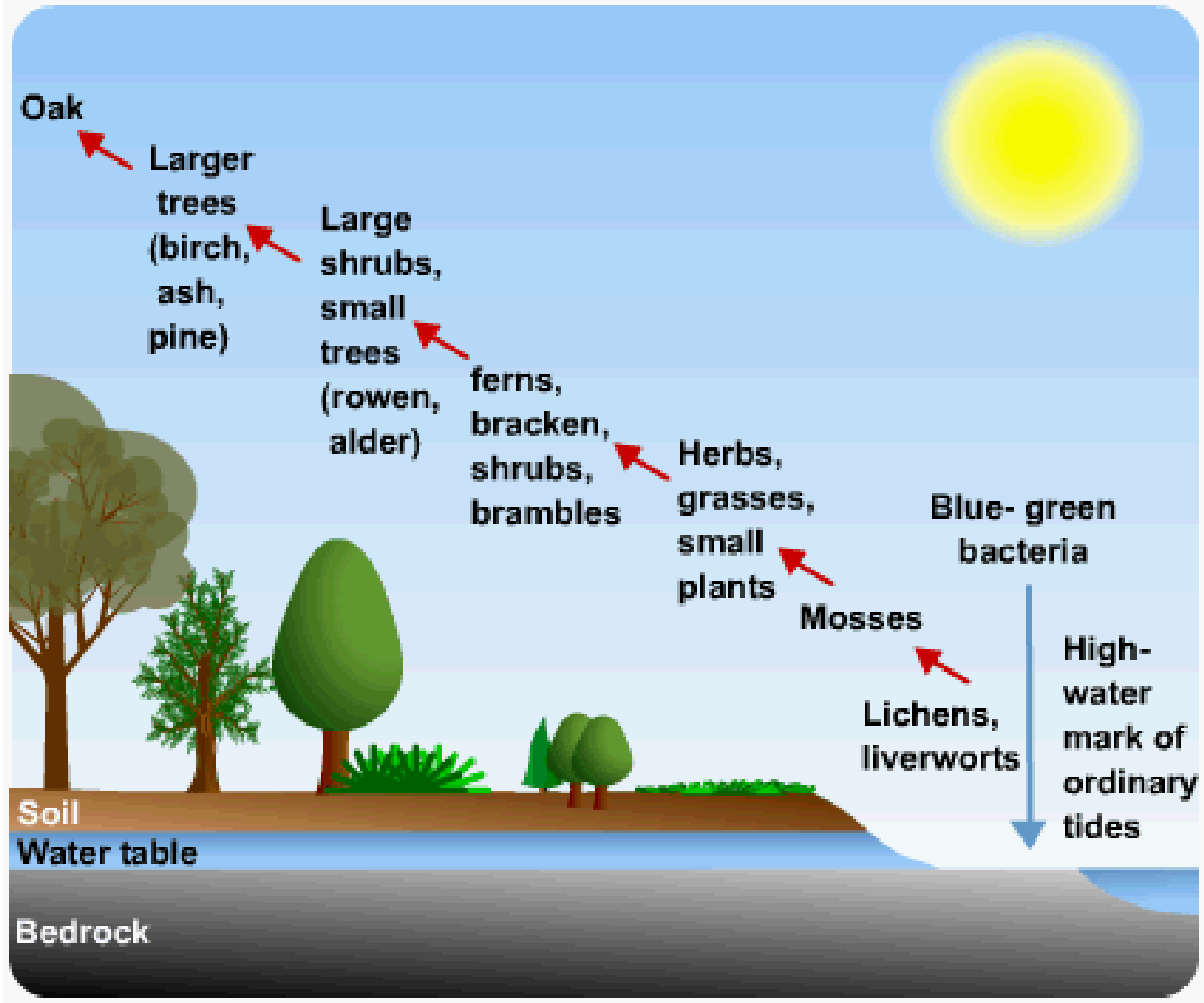
- Other factors that contribute to changes in communities include succession

- Succession = series of changes in the composition of an ecological community over time
  - Two types: Primary and Secondary

Primary Succession

- Building up of a community where life DID NOT previously exist
  - Ex) bare rock (Stone Mountain, volcanic eruptions, glacial retreat), sand dunes




Oak
Larger trees (birch, ash, pine)
Large shrubs, small trees (rowen, alder)
ferns, bracken, shrubs, brambles
Herbs, grasses, small plants
Mosses
Lichens, liverworts
Blue- green bacteria
High-water mark of ordinary tides
Soil
Water table
Bedrock

Secondary Succession

- Building up of a community where life DID previously exist
  - Ex) natural disaster, forest fire

Pioneer Species

- First species to grow in an area
  - Ex) lichen (fungus + algae), moss

Climax Community

- Stable, mature community that undergoes little or no change in species
  - When equilibrium is reached after succession occurs

Species Interactions (Symbiosis)

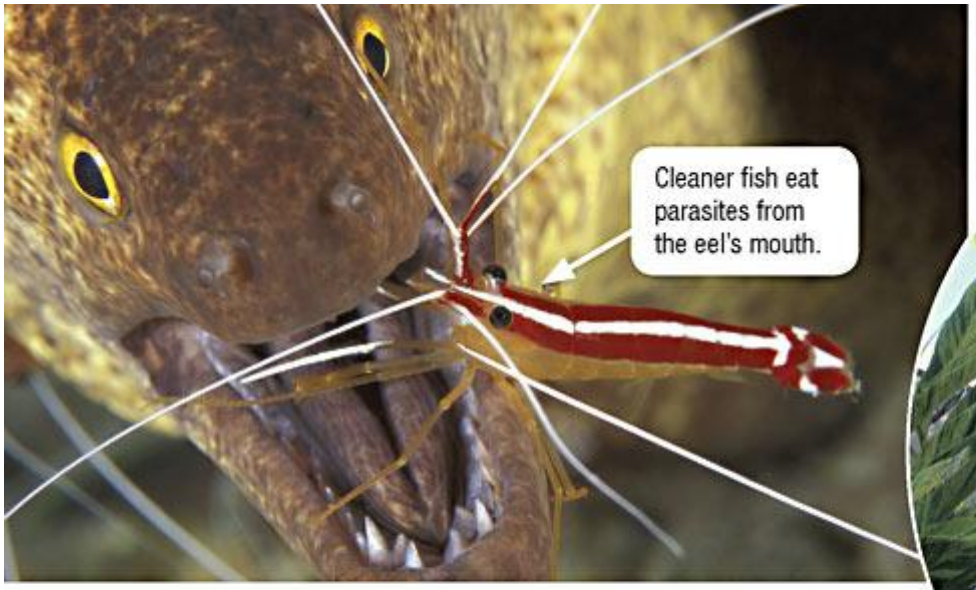
- 1) Predation - act of one organism killing another for food
  - Ex) snake hunting a mouse

- 2) Competition – fighting for resources
  - Ex) 2 lions fighting for a zebra

- 3) Parasitism – one organism is harmed and the other benefits
  - Ex) ticks, mosquitos

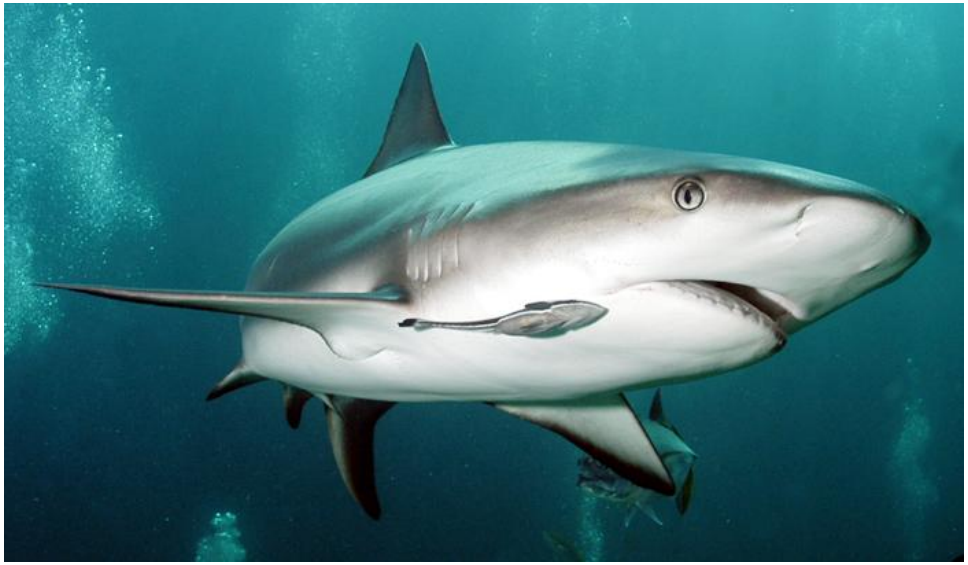
Species Interactions (Symbiosis)

- 4) Commensalism – one organism benefits and the other is neither harmed or helped
  - Ex) fish swimming under a shark to eat the scraps
- 5) Mutualism – both organisms benefit
  - Ex) Bees and flowers


Cleaner fish eat parasites from the eel's mouth.


Orchids receive more sunlight when attached to trees.


4to40



Population

Population

- Population Growth Rate
  - Birth rate – Death rate = Growth rate

- How do we determine population sizes in the real world?
  - Sample of larger population, mark and recapture technique

Limiting Factors

- Any factor that can affect the size of a population
  - 2 Types: density-independent and density-dependent

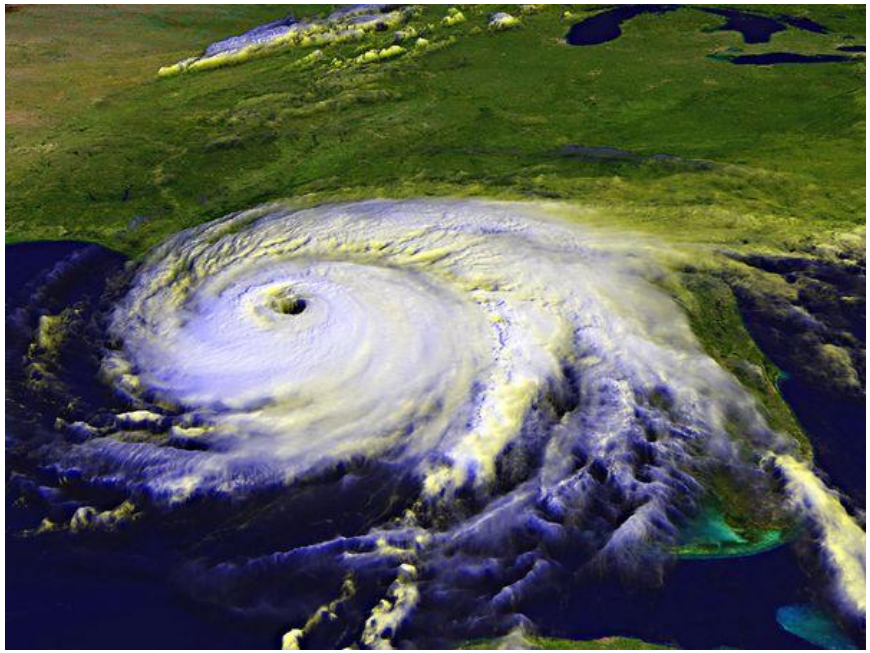
Factors that affect population growth:

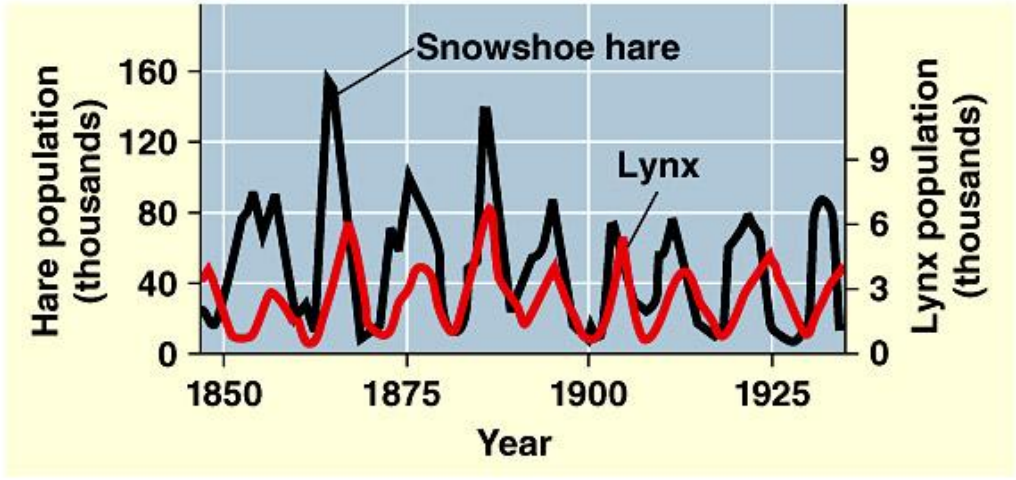
Density-independent factors:

- Limiting factors that influence a population regardless of how many are in the population
  - Ex) natural disaster, floods

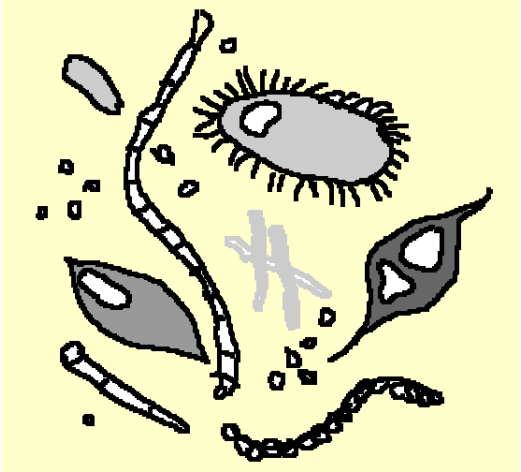
Density-dependent factors:

- Limiting factors that will impact the population as it becomes very large and dense
  - Ex) competition for resources, disease



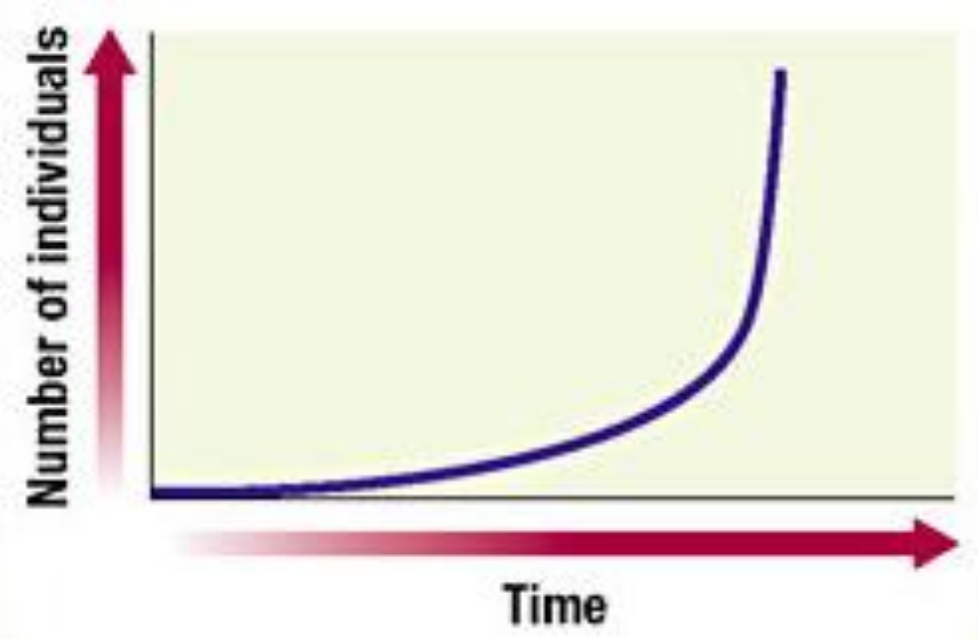


Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.



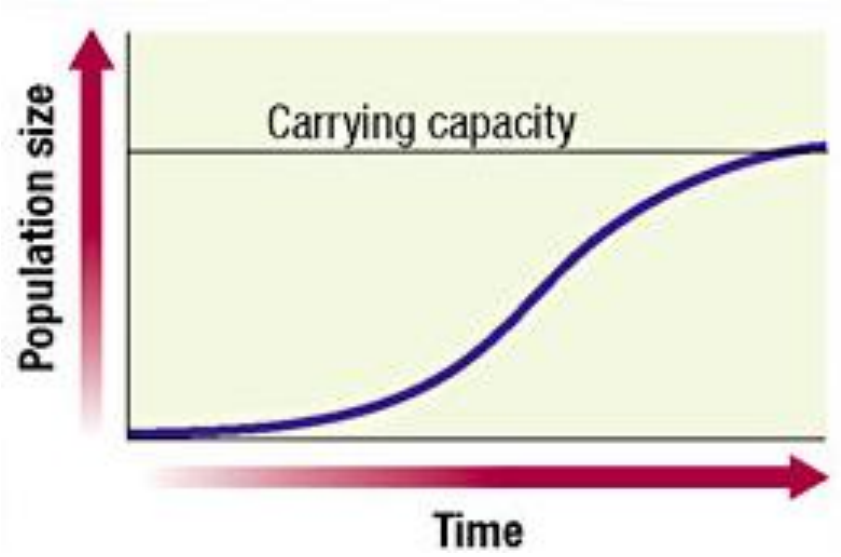
Population

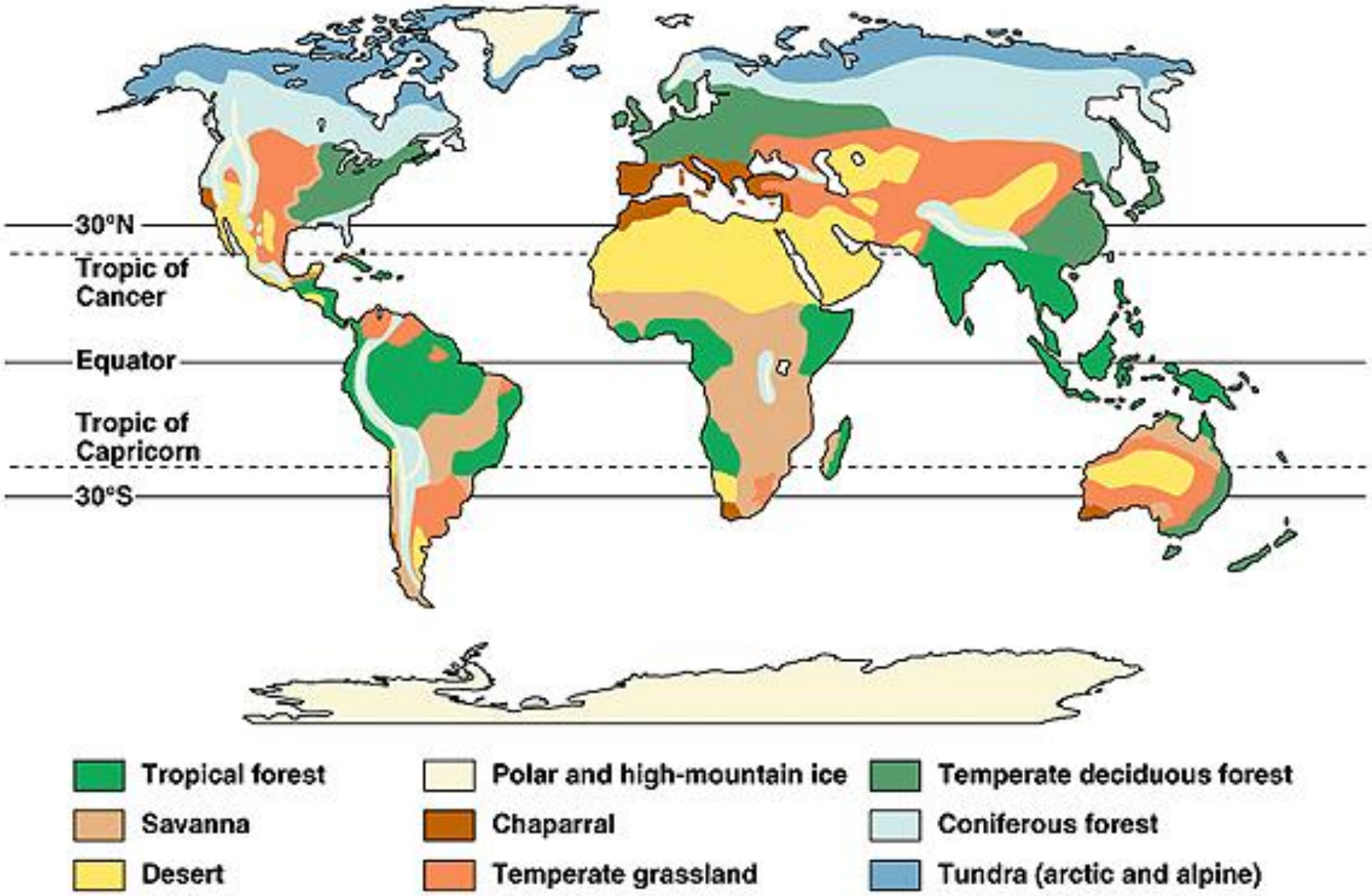
- <u>Exponential Model of Population Growth:</u>
  - Population growth under ideal conditions
  - Rapid growth over a short period of time



Population

- <u>Logistic Model of Population Growth</u>
  - Population growth that is slowed by limiting factors as the population size increases
  - **Carrying Capacity** = maximum amount of organisms that can live off the resources in an area




30°N
Tropic of Cancer
Equator
Tropic of Capricorn
30°S
Tropical forest
Savanna
Desert
Polar and high-mountain ice
Chaparral
Temperate grassland
Temperate deciduous forest
Coniferous forest
Tundra (arctic and alpine)

Biomes

Factors that define a biome

- Climate (Precipitation and Temperature)
- Unique Plant and Animal life
- Video: Intro to Biomes

Tundra

- Cold and largely treeless, lichen/moss and grasses/wildflowers
- Has layer of permafrost (permanently frozen soil)
- Little precipitation and nutrient poor soil
- Furthest northern-most biome
- Reindeer and caribou / polar bears and penguins

Tundra

- Temperature: -25 to 5°C
- Precipitation: 0 to 20 cm
- Soil: Permafrost
- Vegetation: Mosses, lichen, and short grasses
- Location: Northern N. America, Europe, and Asia

Taiga

- Cone-bearing trees; biome south of the tundra
- Plants adapted to long cold winters, short summers, and nutrient poor soil
- Animals either hibernate in winter or migrate, wolves and rabbits

Taiga

- Temperature: -20 to 20 °C
- Precipitation: 5 to 25 cm
- Soil: Nutrient poor
- Vegetation: Conifers
- Location: Northwestern US, Canada; just under Tundra

Deciduous Forest

- Biome we live in
- Trees lose leaves in the fall
- Have pronounced seasons
- Deer, birds, small animals, and bears

Deciduous Forest

- Temperature: 10 to 20 C
- Precipitation: 15 to 30 cm
- Soil: fertile
- Vegetation: Broad leaf trees
- Location: Eastern US, Europe, Japan

Grassland

- Includes the Steppe, Prairie, and Savanna
- Dominated by grasses; mid-west USA
- Too dry to support trees and has rich, fertile soil
- Prairie dogs and snakes

Grassland

- Temperature: 5 to 30 C
- Precipitation: 20 to 35 cm
- Soil: fertile
- Vegetation: grasses, herbs, shrubs
- Location: Central US

Savanna

- Have alternating wet and dry seasons
- Plants and animals deal with long periods without rain, some umbrella trees
- Soil low in nutrients compared to mid-west grasslands
- Zebra and lion

Savanna

- Temperature: 25 to 30 C
- Precipitation: 30 to 35 cm
- Soil: compact
- Vegetation: grasses and trees
- Location: Africa, N. Australia

Desert

- Very little precipitation
- Vegetation is sparse except for plants that have adapted to dry conditions
- Not all are hot
- Jackrabbits and lizards; cactus and other sebaceous plants

Desert

- Temperature: 10 to 35 C
- Precipitation: 15 to 25 cm
- Soil: sandy
- Vegetation: cacti, bushes
- Location: US, Africa, Mexico

Tropical Rainforest

- Lots of rainfall; tall trees
- Located on the equator
- Stable, year round growing season
- Largest biodiversity on land

Tropical Rainforest

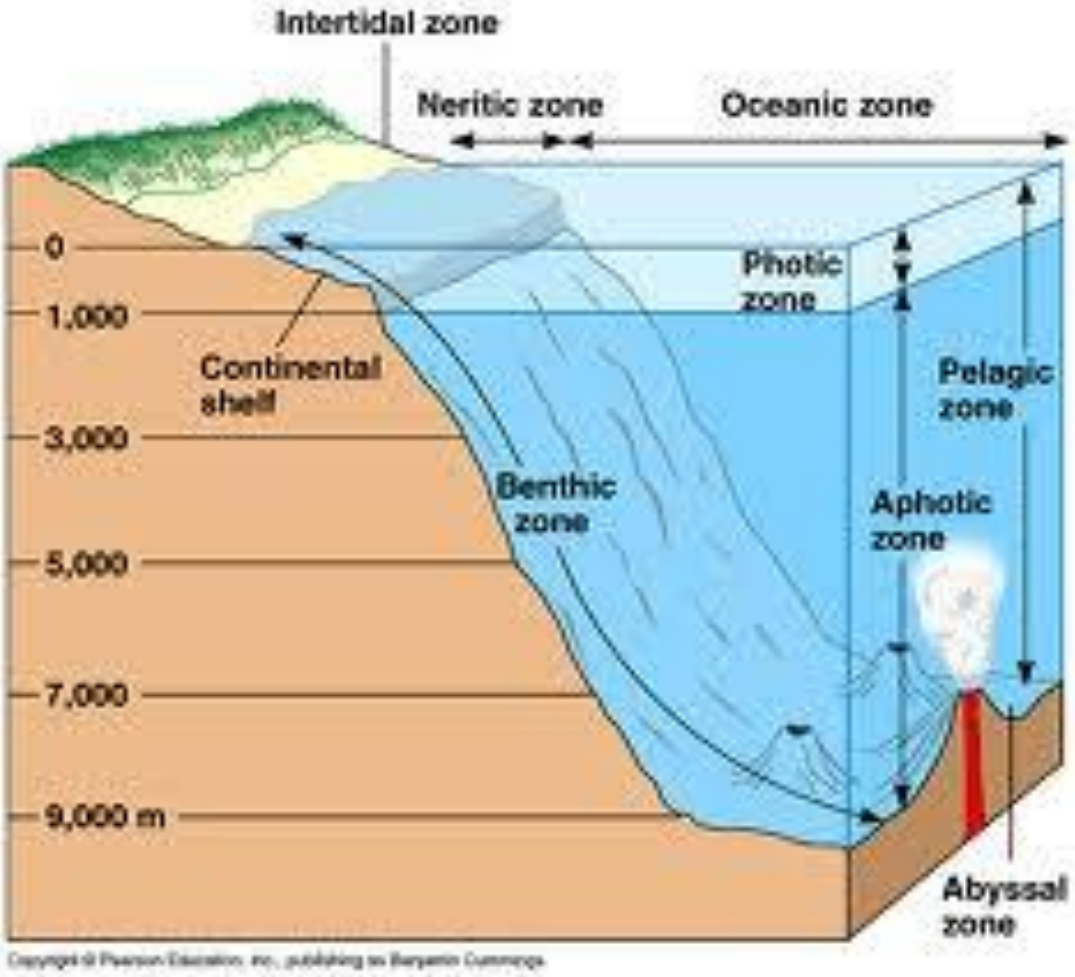
- Temperature: 25 to 30 C
- Precipitation: 30 to 40 cm
- Soil: nutrient poor
- Vegetation: large trees, large diverse
- Location: S. and C. America, Africa

Aquatic Biomes

Marine

- Contains salt water
- Many zones divide the ocean and different organisms are found in each zone
  - Ex: Oceanic zone (open ocean) – whales
    Intertidal zone (beach) – ghost crab
    Photic zone (has light) – algae and seaweed

Zones of the Ocean



Oceanic Zone

- Characteristics: **Open sea**
- Type of Water: Marine
- Plants and Animals: Whales, dolphins, algae, seaweed

Neritic Zone

- Characteristics: **Over continental shelf, can contain coral reefs, which are the most biodiverse water biome**
- Type of Water: Marine
- Plants and Animals: Sharks, sponges, shrimp, tuna, kelp

Intertidal Zone

- Characteristics: **Area is exposed to air part of the day due to tides**
- Type of Water: Marine
- Plants and Animals: sea stars, sand dollars, sea palms, grasses

Other Zones

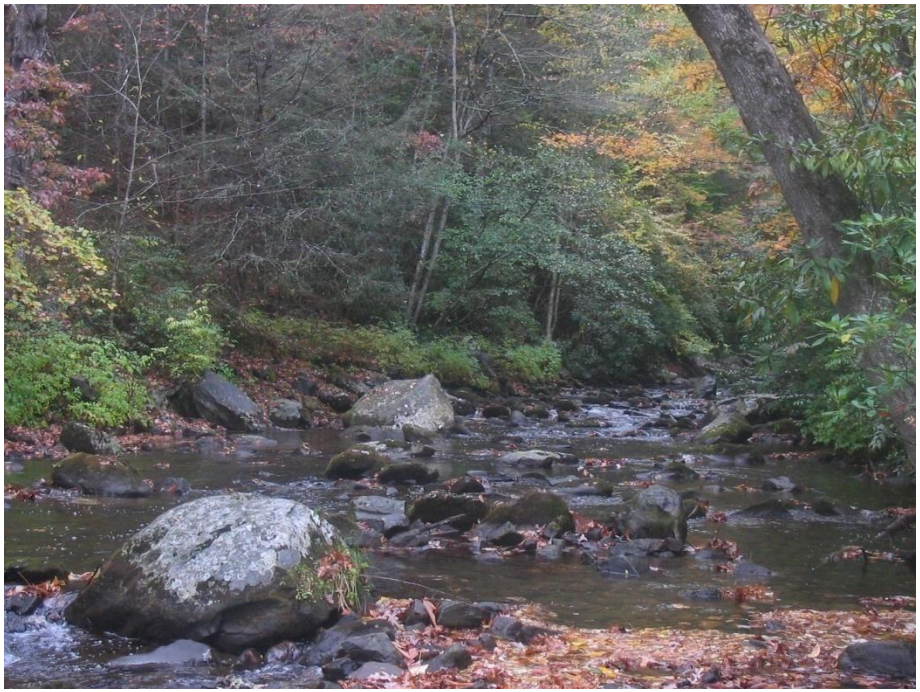
- Photic – has light
- Aphotic – no light
- Pelagic – area from surface to deep into the ocean
- Benthic – lowest zone of the ocean along the ocean floor

Freshwater: Lakes and Ponds

- **Characteristics: Inland body of water, can vary in size with less than 1% salt content**
- Type of Water: Fresh
- Plants and Animals: Fish, frogs, ducks, lilypads, trees

Freshwater: Rivers and Streams

- Characteristics: Running water, curve or meander, make up watersheds
- Type of Water: Fresh
- Plants and Animals: Salmon, dragonflies, algae, trees



Estuaries/Wetlands

- **Characteristics: Mixture of fresh and salt water, located along the coast and behind islands**
- Type of Water: Fresh, Salt, and Mixed
- Plants and Animals: Oysters, crabs, birds, mangrove trees, marsh grass