Energy Flow

- The flow of energy through an ecosystem is one of the most important factors that determines the system's capacity to sustain life.

- **Sunlight** is the main energy source for life on Earth. Some organisms rely on energy stored in inorganic chemical compounds.

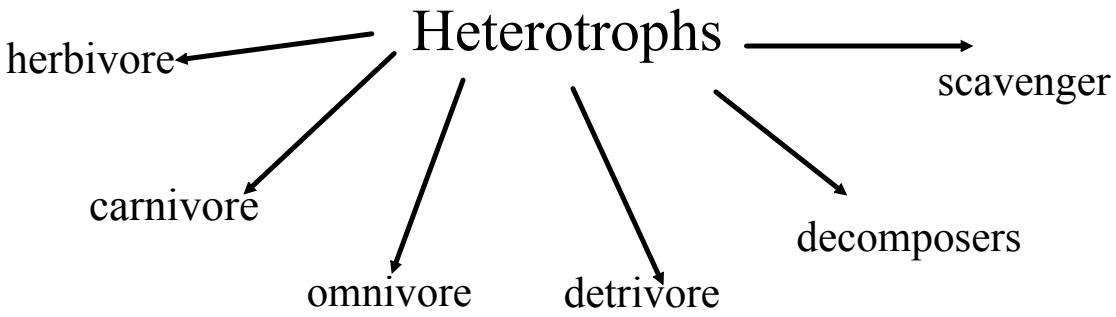
- **Autotrophs**(producers) capture energy from sunlight or chemicals to produce their own food. PHOTOSYNTHESIS

carbon dioxide + water ---light----> carbohydrates + oxygen

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

- Organisms that rely on other organisms for their energy and food supply are called **heterotrophs** (consumers). These include animals, fungi and bacteria.

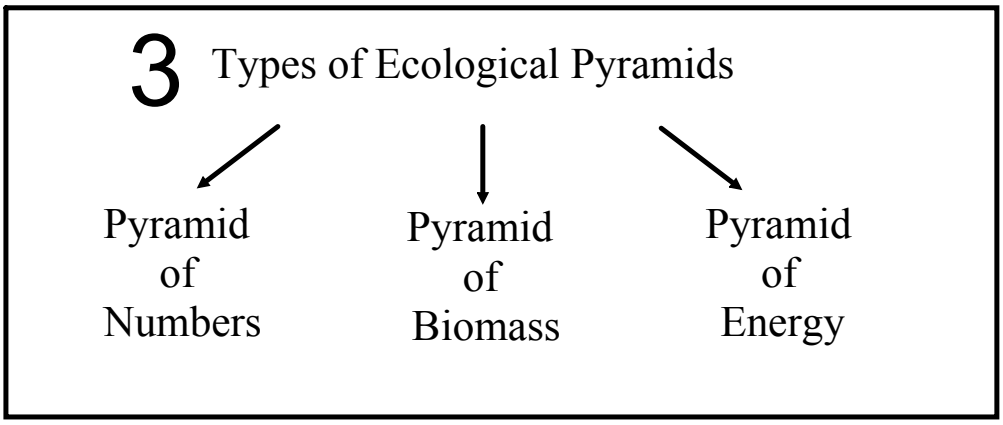
- When organisms use chemical energy to produce carbohydrates, the process is called **chemosynthesis** The process is performed by several types of bacteria that live in volcanic vents, hot springs and tidal marshes.



Herbivores, such as cows, obtain energy by eating only plants.
Carnivores, such as snakes, eat only animals.
Omnivores, such as humans, eat both plants and animals.
Detrivores, such as earthworms, feed on dead matter.
Decomposers, such as fungi, break down organic matter.
Scavengers, such as vultures, consume the carcasses of other animals.

Ecological Pyramids

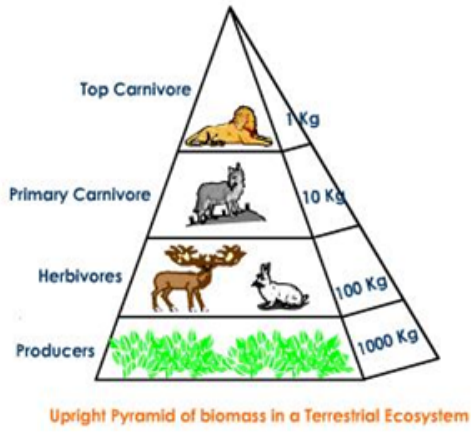
Ecological pyramids are graphical representations of the trophic structure of ecosystems.



Pyramid of Biomass

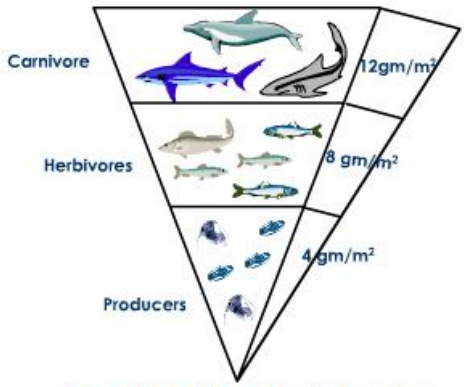
- the graphic representation of the relationship between the amounts of biomass* at different trophic levels

*biomass - the total mass of all the living organisms in a given area



Upright Pyramid of biomass in a Terrestrial Ecosystem

Maximum mass occurs in producers.

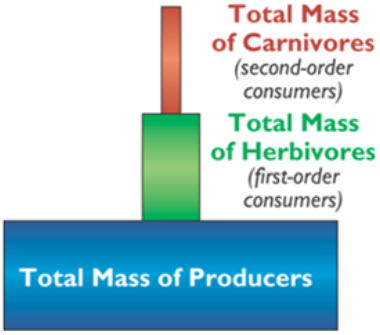


Inverted Pyramid in an Aquatic Ecosystem

Biomass of trophic levels depend upon the reproductive potential and longevity of the members.

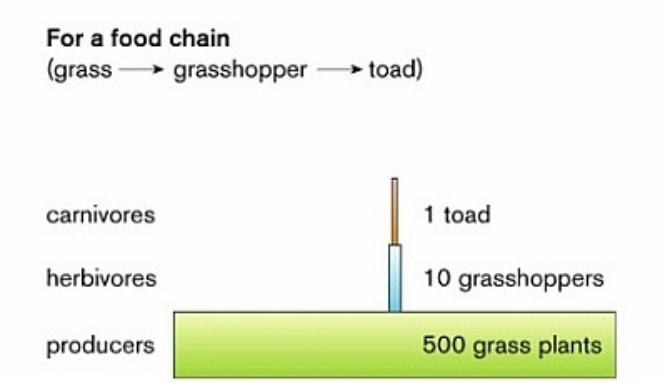
Pyramid of Biomass

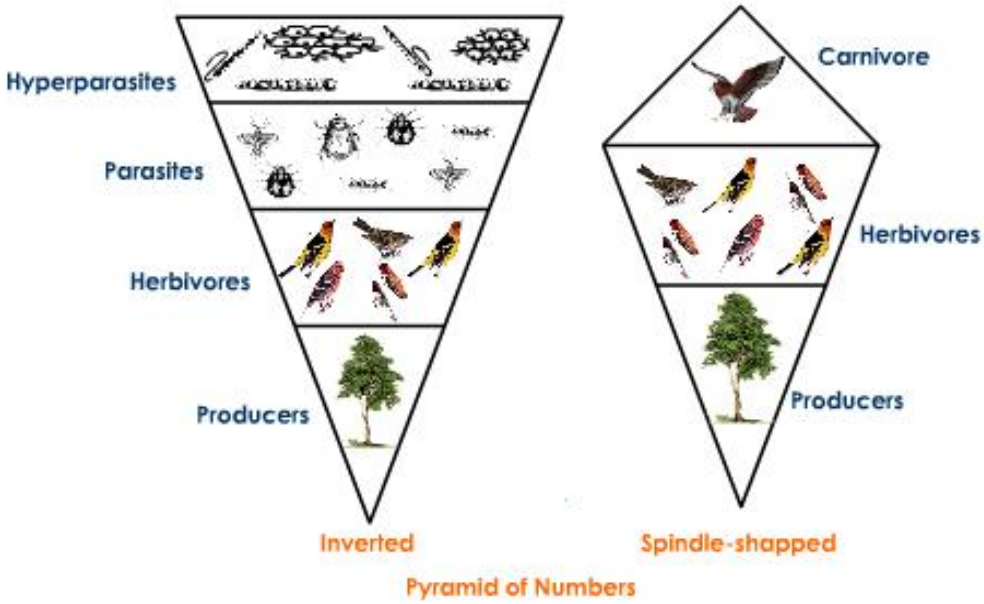
The biomass of the producers is always greater than the biomass of the herbivores, and the biomass of the herbivores is always greater than the biomass of the carnivores. The biomass decreases with each additional step in a food chain. A diagram that shows this decrease in biomass is a pyramid of biomass.



Pyramid of Numbers

- the graphic representation of the number of individuals at various trophic levels
- usually shows a large number of producers with diminishing numbers of consumers





hyperparasite - an organism that is parasitic on or in another parasite

Pyramid of Energy

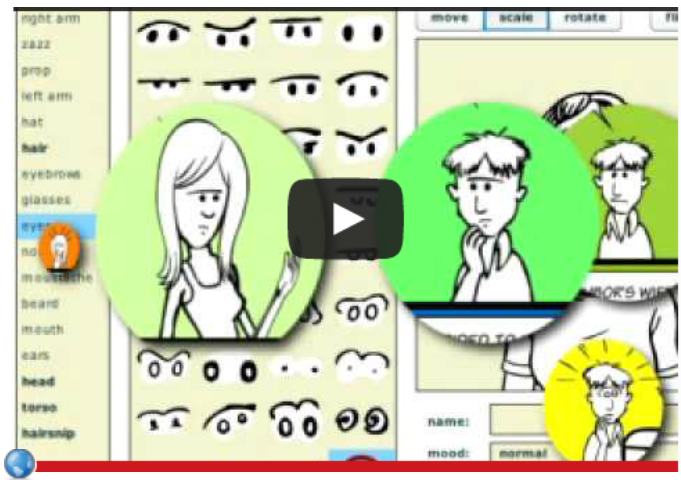
- a graphic representation that shows the amount of energy that is available at each trophic level

Can an energy pyramid be inverted?

Never

Notes - Pyramids of Energy.pdf

Create a toonlet to demonstrate what you have learned from the reading.



Notes - Pyramids of Energy.pdf

What Is the Pyramid of Energy?
Student Information Pages

Student Pages

Imagine you're driving down the road in a car. As you look out the window you notice a stretch of land with plants as far as the eye can see. Grass, flowers, trees, and other plants are visible in every direction. You probably wouldn't be too shocked or surprised. But imagine looking out the window to find animals as far as the eye can see. Snakes, hawks, rabbits, and other animals so thick you'd have to step over them to take a walk!

Why does our world have so much more plant life than animal life?

One explanation is called the Pyramid of Energy. You may know that all living things need energy, from the smallest bacteria to the largest plants or mammals. You may also know that people use food chains and food webs to show how this energy is passed from the sun to *producers* (plants) and then to *consumers* (animals, fungi, bacteria, etc.). What you may not know is that **every time energy is passed from one living thing to the next, only a small portion of the energy makes it to that next living thing.** By the time you get to the end of any food chain, most of the energy that was available at the beginning is no longer available. Scientists came up with the Pyramid of Energy to explain this.

The Pyramid of Energy

The Pyramid of Energy is a model that uses a pyramid shape to show that the energy available for consumers decreases as it travels through a typical food chain or web.

Producers are at the bottom of the pyramid because they are able to transform the sun's energy into a large amount of plant energy through the process of photosynthesis. Producers are the base of energy for most food chains and food webs.

Animals that eat plants make up the next level. These animals are called *primary consumers* because they are the first level of consumers. Primary consumers rely on plants for their energy. This level of the pyramid is smaller than the producer level because most of the energy used at the producer level is used by producers for their life processes (respiration, photosynthesis, reproduction, etc.) and transformed to heat before they are consumed.

Animals that eat primary consumers make up the next level. These animals are called *secondary consumers* because they are the second level of consumers. Secondary consumers rely on primary consumers for most of their energy. This level of the pyramid is smaller than the primary consumer level because most of the energy used at the primary consumer level is used for their life processes (respiration, digestion, reproduction, etc.) and transformed to heat before these animals are consumed.

Animals that eat secondary consumers make up the next level. These animals are called *tertiary consumers* because they are the third level of consumers. Tertiary consumers rely on secondary consumers for most of their energy. This level of the pyramid is smaller than the secondary consumer level because most of the energy used at the secondary consumer level is used for their life processes and transformed to heat before these animals are consumed.

It's possible to have additional levels of consumers, but in most food chains energy runs out by the second or third level.

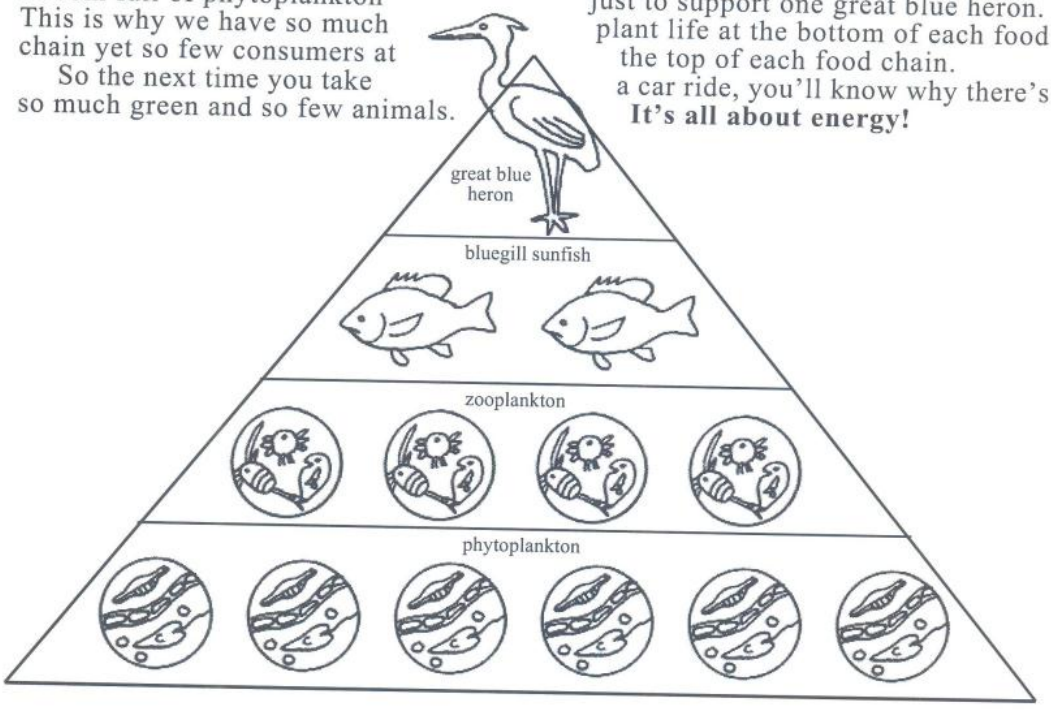
Use this page with the ***Science for Ohio*** What is thePyramid of Energy? 3D Model.

What Is the Pyramid of Energy?
Student Information Pages
(continued)

Student Pages

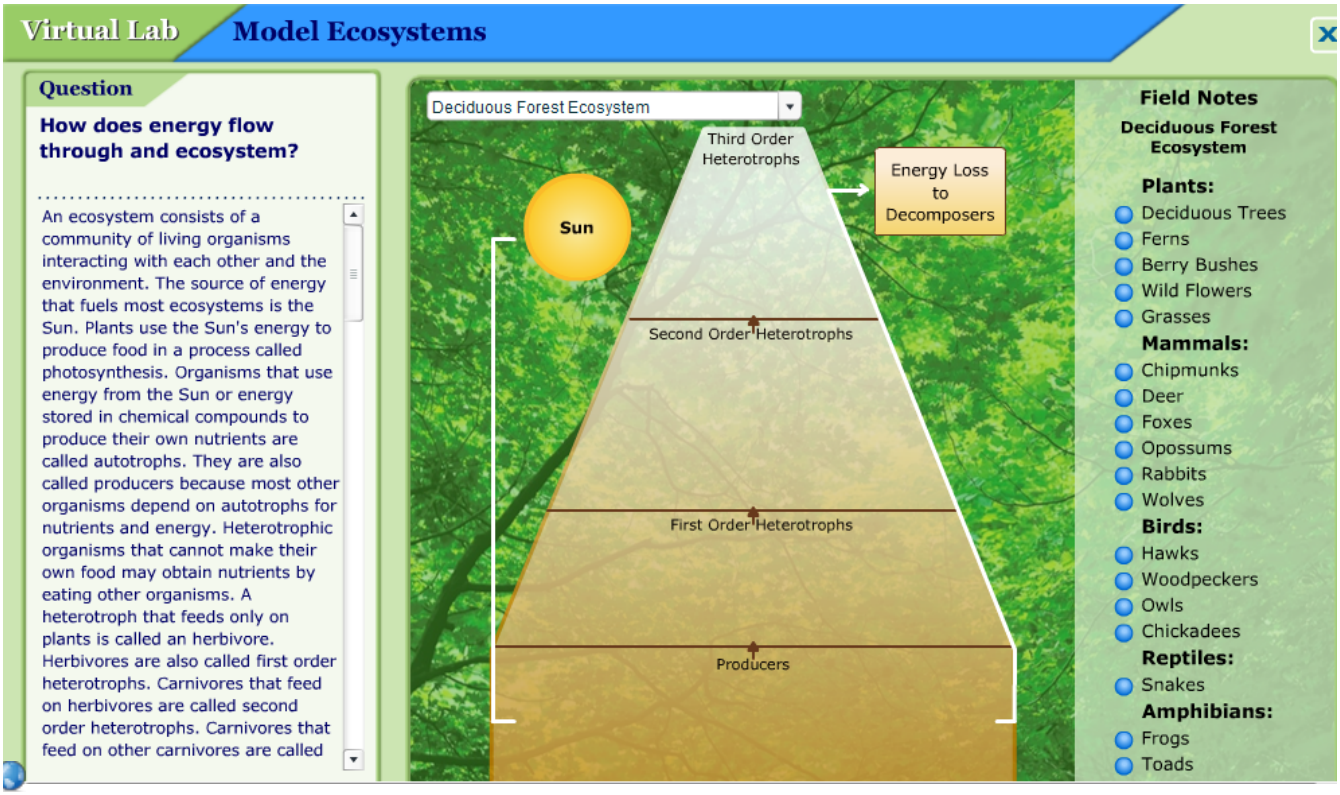
The Ten Percent Rule

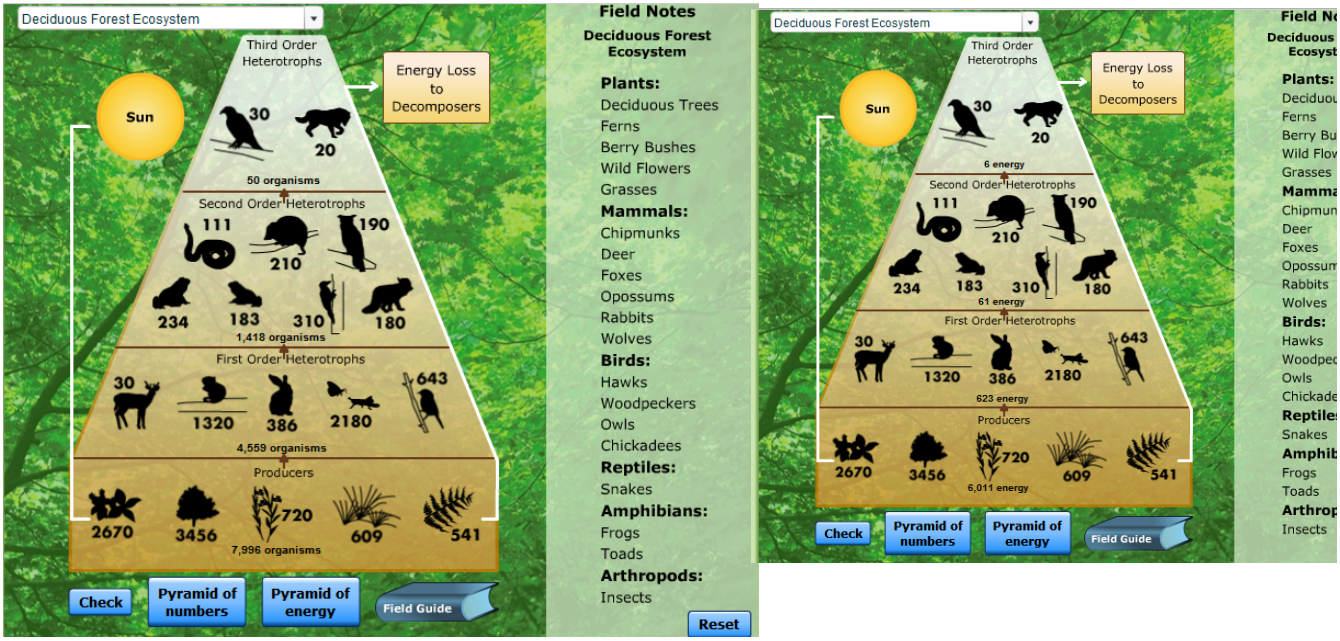
How much energy is lost from one level to the next? Scientists say that on average 90% of the available energy is used for life processes such as respiration, photosynthesis, and reproduction and transformed to heat energy before an organism is consumed. This means **only about 10% of the original energy is left to feed the next level.** This 10% is stored in the tissues (leaves, stem, muscles, organs, fat, etc.) of the organism. To understand this more clearly, let's look at the wetland example on the Pyramid of Energy 3D Model. Here producers such as phytoplankton are producing 500,000 calories of energy from sunlight each day. If you gathered all of this phytoplankton into one spot, they might fill a space the size of a room. Since only about 10% of this energy reaches the zooplankton, this leaves about 50,000 calories of energy to support the zooplankton each day. If you gathered all of these zooplankton into one spot, they might fill a space the size of a school dumpster. Since only about 10% of this energy reaches the sunfish, this leaves about 5,000 calories of energy to support the sunfish each day. If you gathered all of these sunfish into one spot, they might fill a space the size of a trash can. Since only about 10% of this energy reaches the great blue herons, this leaves about 500 calories of energy to support herons each day. If you gathered all of the herons into one spot, **you would have only one!** Fortunately, animals don't just depend on one type of consumer to meet their energy needs. But in essence it takes the energy of a room full of phytoplankton just to support one great blue heron. This is why we have so much plant life at the bottom of each food chain yet so few consumers at the top of each food chain. So the next time you take a car ride, you'll know why there's so much green and so few animals. **It's all about energy!**



Use this page with the ***Science for Ohio*** What is thePyramid of Energy? 3D Model.

Virtual Lab - Ecosystems
Pyramids of Numbers and Energy




Deciduous Forest Ecosystem
Third Order Heterotrophs
Sun
30
20
50 organisms
Energy Loss to Decomposers
Second Order Heterotrophs
111
210
190
234
183
310
180
1,418 organisms
First Order Heterotrophs
30
1320
386
2180
643
4,559 organisms
Producers
2670
3456
720
609
541
7,996 organisms
Check
Pyramid of numbers
Pyramid of energy
Field Guide
Field Notes
Deciduous Forest Ecosystem
Plants:
Deciduous Trees
Ferns
Berry Bushes
Wild Flowers
Grasses
Mammals:
Chipmunks
Deer
Foxes
Opossums
Rabbits
Wolves
Birds:
Hawks
Woodpeckers
Owls
Chickadees
Reptiles:
Snakes
Amphibians:
Frogs
Toads
Arthropods:
Insects
Reset
Deciduous Forest Ecosystem
Third Order Heterotrophs
Sun
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6 energy
Energy Loss to Decomposers
Second Order Heterotrophs
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First Order Heterotrophs
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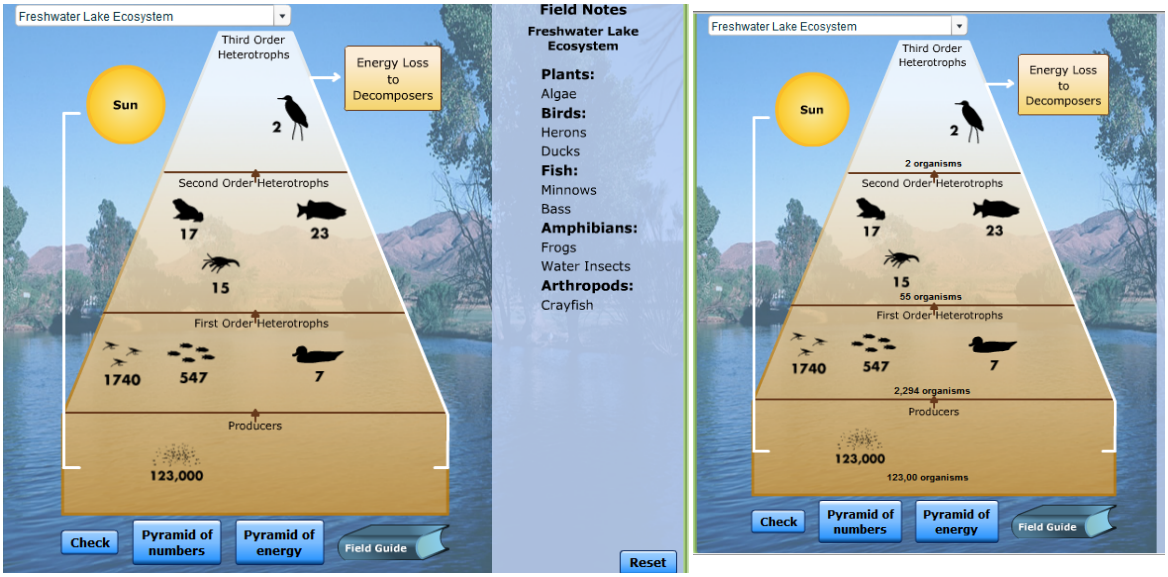
Check
Pyramid of numbers
Pyramid of energy
Field Guide


Freshwater Lake Ecosystem
Third Order Heterotrophs
Energy Loss to Decomposers
Sun
2
Second Order Heterotrophs
17
23
15
First Order Heterotrophs
1740
547
7
Producers
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Check
Pyramid of numbers
Pyramid of energy
Field Guide
Field Notes
Freshwater Lake Ecosystem
Plants:
Algae
Birds:
Herons
Ducks
Fish:
Minnows
Bass
Amphibians:
Frogs
Water Insects
Arthropods:
Crayfish
Reset
Freshwater Lake Ecosystem
Third Order Heterotrophs
Energy Loss to Decomposers
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Second Order Heterotrophs
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First Order Heterotrophs
1740
547
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Producers
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123,00 organisms
Check
Pyramid of numbers
Pyramid of energy
Field Guide

Matter in Ecosystems

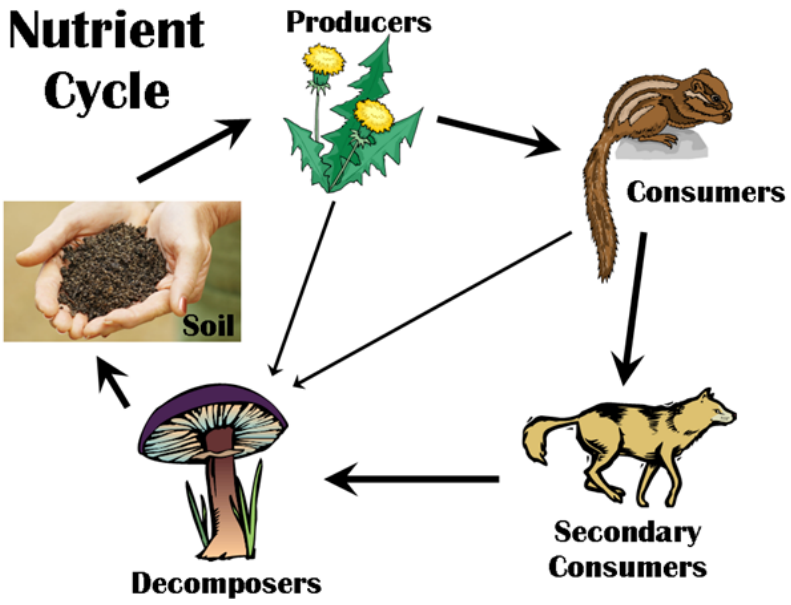
An ecosystem needs more than energy to function. It also needs matter. Matter is used by organisms in ecosystems for life processes. Most ecosystems need over 20 elements. Just the plants in most ecosystems need 16 elements. These essential elements are called nutrients.

Remember: Energy flows through an ecosystem in one direction.

Nutrient Cycles

Nutrients are recycled through ecosystems.

Producers get their nutrients from the soil, water and air.
Herbivores get nutrients when they eat producers.
Carnivores get nutrients when they eat herbivores.
Decomposers break down animal wastes and dead organisms.
The actions of decomposers release nutrients back into the soil, water and air so producers can use them again.



(Water and air not shown in this diagram.)

Cycles to be studied:

1. water cycle
2. carbon cycle
3. nitrogen cycle
4. phosphorus cycle

NOTES - Nutrients and Cycles.pdf

Re-order the descriptions on the right to line up with the terms on the left.

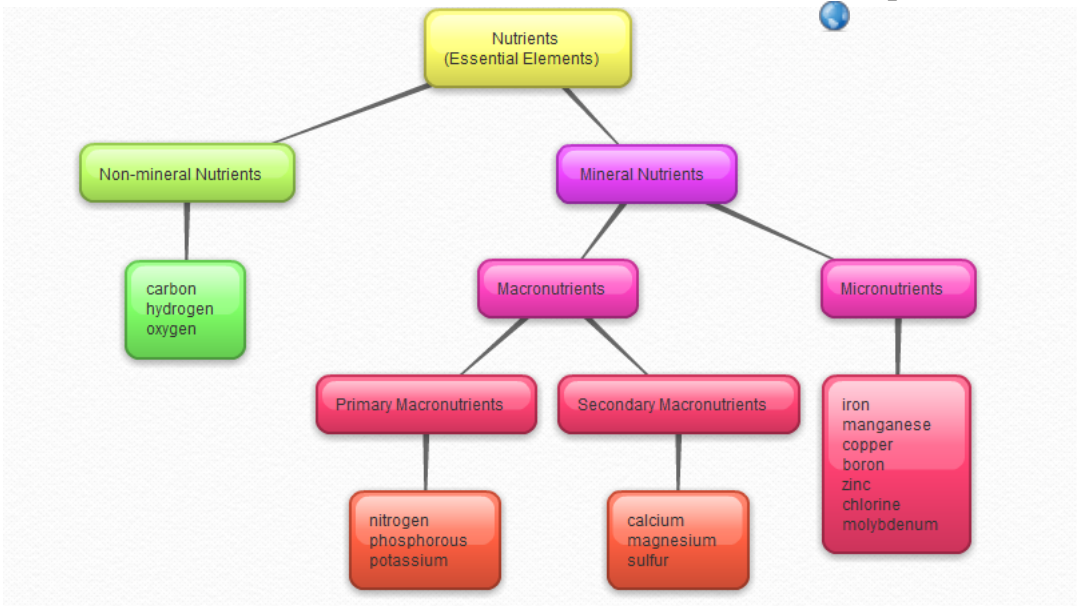
non-mineral nutrients	magnesium - one of the atoms in a chlorophyll molecule
mineral nutrients	needed in relatively large amounts for plant growth (found in commercial fertilizers) -nitrogen, phosphorus and potassium
macronutrients	iron - needed to make hemoglobin molecules in red-blooded animals
primary macronutrients	nutrients which enter an ecosystem from bedrock
secondary macronutrients	nutrients which enter an ecosystem in the form of water and carbon dioxide - oxygen, carbon, hydrogen (building blocks of life)
micronutrient	required in greater amounts than micronutrients

Correct Matches

non-mineral nutrients	nutrients which enter an ecosystem in the form of water and carbon dioxide - oxygen, carbon, hydrogen (building blocks of life)
mineral nutrients	nutrients which enter an ecosystem from bedrock
macronutrients	required in greater amounts than micronutrients
primary macronutrients	needed in relatively large amounts for plant growth (found in commercial fertilizers) -nitrogen, phosphorus and potassium
secondary macronutrients	magnesium - one of the atoms in a chlorophyll molecule
micronutrient	iron - needed to make hemoglobin molecules in red-blooded animals

*Shows 16 elements which most plants need.

https://bubbl.us/



Attachments

Notes - Pyramids of Energy.pdf

NOTES - Nutrients and Cycles.pdf