

*Nature encourages  
no looseness,  
pardons no errors.*  
- Ralph Waldo Emerson

**TOPICS INCLUDE:**

- Ecosystems
- Energy
- Succession

# AP ENVIRONMENTAL SCIENCE



## UNIT 2: THE LIVING WORLD (PART A)

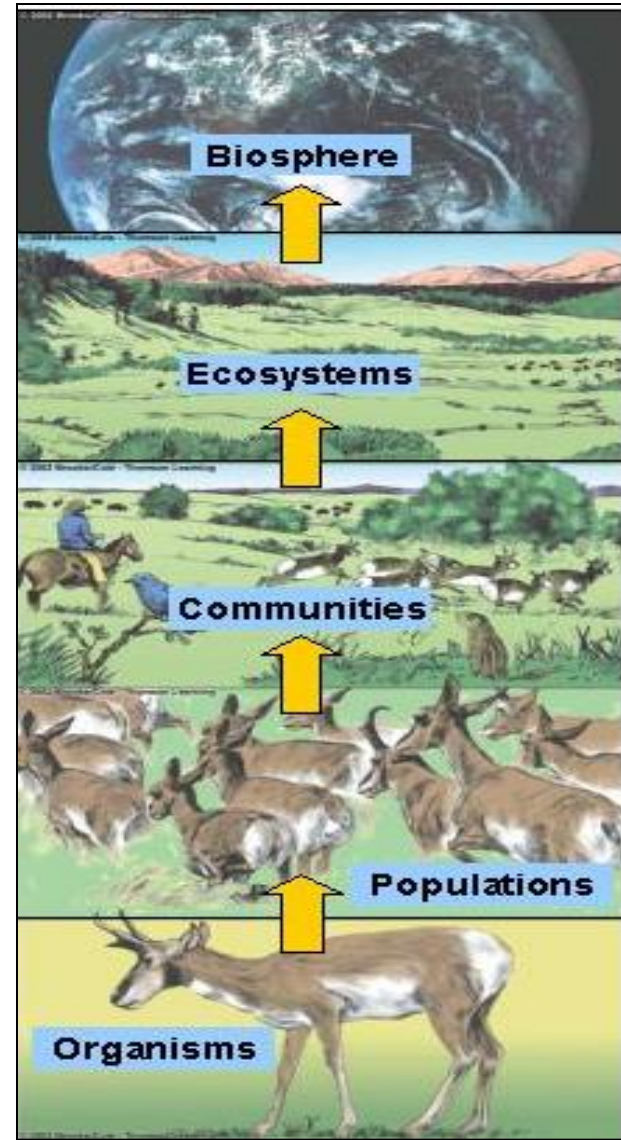
## II. THE LIVING WORLD (10-15%)

- A. Ecosystem Structure** – biological populations and communities, ecological niches, interactions among species, keystone species, species diversity and edge effects, major terrestrial and aquatic biomes
- B. Energy Flow** – photosynthesis and cellular respiration, food webs and trophic levels and ecological pyramids
- C. Ecosystem Diversity** – biodiversity, natural selection, evolution, and ecosystem services
- D. Natural Ecosystem Change** – climate shifts, species movement and ecological succession
- E. Natural Biogeochemical Cycles** – carbon, nitrogen, phosphorus, sulfur, water, and conservation of matter



# NATURE OF ECOLOGY

- *Ecology*- study of relationships between organisms and their environment
  - examines how organisms (biotic) interact with their nonliving (abiotic) environment such as sunlight, temperature, moisture, and vital nutrients

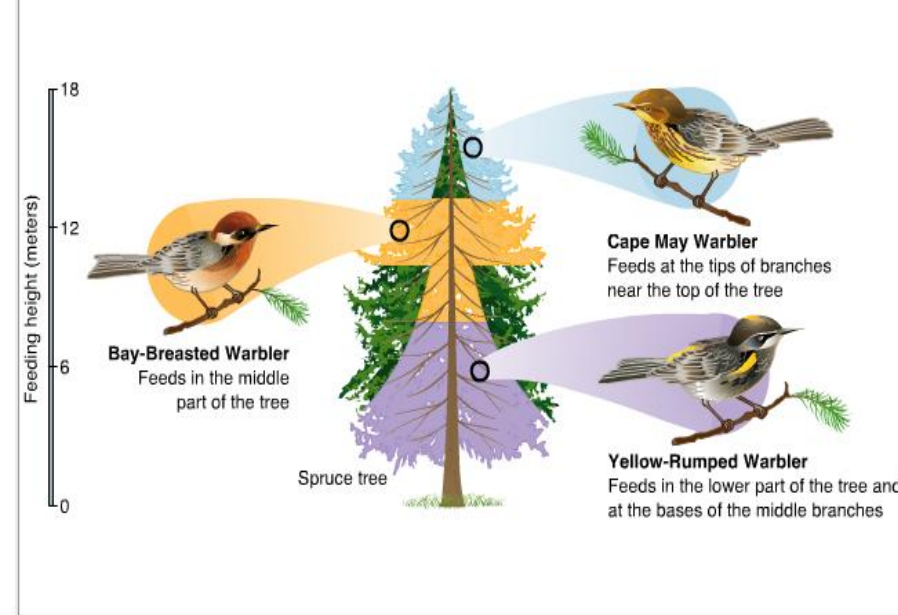


# STRUCTURE OF ECOSYSTEMS

TERM	DEFINITION
ECOSYSTEMS	communities of different species interacting together and the abiotic or nonliving environment
PRIMARY PRODUCER (AUTOTROPH)	organisms that make their own food by photosynthesis (ex. plants, phytoplankton, algae)
CONSUMER (HETEROTROPH)	organisms that eat living or dead material
PREDATOR	organisms that kill and eat other animals
PREY	organisms that are eaten by a predator
DETRIVORE	organisms that feed on dead or dying organisms
DECOMPOSER	type of detritivore that feeds on leaves or rotting wood breaking them down into simpler inorganic molecules (ex. fungi and bacteria)
NICHE	a role an organism play in its environment
HABITAT	a place where an animal lives

# ECOLOGICAL NICHE

- description of organisms adaptive traits, habitat and place in the food web
- reflects the specific adaptations that a species has acquired through evolution



**Warbler Niches** Each of these warbler species has a different niche in its spruce tree habitat. By feeding in different areas of the tree, the birds avoid competing with one another for food. **Inferring** What would happen if two of the warbler species attempted to occupy the same niche?

# GENERALIST VS. SPECIALIST SPECIES

## GENERALIST

- live in broad niche
- withstand wide range of environmental conditions
- EX: cockroach, mice, humans

## SPECIALIST

- live in narrow niche
- sensitive to environmental conditions
- more prone to extinction
- EX: giant panda (fed only on bamboo)



# BIOMES

- ◉ **biome**: large regions characterized by a distinct climate & specific life-forms, especially vegetation, adapted to the region.

## major biomes:

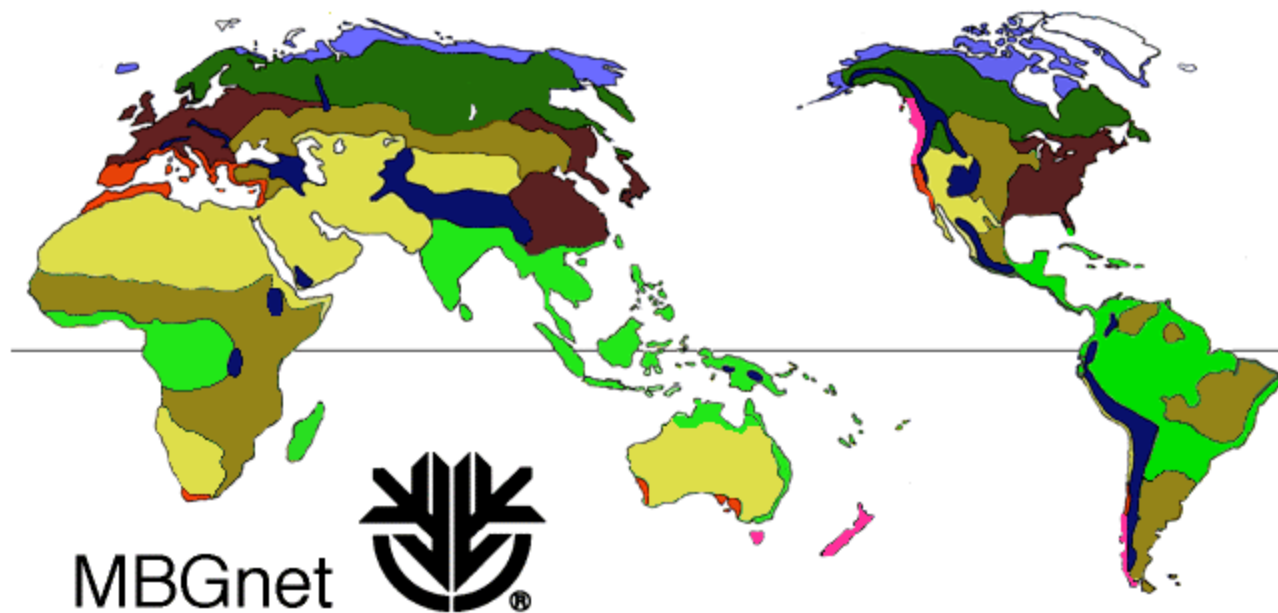
- temperate grassland, temperate deciduous forest, desert, tropical rain forest, tropical deciduous forest, tropical savannah, coniferous forest, tundra

- ◉ **aquatic life zone**: major marine or freshwater portion of the ecosphere, containing numerous ecosystems.

## major aquatic life zones:

- lakes, streams, estuaries, coastlines, coral reefs, & the deep ocean

# MAJOR TERRESTRIAL AND AQUATIC BIOMES

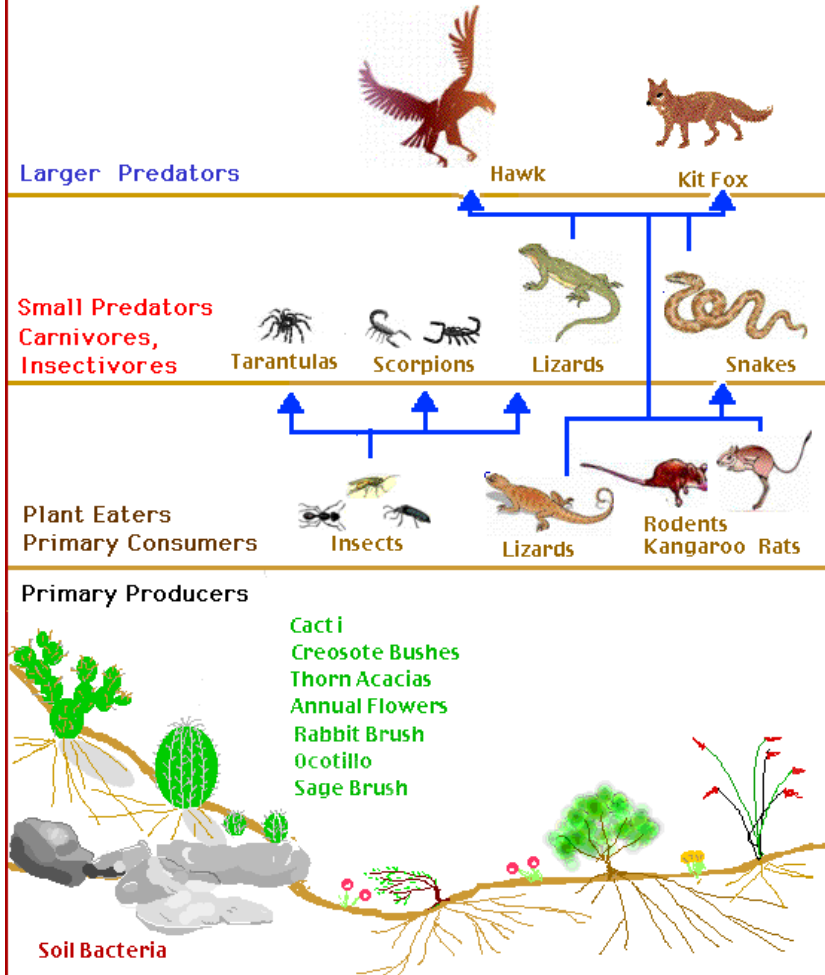


MBGnet



- |   |  |   |   |  |  |
|---|--|---|---|--|--|
|  Tundra              |  Chaparral                  |  Grassland                   |  Taiga       |  Desert |  Mountain Zones |
|  Tropical Rainforest |  Temperate Evergreen Forest |  Temperate Deciduous Forest |  Polar Ice |  |  |

## A Food Web in the Desert Biome



## DESERT

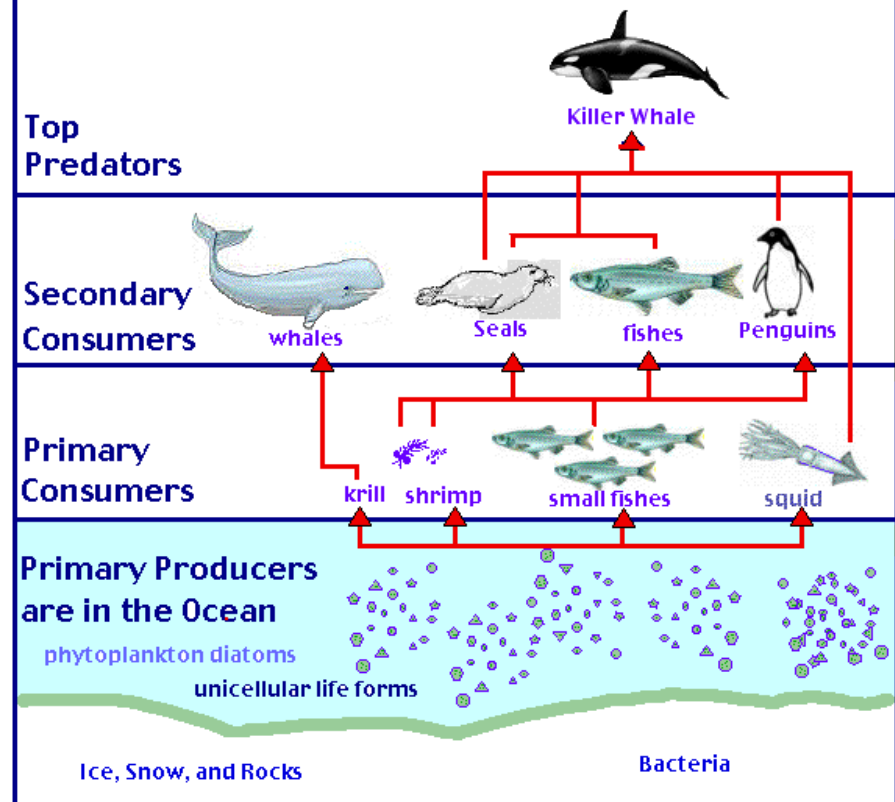
- occur b/w 15<sup>o</sup> and 25<sup>o</sup> N & S latitude
- occupy 20% of all landmass
- less than 20 inches of rainfall per year
- soils abundant in nutrients; lack organic matter; mostly sand

## OCEANS

- occupy 75% of Earth's surface
- areas of low diversity & productivity (except near shoreline)
- low in N and P, limits plant growth
- large animals occur but in low density

## A Food Web in the Cold Desert Biome

The Food in this Biome is in the Ocean





## TEMPERATE RAIN FOREST

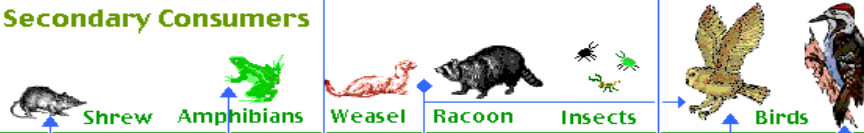
- moderate temperature & rainfall (exceeds 100 inches per year)
- low biodiversity (limited light)
- major resource for timber

### A Food Chain in the Temperate Rain Forest Biome

#### Tertiary Consumers



#### Secondary Consumers

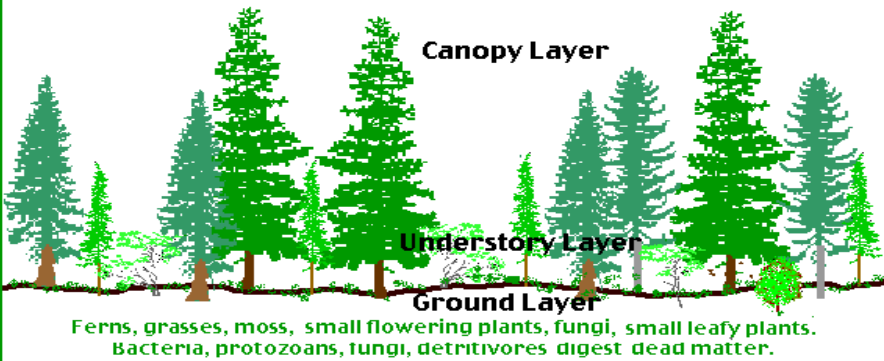


#### Primary Consumers



#### Primary Producers

Ferns   Mosses   Shrubs   Canopy level trees: Conifers: Fir   Hemlock   Cedar   Spruce  
 Shrubs   Flowers   Understory trees: Vine   Maples   Dogwood



### A Food Chain in the Tropical Rain Forest Biome

#### Larger Predators



#### Small Predators, Carnivores, Insectivores

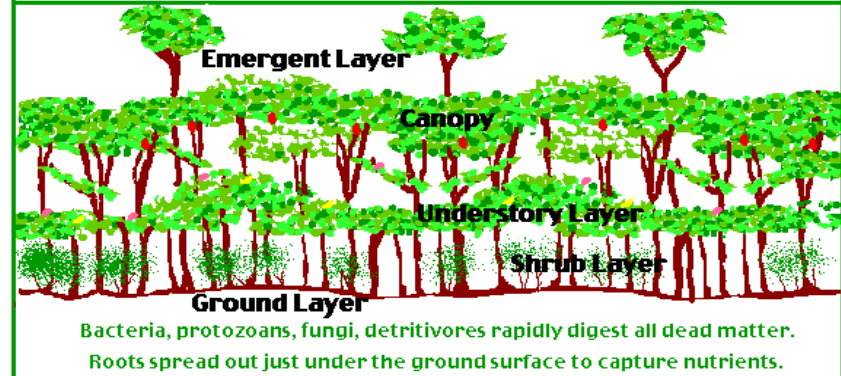


#### Primary Consumers



#### Primary Producers

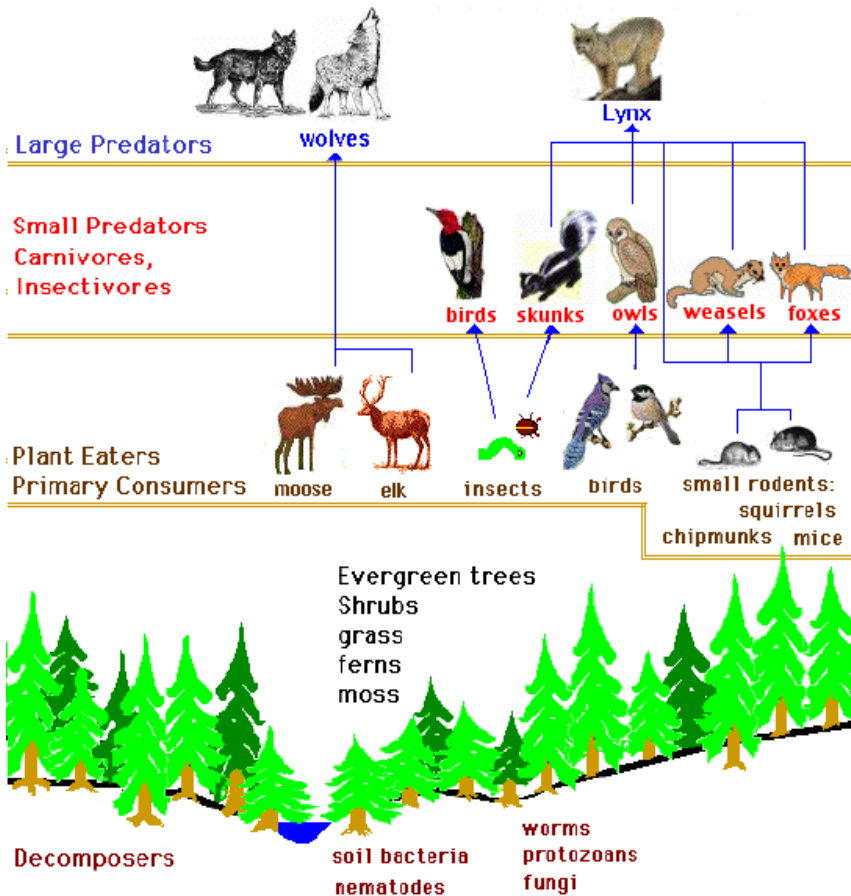
Canopy level trees   Vines   Epiphytes  
 Understory trees   Many flowering plants



## TROPICAL RAIN FOREST

- high & constant temperature (80°F)
- rainfall ranges b/w 75-100 inches per year
- high species diversity
- dense vegetation; soil low in nutrients
- high rate of decomposition
- humans clearing forests (slash & burn) for agriculture

## A Food Web in the Coniferous Forest Biome



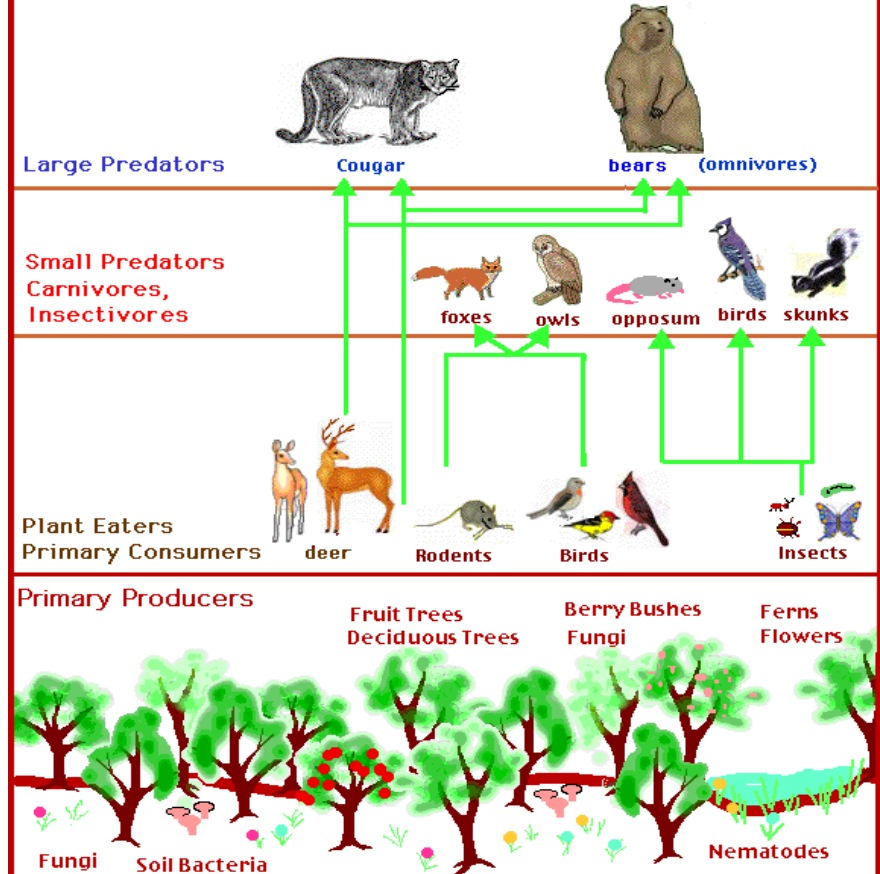
## CONIFEROUS FOREST (TAIGA/BOREAL)

- found b/w 45<sup>o</sup> and 60<sup>o</sup> N latitude
- occupy 17% of land surface
- precipitation during summer
- soil poor in nutrients (leaching by rainfall)
- acidic soil (decomposition of needles)
- deep layer of surface litter
- slow rate of decomposition
- low biodiversity (fires, storms, insects)

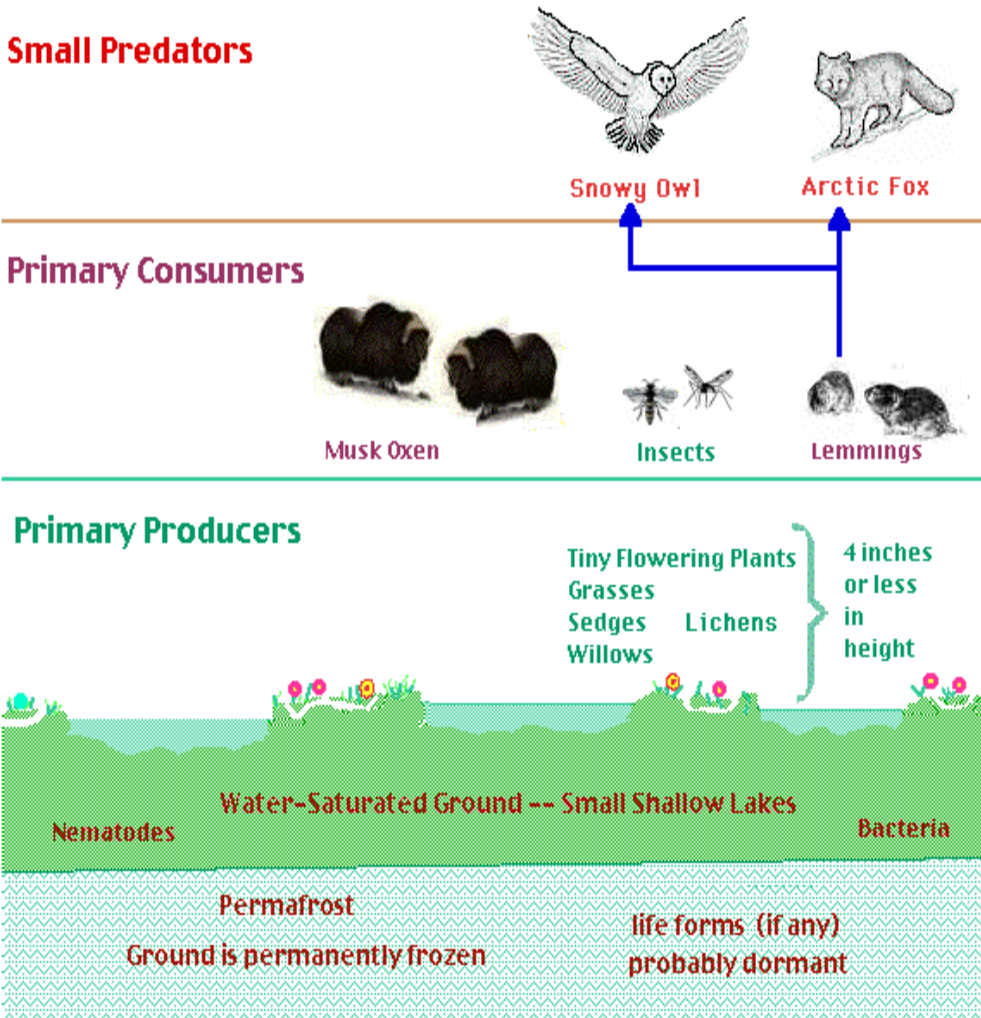
## DECIDUOUS FOREST

- milder temperatures
- rapid decomposition
- small litter on surface
- exploited by humans (agriculture, lumber, and urban development)
- soil poor in nutrients
- tall deciduous trees
- low density of large animals (rich understory prevents ground vegetation)

## A Food Web in the Deciduous Forest Biome



## A Food Web in the Tundra Biome



## OCEANS

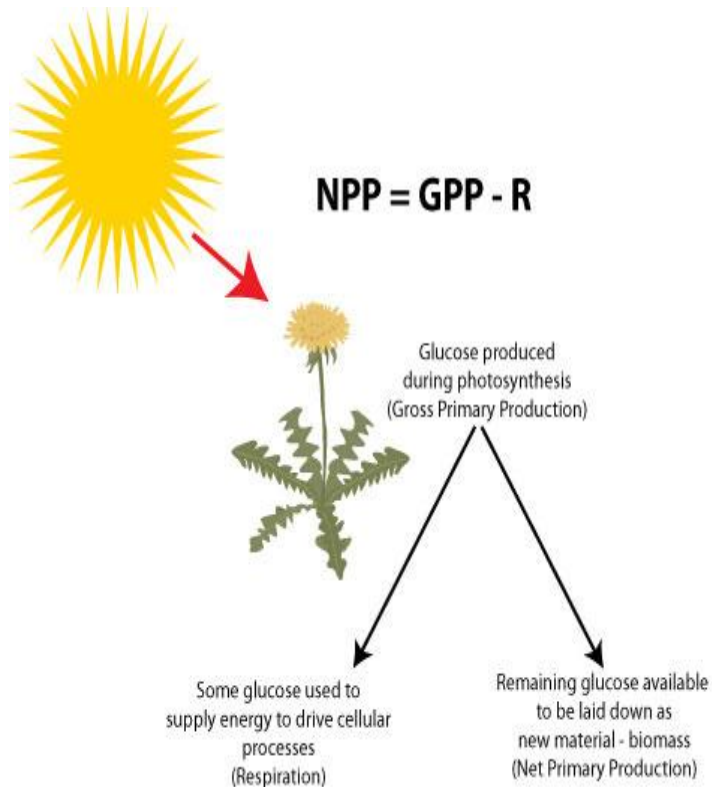
- 60° N latitude and above
- influenced by polar cells
- alpine tundra (mountainous)
  - dominant animals are rodents & insects
- arctic tundra (treeless)
  - low rainfall, low temperature
- growing season lasts 2 months
- soil has few nutrients
- permafrost (permanently frozen ground and barrier for roots)

BIOME	ANNUAL RAINFALL, SOIL TYPE	MAJOR VEGETATION	WORLD LOCATION
Deciduous forest(temperate & tropical)	75-250 cm rich soil w/ high organic content	hardwood trees	North America, Europe, Australia, & Eastern Asia
Tropical rainforest	200-400 cm poor quality soil	tall trees w/few lower limbs, vines, epiphytes, plants adapted to low light intensity	South America, West Africa, & Southeast Asia
Grasslands	10-60 cm rich soil	sod-forming grasses	North American plains & prairies; Russian steppes; South African velds; Argentinian pampas
Coniferous forests (Taiga)	20-60 cm (summer) soil is acidic (vegetation)	coniferous trees	Northern North America, northern Eurasia
Tundra	less than 25 cm soil is permafrost	herbaceous plants	The mountain tops of North America, Europe, & Asia
Chaparral (scrub forest)	50-75 cm (winter) soil is shallow, infertile	small trees w/large hard leaves, spiny shrubs	Western North America, the Mediterranean region
Deserts (cold & hot)	less than 25 cm soil has coarse texture (sand)	cactus, other low-water adapted plants	30 degrees north and south of the equator

# PRODUCERS

## NET PRIMARY PRODUCTIVITY (NPP)

- organisms capable of converting radiant energy or chemical energy into carbohydrates



### Carbon Cycle - Photosynthesis



carbon dioxide

water

sun

glucose

oxygen

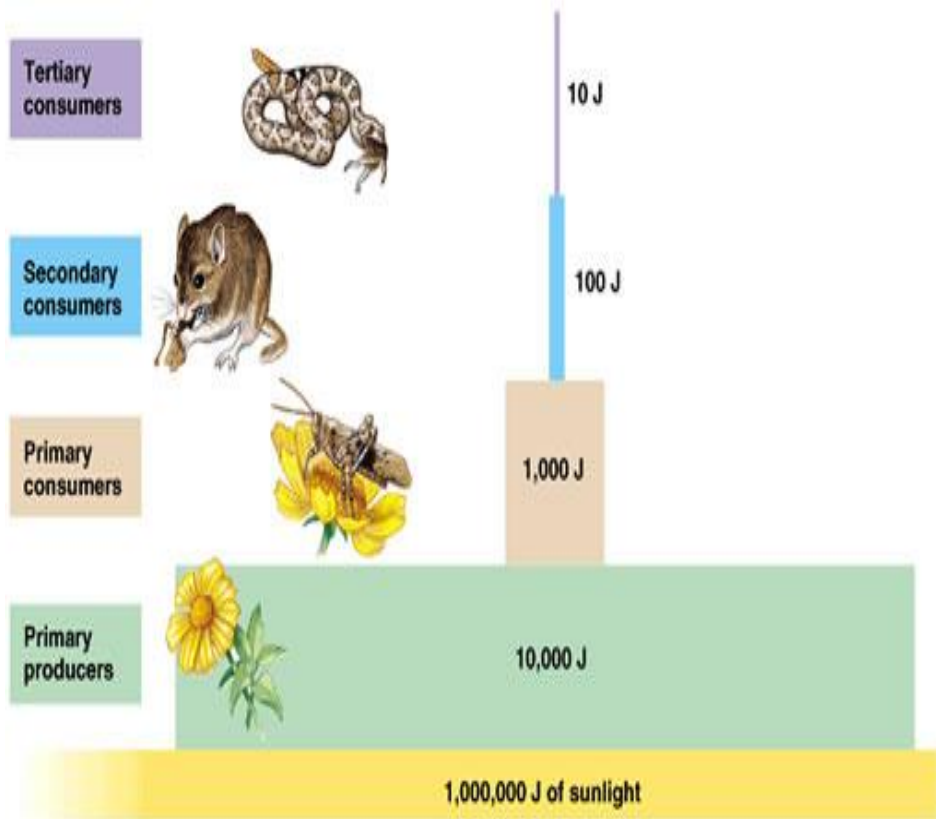
represents any organic matter in plants

- GPP: amount of sugar plants produce in photosynthesis - amount of sugar needed by plants for respiration
- NPP: amount of energy plants pass on to the herbivores in an ecosystem
  - measured in  $\text{kcal/m}^2/\text{y}$
  - limiting factor for consumers



# ECOLOGICAL PYRAMIDS

## TROPHIC LEVELS

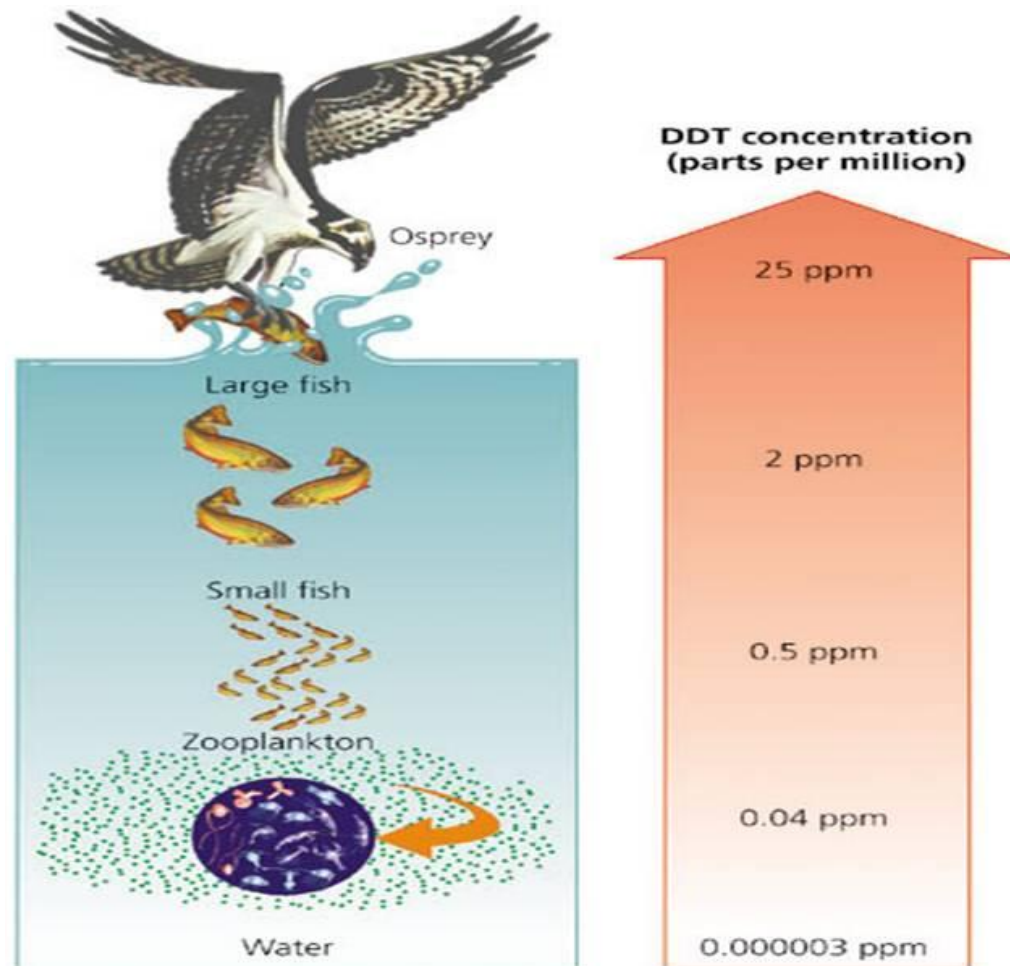


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- ◉ energy flows in one direction through ecosystems starting with the sun
- ◉ each feeding level is referred to as a trophic level
- ◉ with each successive level the amount of energy available decreases
- ◉ 10% energy transfer (rest is released as heat or used for metabolism and anabolism)

# BIOMAGNIFICATION

- pollutants or other toxic compounds may be gained through eating something
- as you go up the food chain, the concentration of these toxic compounds tends to increase



# SPECIES INTERACTIONS

		Species 2		
Species 1		+	-	0
+	Mutualism			
-	Predation/ Parasitism		Competition	
0	Commensalism	Amensalism	Neutralism	

# TYPES OF SPECIES INTERACTIONS

## ◉ COMMENSALISM (+, 0)

- 1 organism benefits and other not affected
- EX: remora/shark (transportation)  
hermit crab/snail shells



## ◉ AMENSALISM (-,0)

- 1 species suffers and other not affected
- usually release of chemical
- EX: bread mold Pencillin (kills bacteria)



# TYPES OF SPECIES INTERACTIONS

## ○ COMPETITION (-,-)



- intraspecific (b/w same species)
- interspecific (b/w different species)
- compete for food, mating partners, territory

## ○ MUTUALISM (+,+)



- both species benefit
- Symbiosis (2 species living together)



# TYPES OF SPECIES INTERACTIONS

## ○ PARASITISM (+, -)

- 1 species benefit at the expense of the other
- parasite can live on host (ectoparasite)
- parasite can live inside host (endoparasite)



## ○ PREDATION (+, -)

- predators hunt and kill prey
- predators are opportunistic - kill & eat



# KEYSTONE SPECIES

- species presence contributes to the diversity of life
- its extinction would lead to the extinction of other life forms
- **EXAMPLES**
  - grizzly bear: transfer nutrients from oceans to forest ecosystems
  - sea stars: prey on sea urchins & mussels , if removed sea urchins population rises → destroying coral reefs
  - sea otters: prey on sea urchins in kelp forest; kelp roots serve as anchor (mini-habitat)



# ECOLOGICAL SUCCESSION

- primary succession:  
succession that takes place on an area that was originally completely empty of life
- secondary succession:  
succession that occurs in an area where life once existed but has then been destroyed
- pioneer plants/communities:  
plants or communities that are the first to be established in an area previously empty of life
- climax community: highest stage of ecological development in an area

