

Ecosystems

1.1 What is an ecosystem?

An ecosystem is a biological environment consisting of all the organisms living in a particular area, as well as all the non-living, physical components of the environment with which the organisms interact, such as air, soil, water, and sunlight.

Some **examples** of ecosystems are:

- Aquatic ecosystem
- Coral reef
- Desert
- Forest
- Large marine ecosystem
- Littoral zone
- Marine ecosystem
- Pond Ecosystem
- Prairie
- Rainforest
- Savanna
- Steppe
- Taiga
- Tundra
- Urban ecosystem

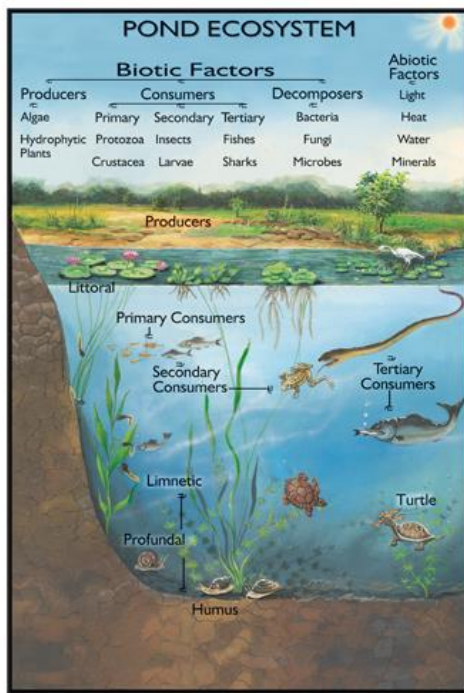
The **biotic** components of an ecosystem refer to the **living components** and the **abiotic** to the **non-living components**. Both are of much importance to an ecosystem. The humidity I a forest makes it possible for mosses to grow on trees, rocks give shelter and shade for ground dwelling insects and the amount of sunlight entering an ecosystem determines which plants can grow there.

ABIOTIC COMPONENTS	BIOTIC COMPONENTS
Sunlight	Primary producers
Temperature	Herbivores
Precipitation	Carnivores
Water or moisture	Omnivores
Soil or water chemistry (e.g., P, NH ₄ ⁺)	Detritivores
etc.	etc.

As an ecosystem can cover a very large area, biologists can use another term to describe where a particular community of organisms lives. This interaction between a community and the abiotic factors, the particular habitat, can be thought of as a **biotope**.

$$\text{Biotope} = \text{habitat} + \text{community}$$

Here below you see an example of a pond ecosystem with its biotic and abiotic components.

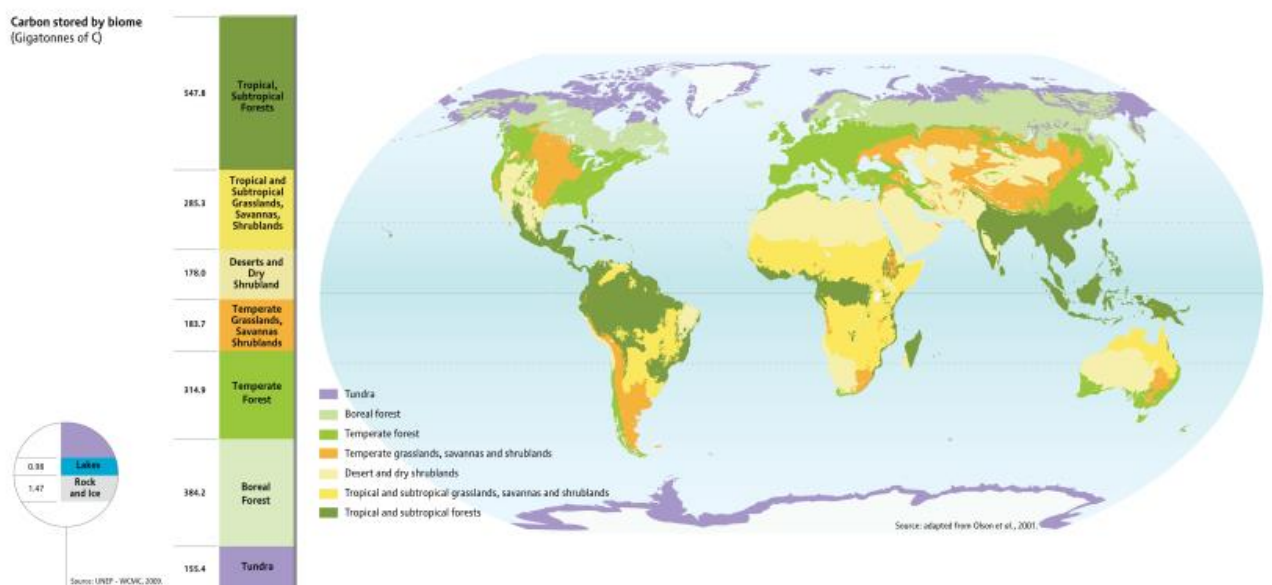


2. Biomes

Some parts of the earth have more or less the same kind of abiotic and biotic factors spread over a large area creating a typical ecosystem over that area. Such major ecosystems are termed as biomes.

Biomes are defined by factors such as plant structures (such as trees, shrubs, and grasses), leaf types (such as broadleaf and needle leaf), plant spacing (forest, woodland, savanna), and climate.

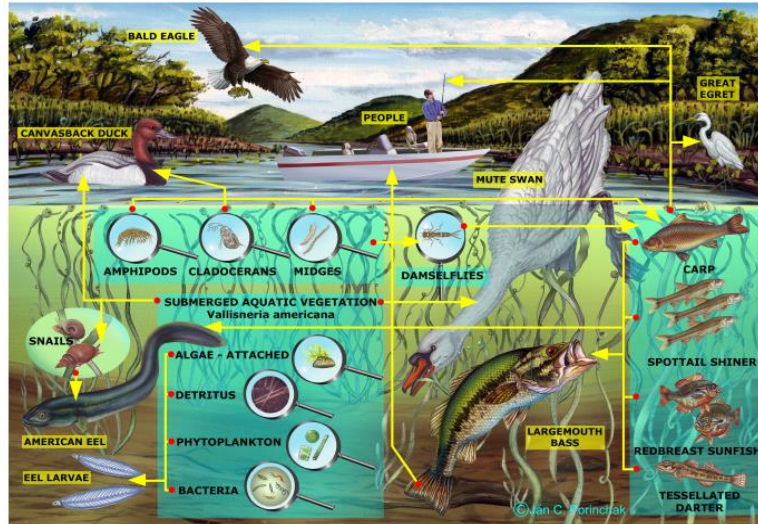
Here below you see a map of the world and the different biomes are coloured, do you see similarities? Which abiotic factors do they share?



3. Biocoenosis

(synonyms -Biotic community, Biological community, and Ecological community)

A biocoenosis describes all **the interacting organisms living together in a specific habitat**. Which interactions do you see in the following illustration?



4. Inter and intraspecific interactions

Interspecific interactions result from the fact that organisms of different species in a community interact with each other. This could be a lion hunting an antelope, moss growing on a tree trunk but also bacteria living on your skin.

They are classified according to the effects that individuals of interacting species have on each other, using symbols: - (negative effects), + (positive effect) and 0 (no effects).

Some of the most common are:

- Competition (-,-)
- Predation (+,-)
- Parasitism (+,-)
- Commensalism (+,0)
- Mutualism (+,+)

TASK: Can you state 2 examples of each type of interspecific interactions named above?

Intraspecific interactions refer to the interactions between individuals within the same species. This could be for example wolves cooperating while hunting (cooperation) or bears fighting with each other for their territory (competition), lions teaching their offspring how to hunt (families), a species of coral growing in an area (corals) or a population of bees cooperating to show each other food sources (social).

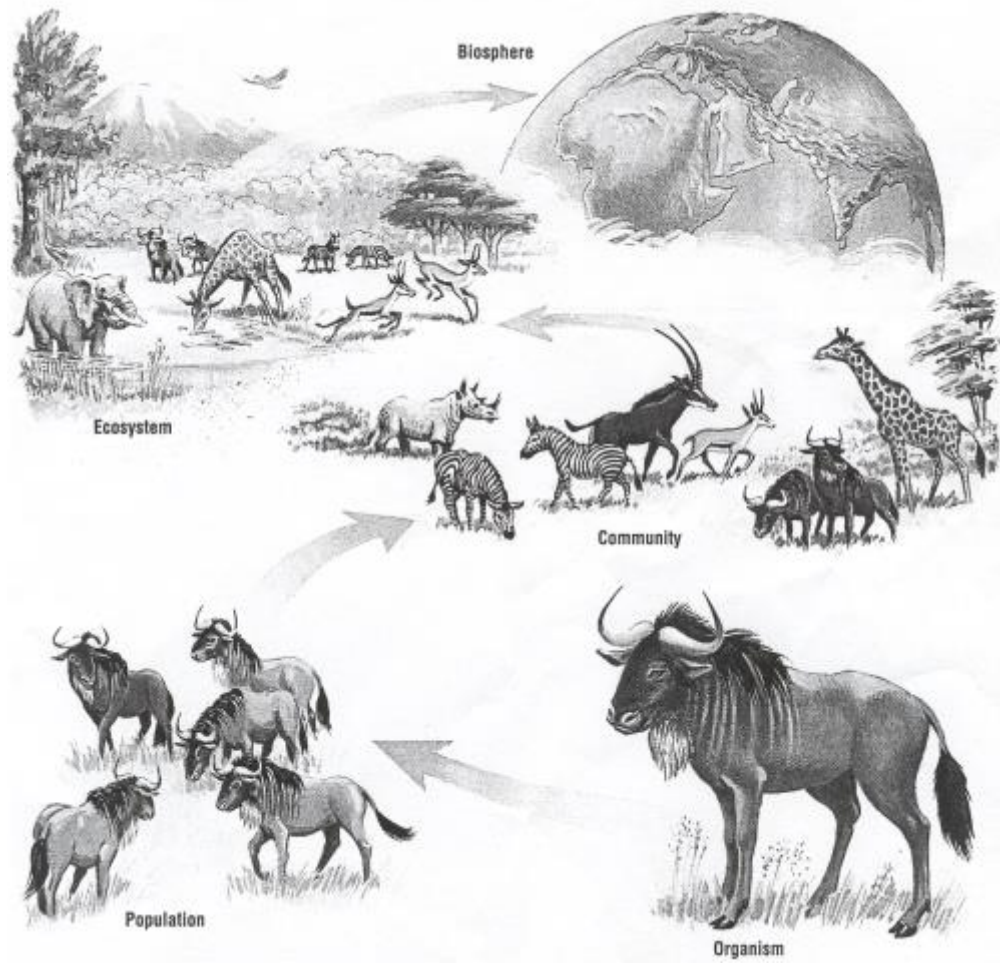
Which relations to you recognise in the following images?



5. The organisation of life

You learned about the organisation of the smallest unit of life to an organism (cells, tissues, organ, organ system, organism), but we could continue adding the relations above and below and come to the following list:

- **Atom**, the smallest building block of matter
- **Biomolecule**, a grouping of atoms
- **Organelle**, a functional grouping of biomolecules
- **Cell**, the basic unit of all life and the grouping of organelles
- **Tissue**, a functional grouping of cells
- **Organ**, a functional grouping of tissues
- **Organ system**, a functional grouping of organs
- **Organism**, the basic living system, a functional grouping of the lower-level components, including at least one cell
- **Population**, a grouping of organisms of the same species
- **Community**, the interactions between different populations in a specific area.
- **Biotope**, the interactions of a community with their habitat.
- **Biocenosis** an interspecific grouping of populations
- **Ecosystem**, a grouping of organisms from all biological domains in conjunction with the physical (abiotic) environment
- **Biome**, a group of ecosystems with similar attributes.
- **Biosphere**, the complete set of ecosystems



6. Trophic levels

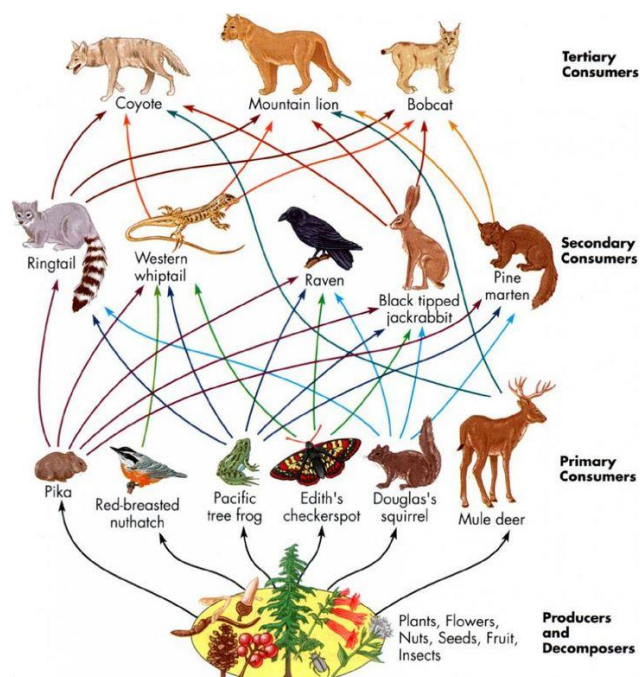
To understand the relationships within an ecosystem, it is useful to group together all the organisms of the biocenosis according to how they obtain nutrients: producers and consumers. This helps visualise the way energy moves through an ecosystem. This complicated interaction is known as a food web, where a single path through the web can be called a food chain.

A **food chain** is a diagram which has drawings or the names of the different organisms in the different trophic levels of the ecosystem. The feeding relationship is indicated by arrows. For example:

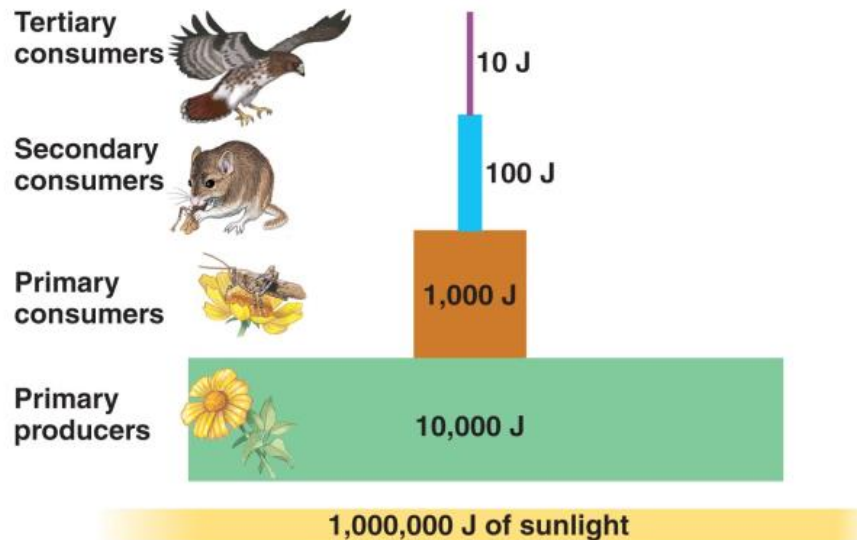
Plant → Grasshopper → Bird → Snake → Owl



Food webs are representations of all the trophic chains in an ecosystem and how they interconnect with each other.



The position an organism occupies in the food chain can be thought of as its **trophic level**.



Green plants, which obtain their energy directly from sunlight from this energy, make organic material from inorganic material, form the level of **producers**. Producers are autotrophs – they make their food. These are the base of all food webs.

The **consumers** are heterotrophic organisms. *Primary consumers* feed on plants (the producers), these are called herbivores. The *secondary consumers* feed on the primary consumers. The tertiary consumers feed on the consumers from the level below.

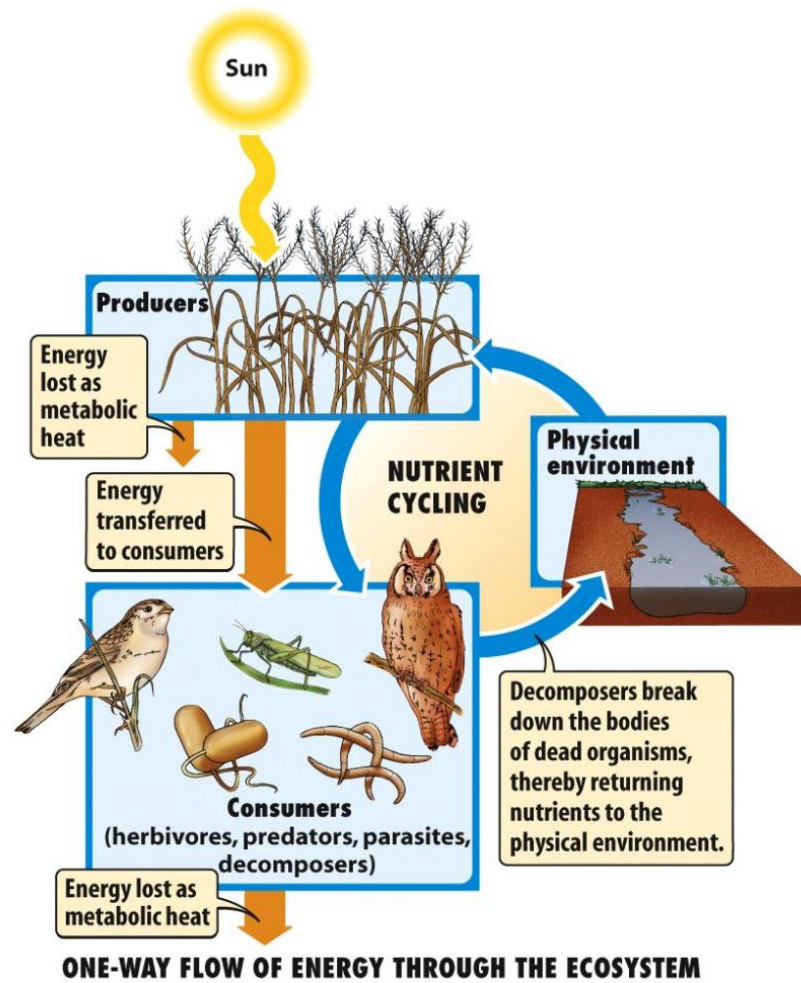
Many animals belong to different trophic levels. The decomposers obtain their energy from the chemical decomposition of dead organisms or from the waste products of plants and animals. They are above all, bacteria and fungi. The role they play is vital, they return the organic material to the environment as inorganic material, so that it can be re-used again by plants.

THE FLOW OF ENERGY

The energy enters an ecosystem by the Sun. Some of that energy reaches the producers and drives the process of photosynthesis but only a small part of that energy is stored in their bodies. All organisms use energy for their life processes, to grow, interact, move etc. and that energy will leave their bodies as heat. So when they are eat every time less energy reaches the next level in the food chain. More or less 10% of the energy passes on to the next level in the chain, the other 90% is used by the organism.

The flow of energy through an ecosystem in an **open cycle**, energy gets lost from it.

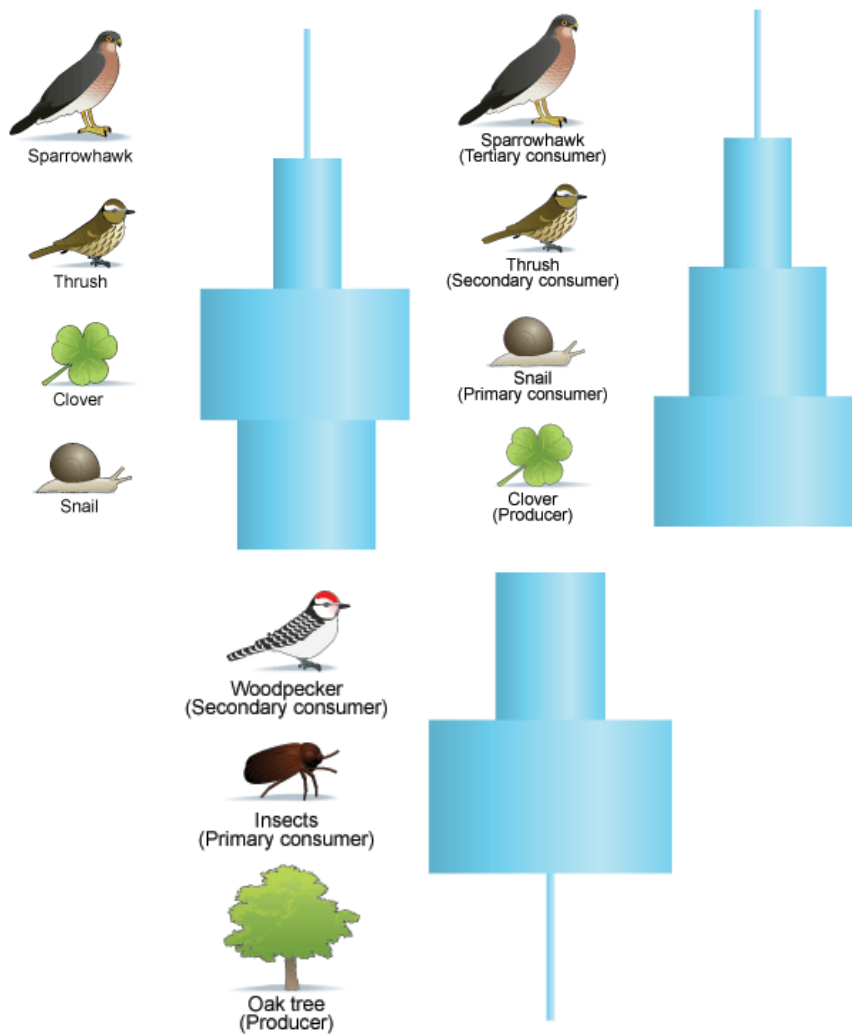
The **flow of matter** in an ecosystem is different, this is a **closed cycle**. Matter does not enter nor exits the biosphere (with exceptions) so matter needs to be recycled.



Pyramids

How can we represent the quantitative data of each different trophic level in a food chain?

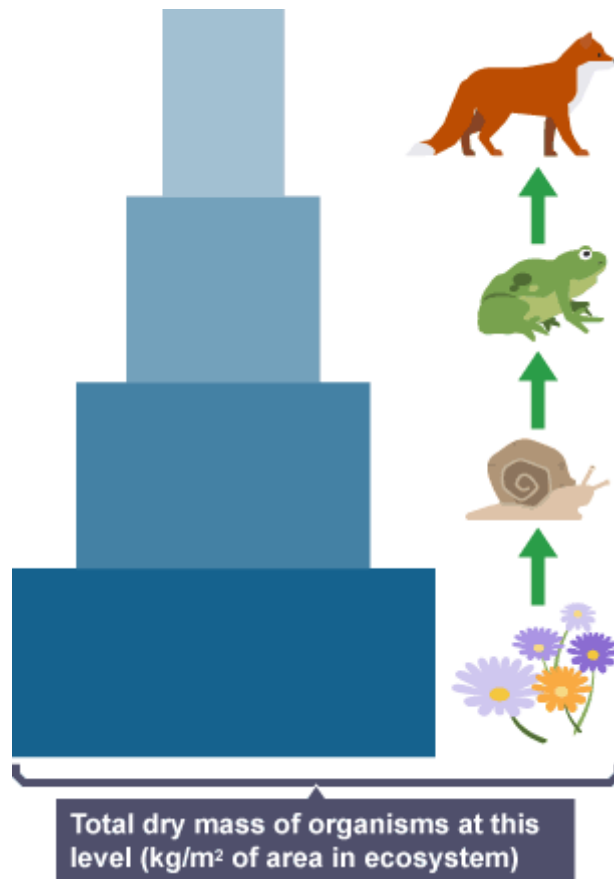
Pyramids of number represent the total number of organisms at each trophic level. They only give an accurate representation of the flow of energy through a food chain *if the organisms are of a similar size*. Compare the examples below:



(<http://www.bbc.co.uk/bitesize/quiz/q39312979>)

As a single tree can support many organisms, this food chain produces an unbalanced pyramid.

Measuring the **biomass** at each trophic level can give a more accurate picture. Biomass is the mass, fresh or dry of living things per unit of area (for terrestrial communities), or unit of volume (in aquatic communities).



<http://www.bbc.co.uk/education/guides/zqyj6sg/revision/2>

At each trophic level, the amount of biomass and energy available is reduced, giving a pyramid shape.