
We share the Earth…

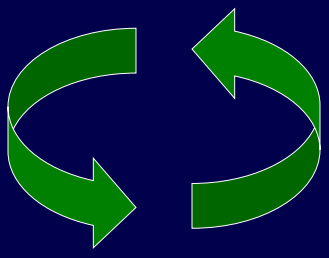
**Ecology & Environmental Issues**

# with a whole lot of other creatures…

# We don't share very well…


## Ecology

- Putting it all together…
  - study of interactions between creatures & their environment, because…



***Everything is connected to everything else***

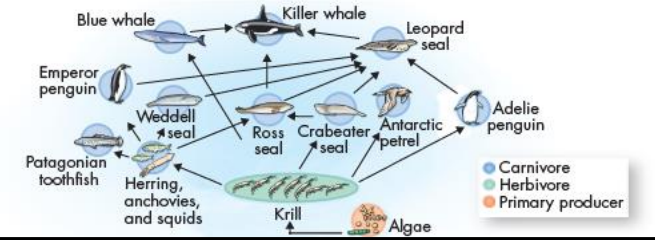
## Essential Question

Explain how all livings are interdependent in the biosphere.

# What is ecology and the factors that it studies?

# What is Ecology?

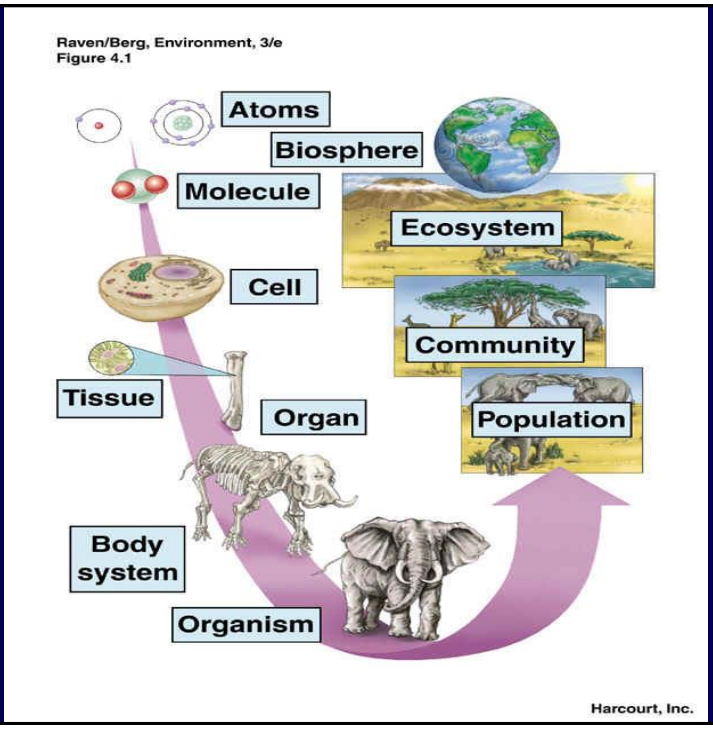
- **Ecology** is the study of interactions among organisms and between organisms and their physical environment.
  - Interactions within the biosphere produce a web of interdependence between organisms and the environments in which they live.
  - Organisms respond to their environments and can change their environments, producing an ever-changing biosphere.



# Levels of Organization (from lowest to highest)

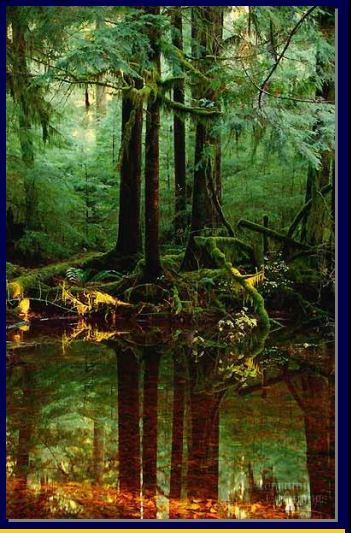
- **Species** is a group of organisms so similar to one another that they can breed and produce fertile offspring.
- **Population** are groups of individuals that belong to the same species and live in the same area.
- **Communities** are assemblages of the different populations that live together in a defined area.
- **Ecosystem** is a collection of all the organisms that live together in a particular place as well as their nonliving or physical environment.
- **Biome** is a group of ecosystems that have the same climate and similar dominant communities.
- **Biosphere** contains the combined portions of the planet in which life exists, including land, water, and air or atmosphere.

## Creatures living in their environment




# Environmental factors

- **Living (Biotic) factors**
  - all plants & animals living in an area
- **Physical (Abiotic) factors**
  - soil, rock, temperature, moisture, sunlight



**habitat = address (where you live)**
**niche = job (the role you play)**

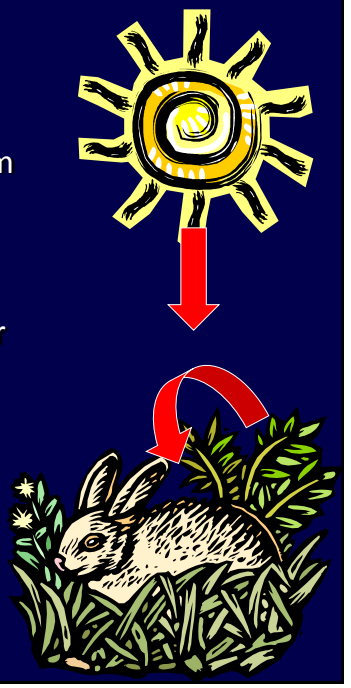
# QUESTION AND ANSWER

**What is ecology and the factors that it studies?**

**How do producers and consumers obtain energy and nutrients?**

# Energy flow in an ecosystem

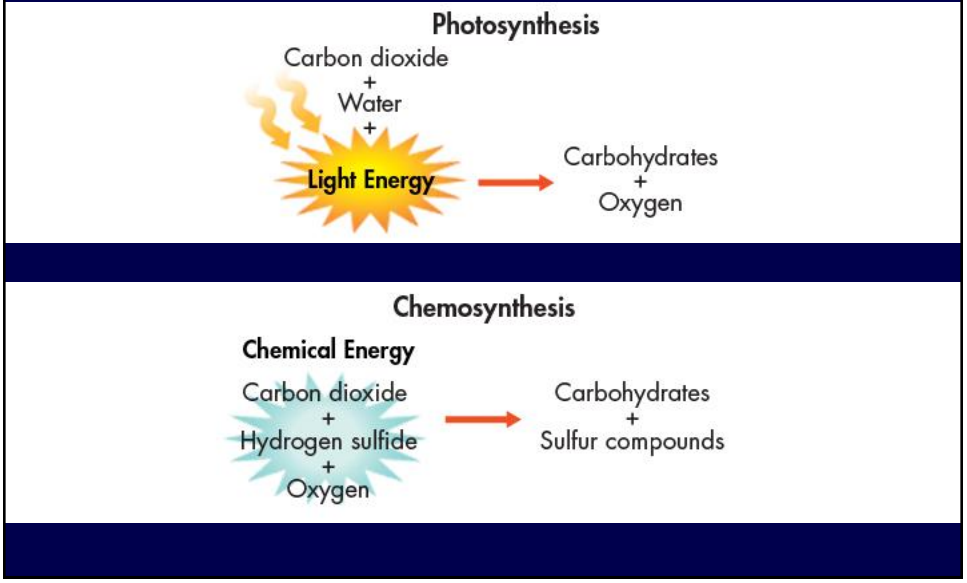
- Energy flows through an ecosystem from the sun to producers to consumers.
- ***Arrows show the way the energy flows.
- Sunlight is the main source of energy for life on Earth.
- **Autotrophs** or **(producers)** use energy from the environment (sunlight or inorganic compounds) to fuel the assembly of simple compounds into complex organic molecules.



# *Autotrophs*

- There are **2** types of autotrophs:
  - 1. Photosynthetic Autotrophs
    - The best known autotrophs are those that harness the power of the sun through the process of **photosynthesis** .
    - They use this energy to convert carbon dioxide and water into oxygen and glucose.
  - 2. Chemosynthetic Autotrophs
    - The second type of autotrophs use chemical energy to make carbohydrates through the process of **chemosynthesis** .
    - This is performed by several types of bacteria that reside in the deep ocean in complete darkness and around volcanic vents.

# Photosynthesis v. chemosynthesis




# *Consumers*

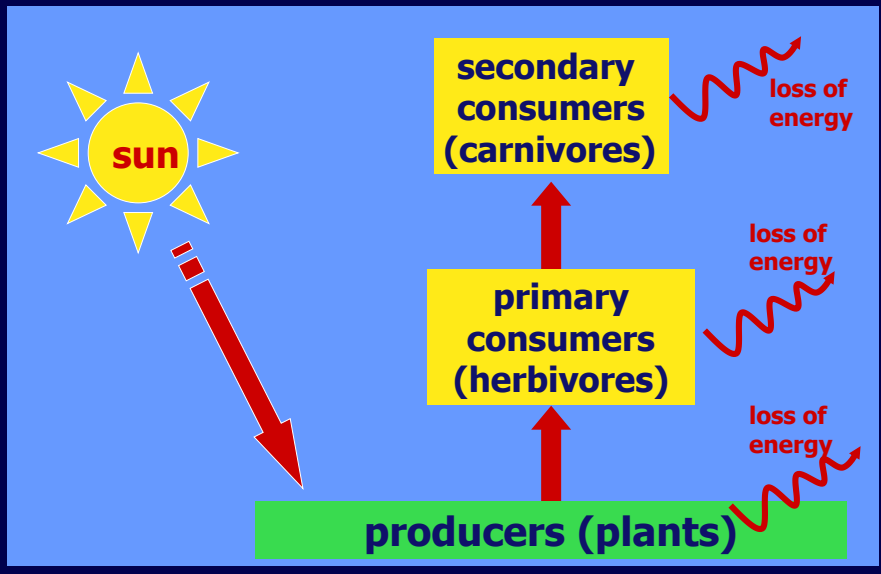
- **Heterotrophs** (consumers) rely on other organisms for their energy and food.
- **Herbivores** obtain energy by eating plants.
- **Carnivores** eat animals.
- **Scavengers** are animals that consume the carcasses of other animals that have been killed by predators or have died of other causes.
- **Omnivores** eat both plants and animals.
- **Detritivores** feed on the remains of plants, animals and other dead matter.
- **Decomposers** breaks down organic matter.

# QUESTION AND ANSWER

**How do producers and consumers obtain energy and nutrients?**

**How does energy flow through an ecosystem?**

# Energy flows through…




# Feeding Relationships

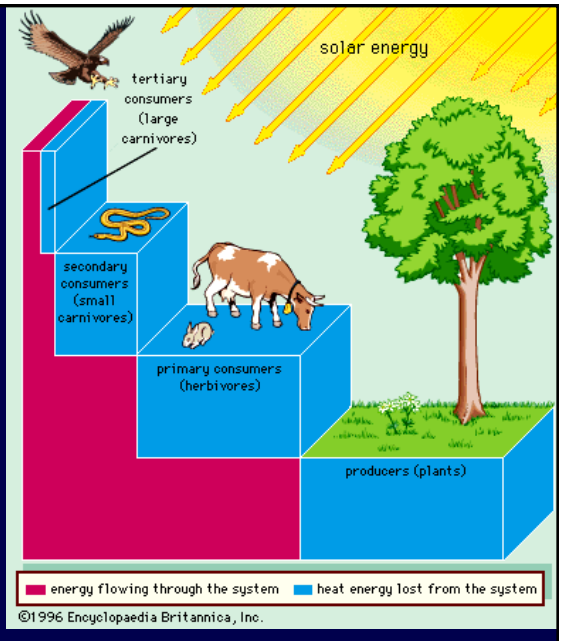
- Energy flow through an ecosystem in **one** direction, from the sun or inorganic compounds to autotrophs (producers) and then to various heterotrophs (consumers).
- **Food Chains** are a series of steps in which organisms transfer energy by eating or being eaten.
- **Food webs** show the complex interactions within an ecosystem.
  - Each step in a food chain or web is called a **trophic level**. Producers make up the first step, consumers make up the higher levels.
  - Primary consumers are herbivores
  - Secondary consumers are heterotrophs that feed on herbivores
  - Tertiary consumers feed on secondary consumers

# How many trophic levels are possible…?

- Trophic means "feeding"
- **Trophic levels** -levels of feeding from producers (plants) to the consumers
  - Few ecosystems have more than 4 or 5 trophic levels
  - Energy diminishes at each level because it is used for life's processes.
- These are not food pyramids!!

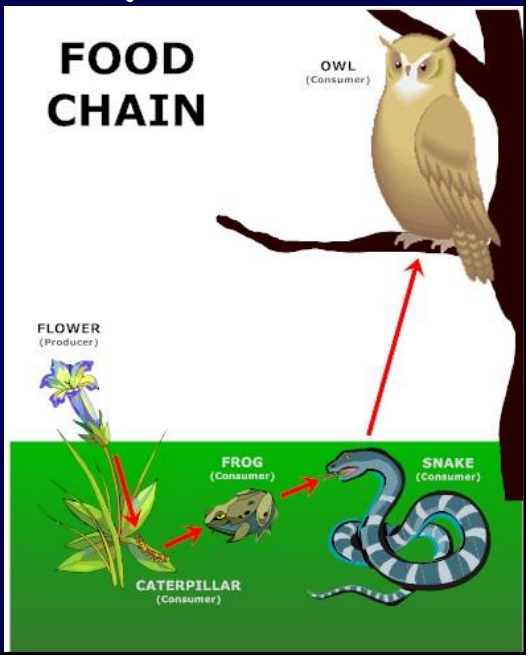
# TROPHIC LEVELS

- Producers (most energy available)-autotrophs
- Primary consumers-herbivores
- Secondary consumers-small carnivores
- Tertiary consumer-large carnivores
- Energy is given off at every level as waste heat by the organisms as they survive.

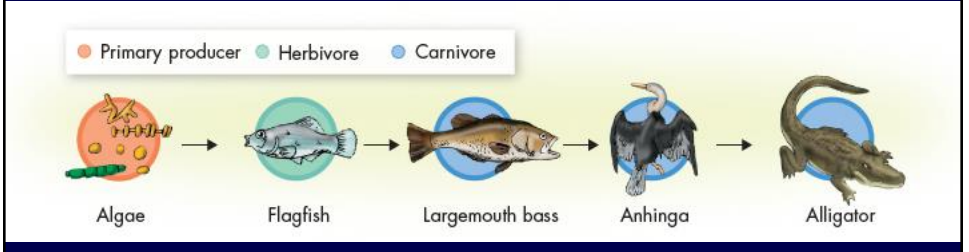


# "Who Eats Who"…

- Food chain- straight line sequence shows simple feeding relationships
- Notice the direction of the arrows!
  - Sun
  - ↓
  - Producers
  - ↓
  - Primary consumers
  - ↓
  - Secondary Consumers
  - ↓
  - Tertiary Consumers

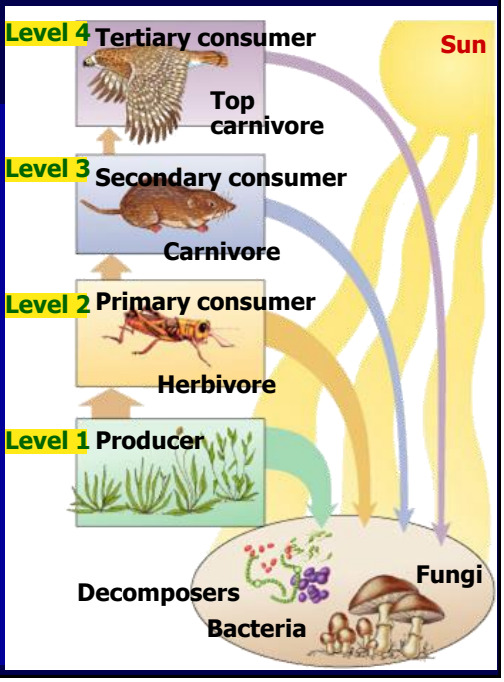



# An example of a food chain



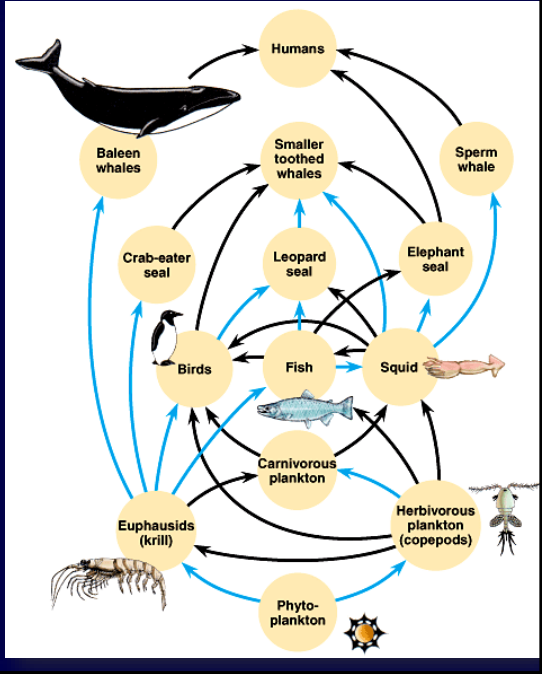
# Food chains

- Feeding relationships
  - all food chains start with energy from the sun
  - first level of all food chains is plants
  - most food chains usually go up only 4 or 5 levels
  - all levels connect to decomposers

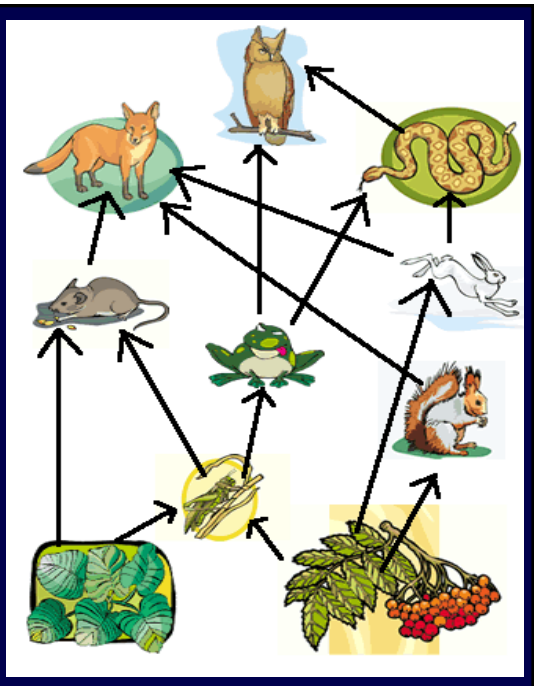


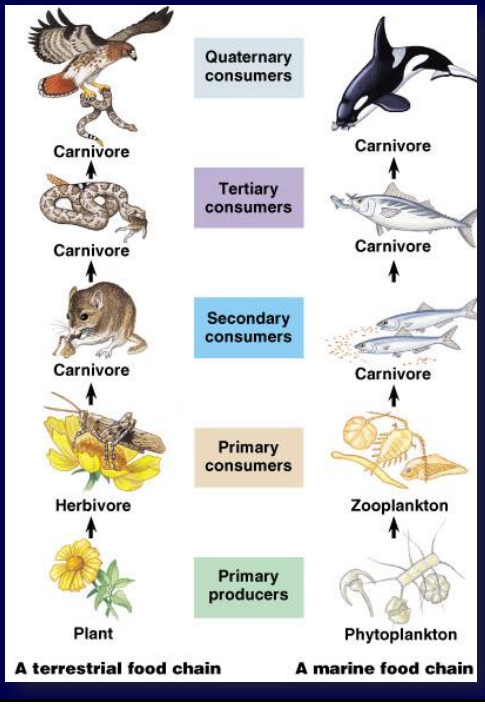

# Food webs

- Food chains are linked together into food webs
- Illustrates the interdependent aspect of the ecosystem
- Many connections throughout ecosystem



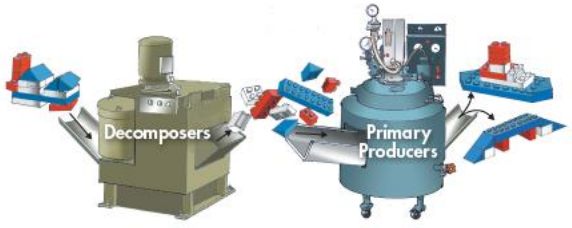
- Food web- illustrates how the many food chains in an ecosystem are related
- Primary consumers?
- Secondary consumers?
- Tertiary consumers?
- Where would decomposers fit in this food web?





## Decomposers and Detrivores in Food Webs

- At the same time, the decomposition process releases nutrients that can be used by primary producers. They break down dead and decaying matter into forms that can be reused by organisms, similar to the way a recycling center works.
- Without decomposers, nutrients would remain locked in dead organisms.

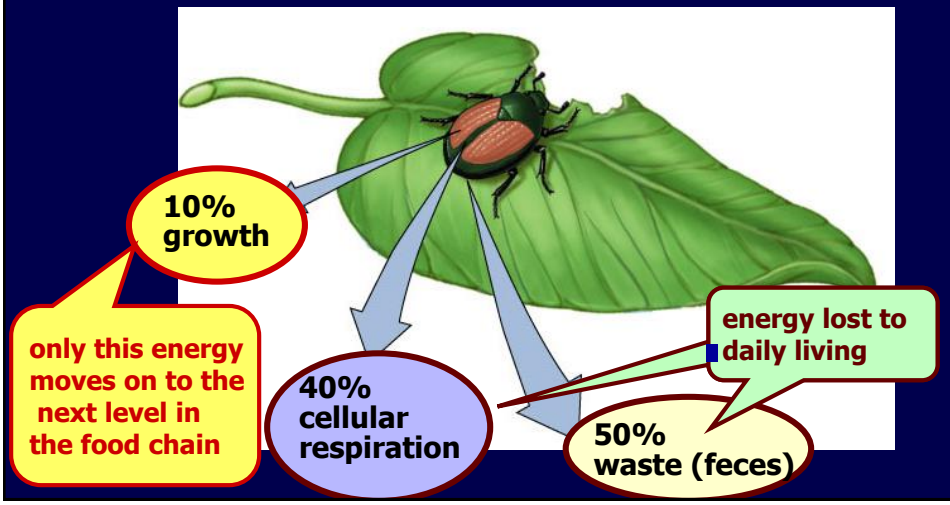



## Ecological Pyramids

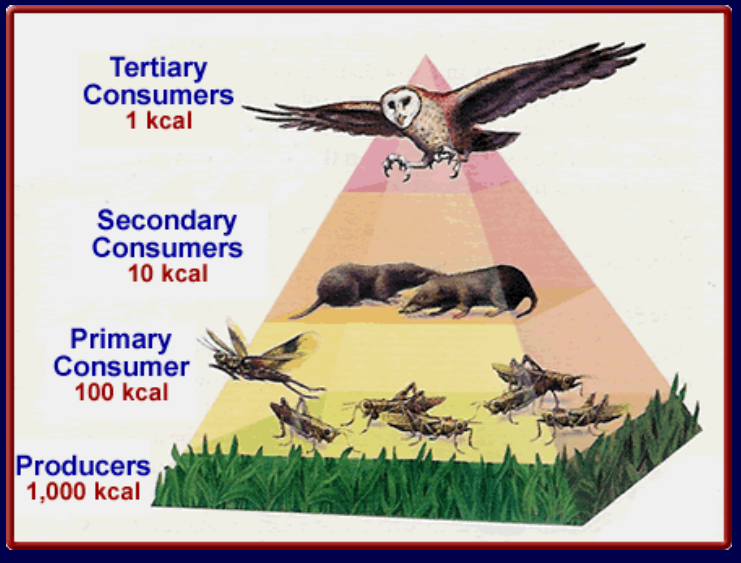
- An **ecological pyramid** is a diagram that shows the relationship amounts of energy or matter contained within each trophic level in a food web or food chain.
- There are **3** types of ecological pyramids:
  - 1. Energy Pyramid
    - An Energy Pyramid shows the relative amount of energy available at each trophic level of a food chain or food web.
      - Only 10% of the energy available within one trophic level is transferred to organisms at the next trophic level.

# Loss of energy

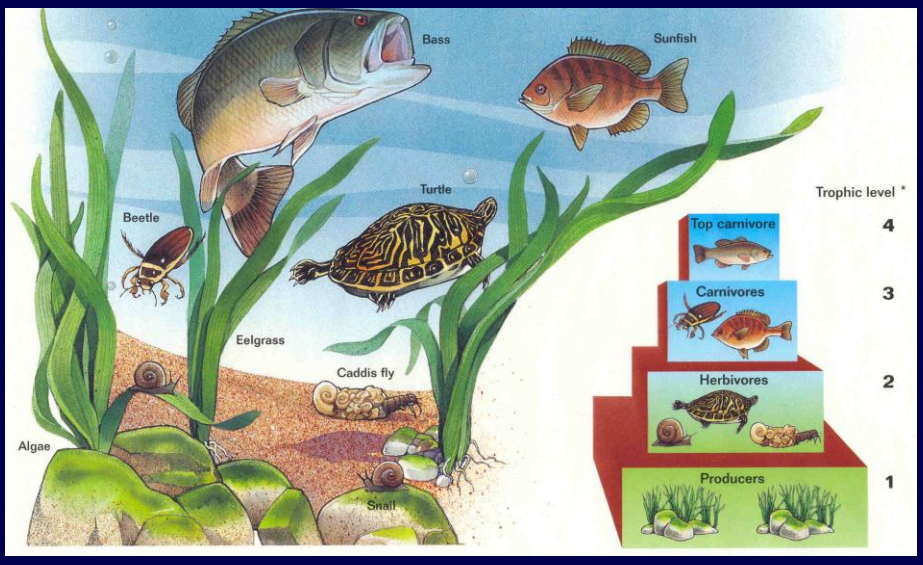
- Loss of energy between levels of food chain
  - To where is the energy lost? The cost of living!




# Energy Pyramid

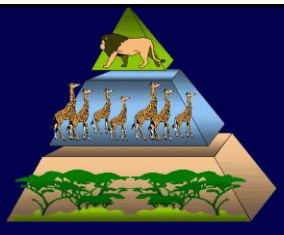


# Pyramid of Energy




- Which level has the most energy AVAILABLE?

# Ecological Pyramids



- 2. Biomass Pyramid
  - Biomass Pyramids show the total amount of living tissue available at each trophic level.
    - Because each trophic level harvests only about one tenth of the energy from the level below, it can support only about one $10^{th}$ the amount of living tissue.
- 3. Numbers Pyramid
  - Numbers Pyramids show the number of species at each trophic level.

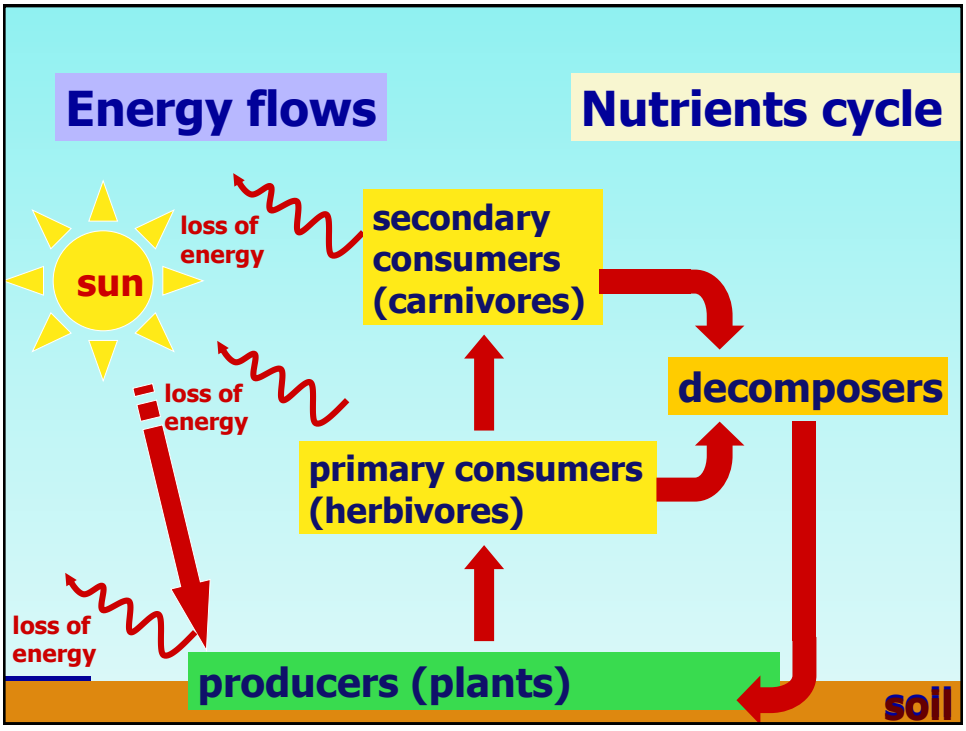
# QUESTION AND ANSWER

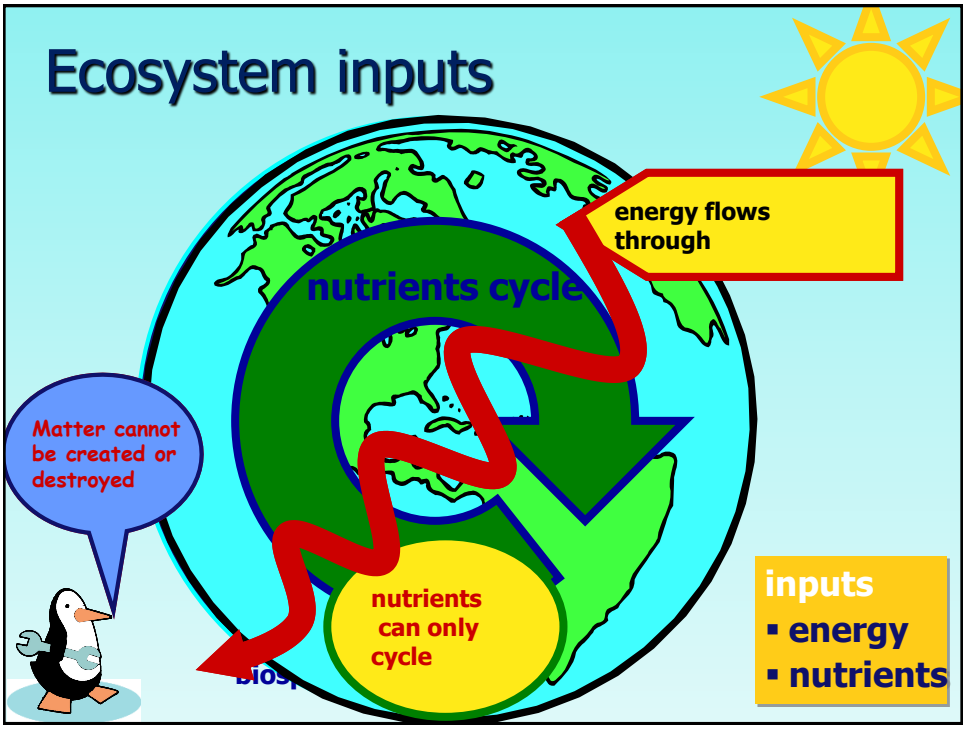
**How does energy flow through an ecosystem?**

**How does matter move through the biosphere?**

# Recycling of Matter

- Unlike the one-way flow of energy, matter is **recycled** within and between ecosystems.
- Elements pass from one organism to another among parts of the biosphere through closed loops called biogeochemical cycles which are powered by energy. Therefore cycles of matter involves *bio*logical processes, *geo*logical processes, and *chemical* processes.
  - As matter moves through these cycles, it is never created or destroyed—just changed.
- These cycles include the Water Cycle and the Nutrient Cycle (which includes the Carbon, nitrogen, and phosphorus cycles).
  - These three basic nutrient cycles are present in all ecosystems allowing organisms to obtain needed nutrients to function effectively.





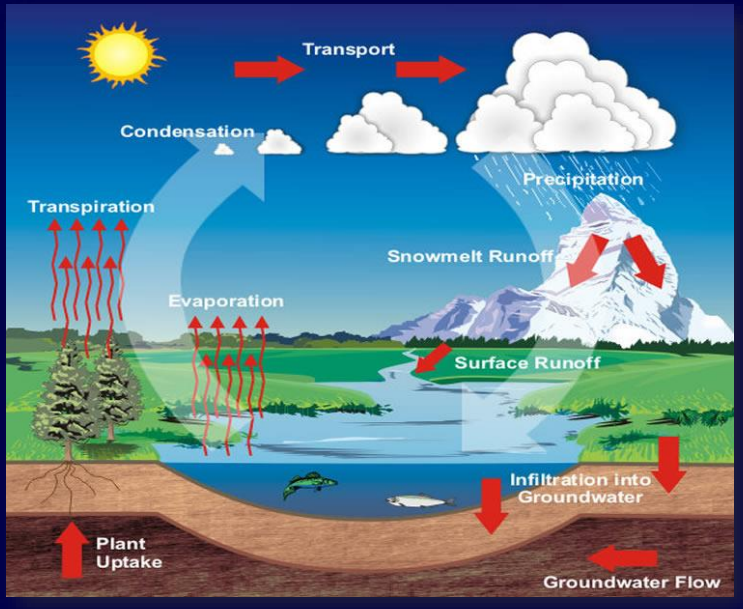

# Water Cycle

- Driving force is the sun and gravity.
- Consists of the alternation between evaporation and precipitation.
- Most water returned to the atmosphere comes from evaporation from the oceans.

# Water Cycle Terminology

- Water vapor- gaseous form of water in atmosphere
- Evaporation- liquid water from bodies of water becomes gas returned to atmosphere.
- Transpiration- loss of water by land plants
- Condensation- process which water molecules gather in atmosphere "change from gas to liquid" when cooled.
- Precipitation- water falls from atmosphere to ground (rain, snow, sleet, or hail)

# Water Cycle



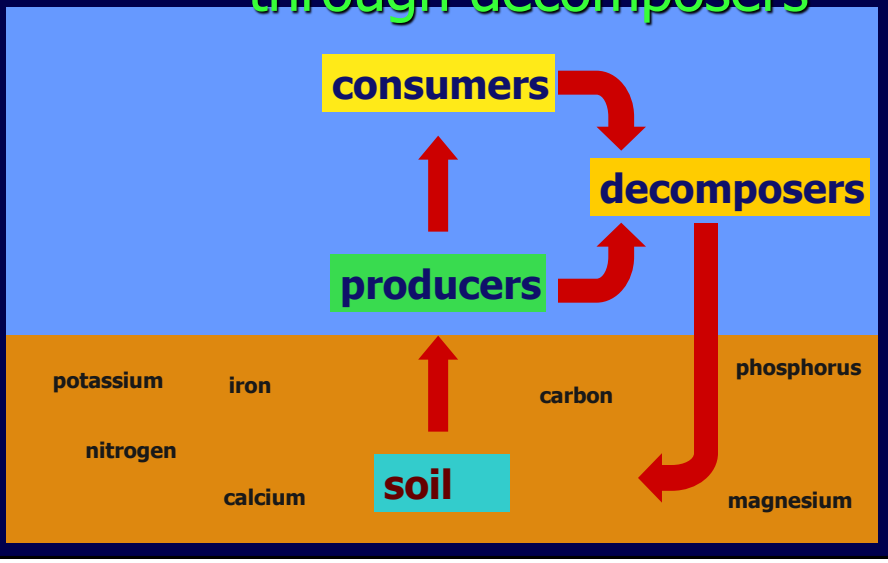
# Why is the water cycle important?

- Water is the most important nonliving (abiotic) component of an ecosystem.
- Water essentially determines what organisms we find in an ecosystem.
- What is the major difference between the tropical rainforest and the desert? Why?

## Nutrient Cycles

- The Nutrient Cycle includes the Carbon, nitrogen, and phosphorus cycles
  - These three basic nutrient cycles are present in all ecosystems allowing organisms to obtain needed nutrients to function effectively.
  - Nutrients cycle as a result of the impact of decomposers

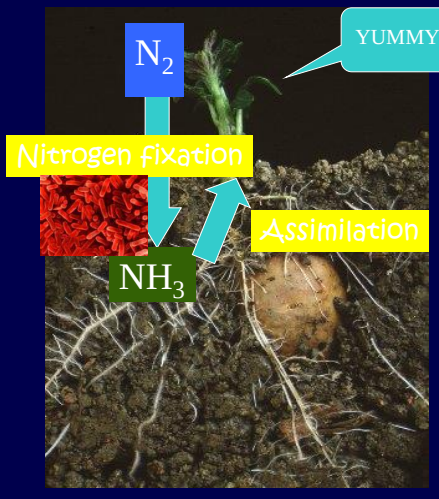
# Nutrients cycle around… through decomposers




# Nitrogen Cycle Terminology

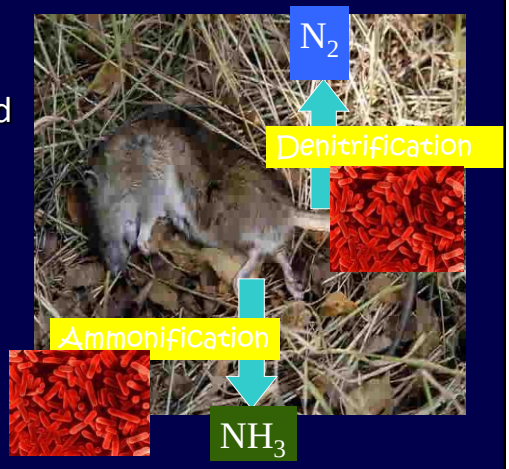
- Nitrogen gas ($N_2$) makes up 78 percent of Earth's atmosphere.
- Nitrogen-containing substances such as ammonia ($NH_3$), nitrate ions ($NO_3$), and nitrite ions ($NO_2$) are found in soil, in the wastes produced by many organisms, and in dead and decaying organic matter.

*** **Nitrogen fixation*****- nitrogen gas in atmosphere converted to ammonia (bacteria in soil, lightning)

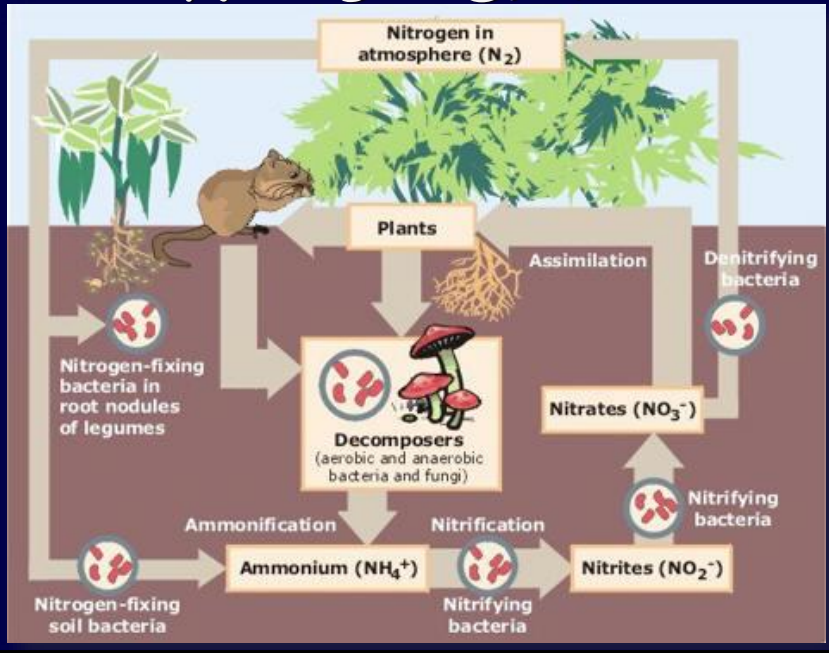


# Nitrogen Cycle Terminology

- Ammonification- decomposers (bacteria and fungi) break down of dead organisms and waste and return nitrogen to soil as ammonia.
- **Denitrification**- conversion of ammonia back to nitrogen gas (decomposers).




# Nitrogen Cycle



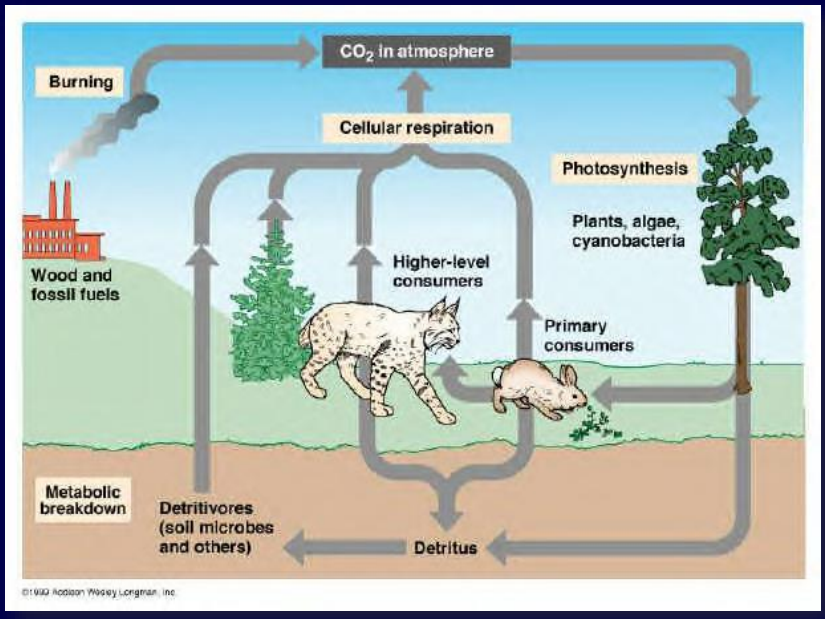
# Carbon Cycle

- Carbon cycles between the living organisms and the non-living components of ecosystem.
- Plants are of great importance to the carbon cycle!!--photosynthesis
- Carbon exists in the atmosphere as carbon dioxide ($CO_2$)
- Why do living things need carbon?
  - Carbon is a major component of all organic compounds, including carbohydrates, lipids, proteins, and nucleic acids.

# Carbon Cycle Terminology

- **Photosynthesis**- process where sunlight, $CO_2$ and $H_2O$ is used to make carbs.
  $CO_2 + H_2O$ + sunlight (energy) → glucose (carb) + $O_2$
- **Respiration**- process by which animals use carbs, taking in $O_2$ given off by plants and give off $CO_2$
  ***THE OPPOSITE OF PHOTOSYNTHESIS!
  glucose (carbohydrate) + $O_2$ → $CO_2 + H_2O$ + energy to live
- **Decomposition**—breakdown of dead organisms and waste, returning carbon to the soil and atmosphere
- **Fossil fuels-** formed by pressure applied to dead organisms that are buried in sediment. They are carbon and release $CO_2$ when burned.
- **Combustion**- burning of fossil fuels

# Carbon Cycle

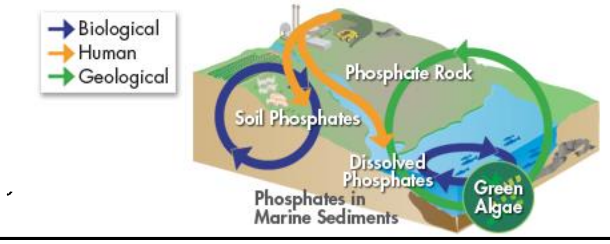



# Why is the carbon cycle important?

- **Organic macromolecules** -energy for living organisms (carbohydrates), cell membranes (lipids), DNA/RNA, and proteins.
- ***Humans in the United States are altering this cycle
  - Deforestation
  - $CO_2$ is a greenhouse gas
  - Burning too many fossil fuels releases extra $CO_2$ into the atmosphere creating global warming due to increased greenhouse effect.

# The Phosphorus Cycle

- Phosphorus forms a part of vital molecules such as DNA and RNA.
- Although phosphorus is of great biological importance, it is not abundant in the biosphere.
- Phosphorus in the form of inorganic phosphate remains mostly on land, in the form of phosphate rock and soil minerals, and in the ocean, as dissolved phosphate and phosphate sediments.

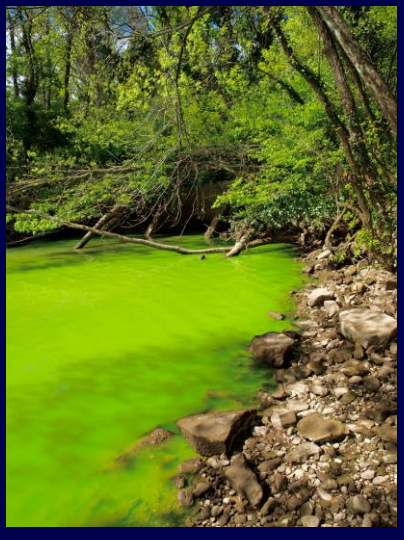


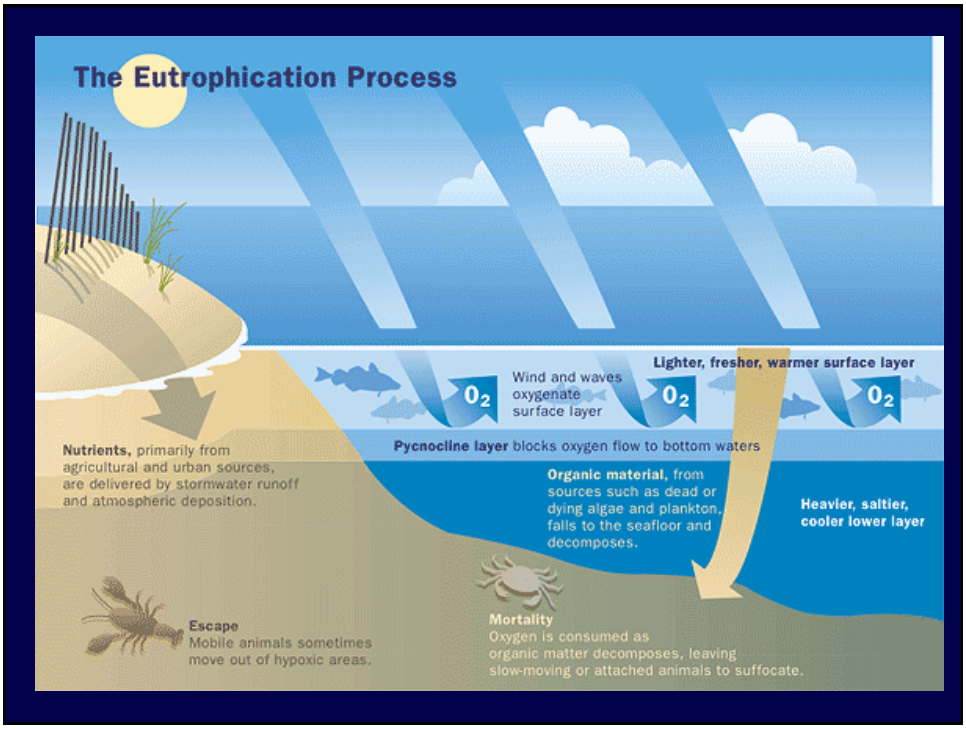

# What factors affect primary productivity?

# Primary Productivity

- **Primary productivity**: rate at which organic matter is created by producers
  - It is controlled by the amount of available nutrients
    - If a nutrient is in inadequate supply, it will limit an organism's growth
      - When the ecosystem is limited by a single nutrient that is scarce or cycles very slowly, this is called a **limiting nutrient**
    - To counter this, farmers apply fertilizers that typically contain nitrogen, phosphorus, and potassium to boost primary productivity, which makes plants grow larger and quicker
    - In oceans, nitrogen is a limiting nutrient. In freshwater environments, often it is phosphorus
      - When an aquatic ecosystem receives a large addition of a limiting nutrient, the immediate result is often a significant increase in algae and other producers and the result is a **algal bloom or eutrophication**.
      - The result is a tainted drinking water supply, degradation of recreational opportunities, and **hypoxia (or oxygen depletion)** which can reduce biodiversity

# Algae Bloom






# QUESTION AND ANSWER

**How does matter move through the biosphere?**

## Essential Question

Explain how all livings are interdependent in the biosphere.