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1.4.6 Energy Flow

Energy Flow

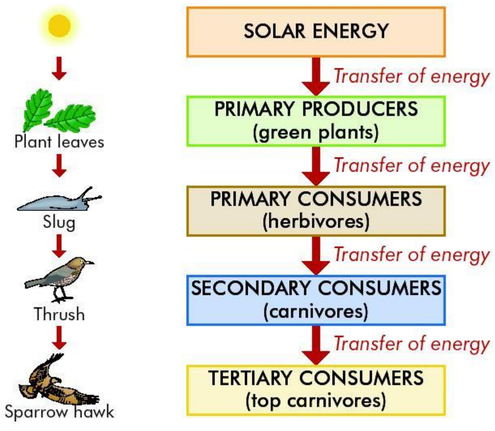
An ecosystem is a community of living organisms interacting with one another and their non-living environment within a particular area, e.g. woodland,.

Energy flow is the pathway of energy transfer from one organism to the next in an ecosystem due to feeding, e.g. along a food chain

Ecosystems require energy which comes from the sun – the primary source of energy

Food Chain

Is a flow diagram that begins with a plant and shows how food/energy is passed through a series of organisms in a community.
Each organism feeds on the one before it.



A food chain ends when there is not enough energy to support another organism.

Woodland food chain

Honeysuckle → aphids → ladybirds → thrushes

Producer → Primary consumer → Secondary consumer → Tertiary consumer

Two types of food chain

1. A Grazing food chain

is one where the initial plant is living e.g.

Grass → grasshoppers → frogs → hawks

Honeysuckle → aphids → ladybirds → thrushes

Seaweed → winkles → crabs → herring gulls

Phytoplankton → zooplankton → copepod → herring.

2. A Detritus food chain

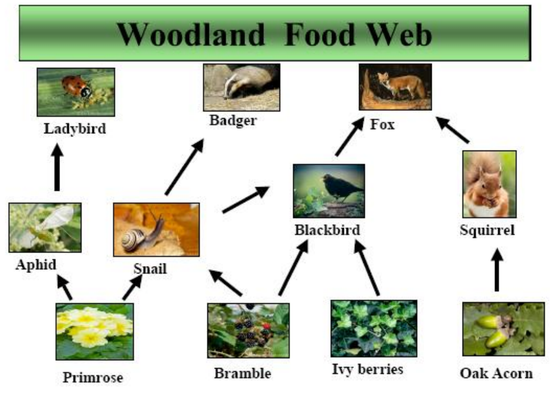
is one where the chain begins with dead organic matter and animal waste (detritus) e.g.

Detritus → edible crab → seagull

Fallen leaves → earthworms → blackbirds → hawks

Food Web

This is a chart showing all the interconnecting food chains in the habitat./ecosystem.



Trophic Levels

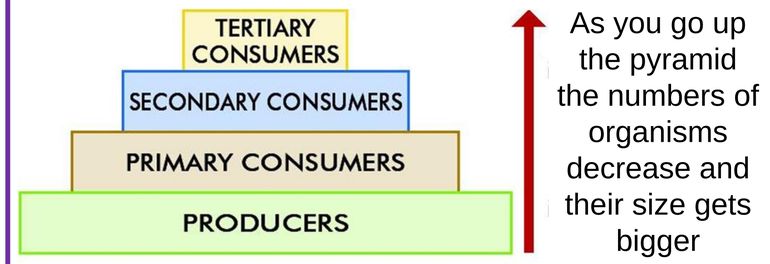
Refers to the position of an organism in a food chain.

Plants are at the 1st trophic level (T1) and

Herbivores occupy the 2nd trophic level (T2).

Carnivores that eat herbivores are at the 3rd trophic level (T3).

The 4th trophic level (T4) is often occupied by the top carnivore.



Pyramid of Numbers

A diagram that represents the numbers of organisms at each trophic level in a food chain.

Bottom layer is the largest and represents a very large number of primary producers

The next layer smaller and represents a smaller number of primary consumers

The next layer – the no. of secondary consumers

The uppermost layer where there may be only one tertiary consumer

1.4.6 + 1.4.10.H Pyramid of Numbers

Use of Pyramid of Numbers

Ecological pyramids are used to compare different communities of the ecosystem by comparing trophic levels.

They attempt to discover and show the energy structure of an ecosystem as a chart by counting the number of individuals at each trophic level.

In general:

The number of organisms declines as you go up the pyramid

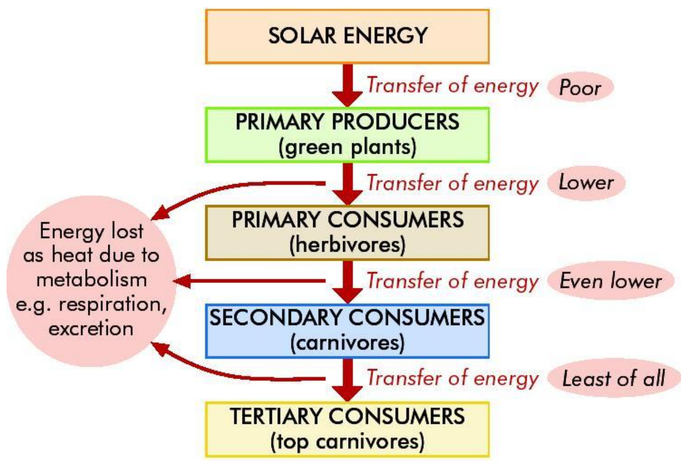
This is due to the large energy loss (about 90%) between each trophic level

As a result there is less energy available to organisms higher up the pyramid

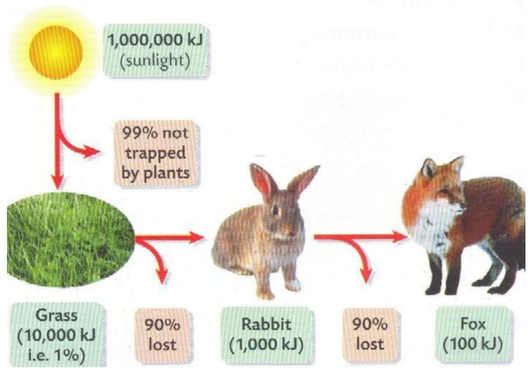
Loss of energy and body size increase as you go up the pyramid

Energy Transfer

This is the flow of energy ***into the ecosystem*** from the sun; and ***within the ecosystem*** through the different trophic levels along food chains, and finally ***out of the ecosystem*** into the atmosphere as heat loss due to respiration.



Energy loss in a Food Chain or Ecosystem

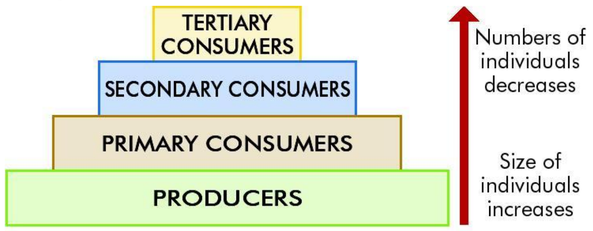


From the diagram above we can see that only about 10% of the energy in an organism is transferred when one member of a food chain is eaten by the next

The large energy loss from one trophic level to the next explains why food chains contain no more than four or five levels

Each trophic level contains less energy than the previous one

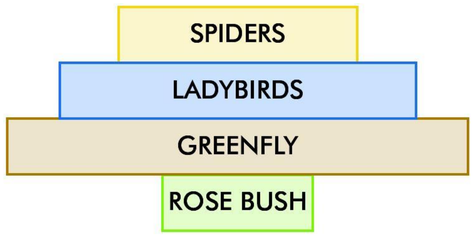
Normal Pyramid of Numbers



Limitations of use

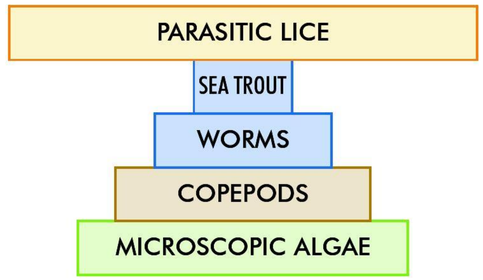
The size of organisms is not considered in a pyramid of numbers.

e.g. one rose bush can support thousands of greenfly.



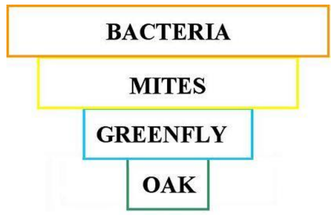
A distorted Pyramid of Numbers

A similar problem arises with parasites – numerous parasites on one host – resulting in a distorted pyramid

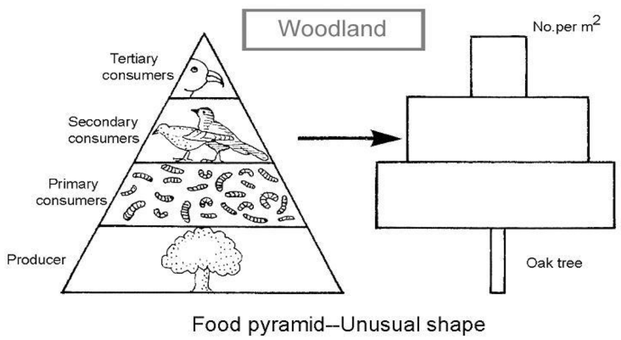


An inverted Pyramid of Numbers

When organism size is not considered very unusual pyramid shapes are likely to occur.



Another example



Food pyramid--Unusual shape

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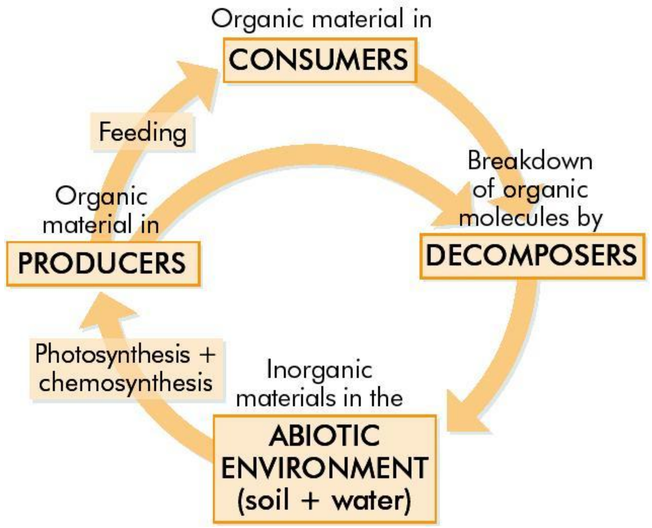
1.4.7 – 1.4.8 Niche & Nutrient Recycling

Niche

A **niche** is the functional role of an organism in an ecosystem.

Nutrient Recycling



ensures that there is no real longterm drain on the Earth's nutrients, despite millions of years of plant and animal activity.

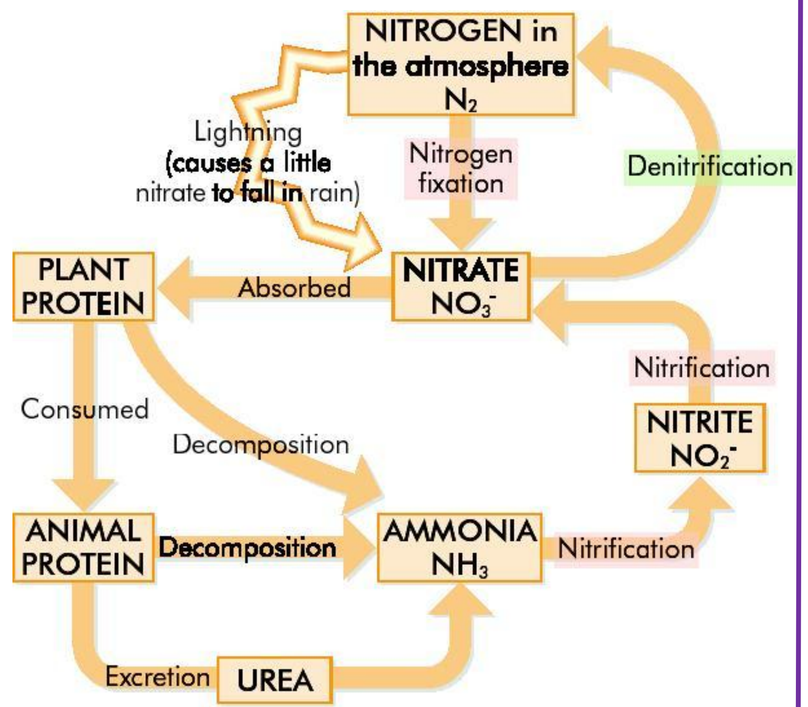
Nitrogen Cycle

All organisms need nitrogen for protein, DNA & RNA manufacture
78% of the Earth's atmosphere is nitrogen gas, but it cannot be used in this form by plants and animals. Nitrogen gas must first be 'fixed', i.e. changed to a suitable form (ammonia or nitrate) before it can be used.

- ***Nitrogen-fixing bacteria*** in the soil convert N_2 gas in the air into ammonia (NH_3). This accounts for the majority of all N_2 fixation.
- ***Lightening storms*** and *fuel burning in car engines* produce nitrates, which are washed by rain into the soil water.
- Nitrates are absorbed by plant roots and converted to plant protein.
- Plant proteins are passed along food chains to become animal protein.
- When organisms die, their proteins are converted to ammonia by bacterial decomposition.
- ***Nitrifying bacteria*** in the soil then convert ammonia (NH_3) into nitrites (NO_2^{2-}) then into nitrates (NO_3^-).
- Nitrates can be absorbed by other plants to continue the cycle.
- ***Denitrifying bacteria*** convert soil nitrates into N_2 gas.

  This is a loss of N_2 from the cycle.

  Only happens in anaerobic conditions (when O_2 levels are low) – due to flooding or accumulation of sewage.
- Nitrate also enters the cycle through the addition of nitrogen rich fertilisers to the soil – made industrially from nitrogen gas.



Carbon Cycle

Carbon forms part of all organic nutrients – carbohydrates, fats and proteins.

Carbon dioxide is **removed** from the environment by photosynthesis in plants, and under certain conditions, over long periods of time, some of these plants may form fossil fuels such as coal, oil, peat and natural gas.

Carbon dioxide is **returned** to the environment by:
1. Respiration in plants, animals & micro-organisms.
2. Decay caused by micro-organisms.
3. Combustion i.e. burning fossil fuels