Unit 5:
Structure of the ecosystems

1. Ecosystems

2. The physical environment

3. Living beings relationships

4. Trophic structure of the ecosystem

5. Matter and energy in ecosystems

6. Ecological niche and habitat

Think and answer

a. What factor (light, temperature, etc) can affect to the living beings in the photograph?

b. Can any living being live absolutely isolated without contact with other living beings? Why?

c. Put some examples of adaptations to the environment of the living beings in the photograph

UNIT OBJECTIVES

In this unit you will learn:

- To learn what an ecosystem is and which its components are.
- To distinguish between biotic and abiotic factors within the ecosystem.
- To deduce the adaptations living beings develop to survive.
- To distinguish the types of ecological relationships among organisms.
- To identify the trophic levels and how they connect in the food web.
- To understand between the behavior of energy and matter.
- To distinguish between ecological niche and habitat.

1. Ecosystems.

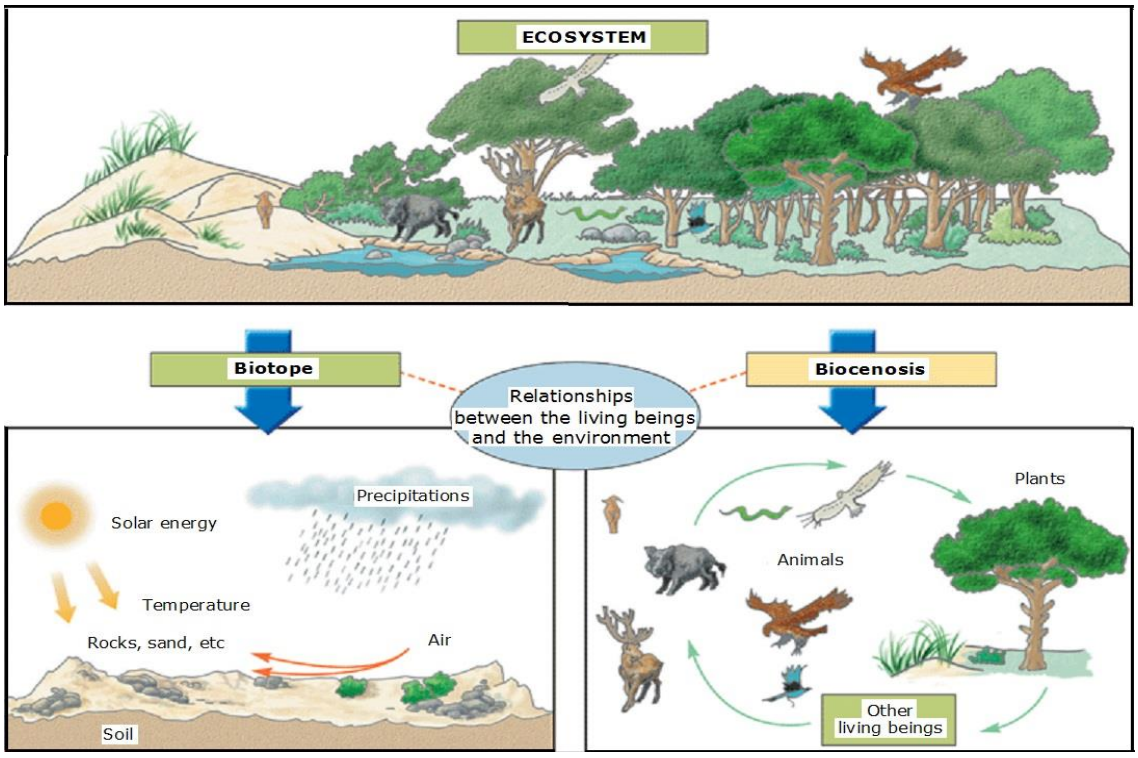
An **ecosystem** is the join of organisms which lives in a particular area, the physical components and conditions of this area and the relationships that these living beings establish among them and with their physical environment.

Ecosystems can be very diverse. They can be aquatic (e.g. a river) and terrestrial (e.g. a field). They can be small and with well-defined limits, like for example, a lake, and they can be large and with undefined limits as an ocean or a forest.

Biomes are large geographical areas with similar climatic conditions that have similar ecosystems too. The **ecosphere** is formed by all the ecosystems of the Earth.

Ecosystems have two components: biotope and biocenosis.

- The **biotope** is the inert part of the ecosystem formed by:
  - the *physical environment* (rocks, air or water)
  - the *abiotic factors*. They are the physical and chemical elements of an ecosystem which affect living organisms, such as temperature, humidity, solar radiation, etc.
- The **biocenosis** is the living part of the ecosystem. It is the set of living beings that form part of the ecosystem: animals, plants, fungi and microorganisms. They are known as *biotic factors*.
  - All the organisms of the same species that live together is a **population**.
  - The join of populations of an ecosystem is the **community** or biocenosis.



READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:
Remember: you must make complete sentences.

1.1. Name the appropriate term for each of the following ecosystem components:

a. All the living things in a river
b. The temperature of the sea water
c. All the birds of the same species in a pine forest
d. The sand of a beach

1.2. What is the difference between ecosphere and biosphere?

2. The physical environment: abiotic factors.

Abiotic factors are the variables of the physical environment (light, temperature, humidity, etc) that affect living beings.

The most important abiotic factors are:

- **Temperature**.
  It has an enormous importance in the development of life.
  Freezing occurs below certain temperature values and all cellular activity stops above certain limits.
  Temperature depends on altitude, latitude and the season or day hour. Its influence is bigger in land than in water. Aquatic environments have usually a constant temperature, while in terrestrial environments, temperature changes a lot.

- **Light**
  The amount of solar radiation that arrives to the plants depends on the altitude, the latitude and the time of the year and the hour of the day.
  For plants, light is essential to perform photosynthesis. On the other hand, light affects animals' sleep patterns and other biological activities.
  It is difficult for light to penetrate an aquatic environment and it can only enter until certain depth.

- **Humidity**
  Water is essential for all living beings. The presence or absence of water or the precipitations amount and its distribution determine the type of living beings we can find in an ecosystem.

- **Salinity**
  It is the concentration of salt in water. In aquatic environments, water can be freshwater or salt water depending on the amount of salts it contains.

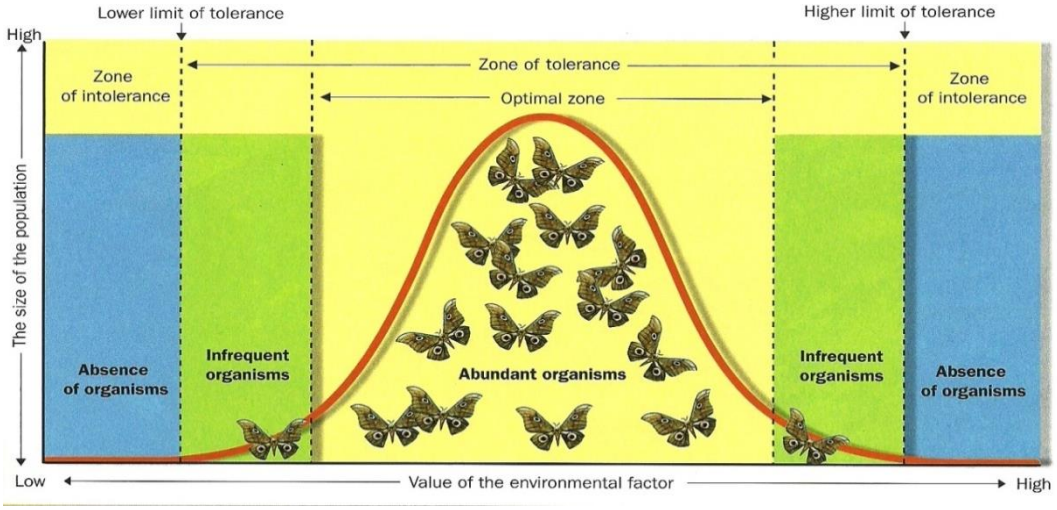
- **Pressure**
  It does not vary very much with altitude in terrestrial environment but it increases considerably with depth in aquatic environment.

The influence of the abiotic factors can be more or less intense depending on the environment.

- The most influential factor in **terrestrial environment** are *temperature* and *humidity*.
- The most influential factors in **aquatic environments** are *light*, *salinity* and *pressure*.

These factors determine the types of living beings which develop in an ecosystem. They have a tremendous impact because they influence the ecosystem in many ways. For example, climate or water supply, affects the behavior and the vital functions of the organisms.

Tolerance limits are the maximum or minimum values of a variable which a species can tolerate. When variables exceed these limits, organisms cannot survive. In this case, this factor is called **limiting factor**.



In order to survive, living beings adapt to their environment. **Adaptation** is the progressive adjustment of a species to the special conditions of the environment where it lives.

How plants are influenced by

Temperature

Some plants lose their leaves when the cold weather starts, beginning a phase of winter rest.

Light

Climbing plants grow over other vegetation so they can reach the sunlight and carry out photosynthesis.

The presence of water

Some plants which live in the desert save a huge quantity of water in their stems to survive the dry environmental conditions.

How animals are influenced by

Light

Some birds, such as the owl, take advantage of the hours of darkness to hunt and daylight hours to sleep.

Temperature

Some animals, like bears, save food during the warm season and hibernate during the cold season (they become inactive).

The presence of water

Reptiles have developed scales over their bodies which protect them and prevent excessive water evaporation.

READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:
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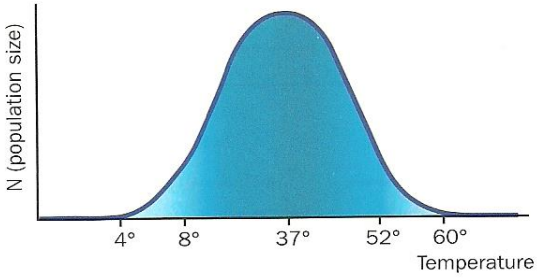
2.1. Look at the graph showing the temperature tolerance for a species and answer:



a. What is the zone of tolerance?

b. Which are the limits of tolerance?

c. Which temperature is the optimal?

2.2. Indicate what abiotic factor correspond each one of these adaptations:

a. Larges leaves

b. Fur and feathers.

c. Hibernation and migration

e. Storing of nutritive substances in roots

f. Reduced leaves or transformed into spines.

g. Skin with scales and without glands.

3. Living beings relationships: biotic factors.

Biotic factors are the relationships or interactions among the living beings of the ecosystem.

There are two types of biotic relationships:
- **Intraspecific relationships** that are the interactions among organisms of the same species.
- **Interspecific relationships** that are the interactions among organisms of different species.

a) Intraspecific relationships

The relationship among individuals of the same species can be:
- **Competitive**. It is a negative relationship. Individuals result harmed.
- **Cooperative**. It is a positive relationship. Individuals result benefited.

- Intraspecific competition

Organisms of the same species have the same needs, so that they will compete over resources if they become scarce.

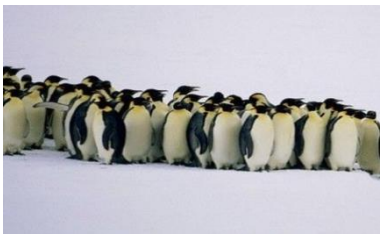
These resources are food, territory and sexual partner. (E. g. Male deers fight for females during the mating season)

- Cooperative relationships

In this case, organisms associate to help each other. In this way they increase the probability of survival. The main positive intraspecific relationships are:

- Gregarious association

It is a large group of individuals of the same species, not necessarily related, which live together, at least for some time. The main gregarious associations are:
- **Herds**, typical of mammals (e.g. buffalo, antelopes, zebras, etc.)
- **Folks**, typical of birds (e.g. doves, flamingos, etc.)
- **Shoals**, typical of many fish species (e.g. sardines, tuna, etc.)


- Family

It is a small group of related individuals of the same species which live together to procreate and protect the young. (E.g. lions, elephants)



- Society

It is a large group of related individuals of the same species organized in a hierarchy. Within the group, different types of individuals carry out different functions. (E.g. bees, ants, termites)



- Colony

It is a group of genetically identical individuals that live together sharing a common structure. (E. g. corals are formed by thousands of identical individuals that share the calcareous skeleton)

b) Interspecific relationships

When individuals of different species interact the relationship can be beneficial (+), harmful (-) or indifferent (0) for both or one of them.

According to this we can summarise the interspecific relationships in this chart:

RELATIONSHIP	SPECIES 1	SPECIES 2
Interspecific competition	-	-
Predation	+ (Predator)	- (Prey)
Parasitism	+ (Parasite)	- (Host)
Commensalism	+ (Commensal)	0
Mutualism	+	+

- Interspecific competition

This relation is mutually harmful for both species. It is established between species with similar necessities that live together in the same place.

The species fight for food or territory (E.g. gnus and zebras, giraffes and gazelles)

- Predation

In this interaction one of the species (the **predator**) hunts and kills other (the **prey**) to feed in. (E.g. cheetahs eat gazelles)

- Parasitism

This is a relationship in which one of species (the **parasite**) lives at expense of another species (the **host**) and harms it in the process. (E.g. ticks suck the dog's blood)

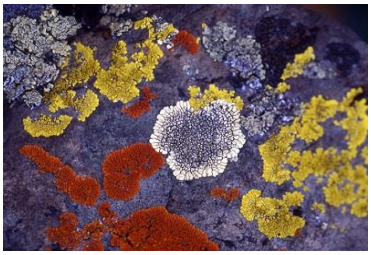
- Commensalism

In this case one of the implicated species (the **commensal**) benefits of the interaction while it is indifferent for the other. (E.g. Remora fish feeds in the rest of food that falls while sharks eat). A special type of commensalism is **inquilinism**, in which one organism uses the other for housing (E.g. Same species of owl lives in trees' holes)

- Mutualism

This relation is mutually beneficial for both species (E.g. bees pollinate flowers, cow herons eat the parasites of buffaloes, etc.). When the relationship is so narrow, that the species involved cannot survive separate the relationship is called **symbiosis** (e.g. Lichens are organism formed by an unicellular alga that lives within the tissues of a fungi)





READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:
Remember: you must make complete sentences.

3.1. Look at the pictures.

a. Are they intra or interspecific relationships?
b. What biotic relations are represented in each one?




3.2. Competition is an interaction in which organisms fight for the same resources. Which type of competition is more intense intraspecific or interspecific one? Why?

3.3. Indicate in the following examples what specie is beneficial and why.

a. Hyenas and vultures are scavenger animals that compete for carrion.
b. Chameleon feed in insects that they hunt with its sticky tongue.
c. Ivy grows on other plants to achieve larger amount of light.
d. Clown fish defend anemone of its predators and anemone protects the fish with its venom.

4. Trophic structure of the ecosystem.

All living beings need energy and matter to perform their vital functions. They obtain this energy and matter from the nutrients in food.

Organisms can be classified according to the way they obtain food. The way they do it also determines their trophic level, that is, their place in the food chain.

a) Trophic levels

A trophic level is a group of living beings in an ecosystem that obtain matter and energy in a similar way and so occupy the same place in the food chain.

We can distinguish three trophic levels in an ecosystem:

- Producers

These are **autotrophic organisms**: plants, algae and some bacteria.
They take in solar energy during photosynthesis and use it to transform inorganic matter (CO_2, H_2O and mineral salts) from their surroundings into organic matter (glucose).

- Consumers

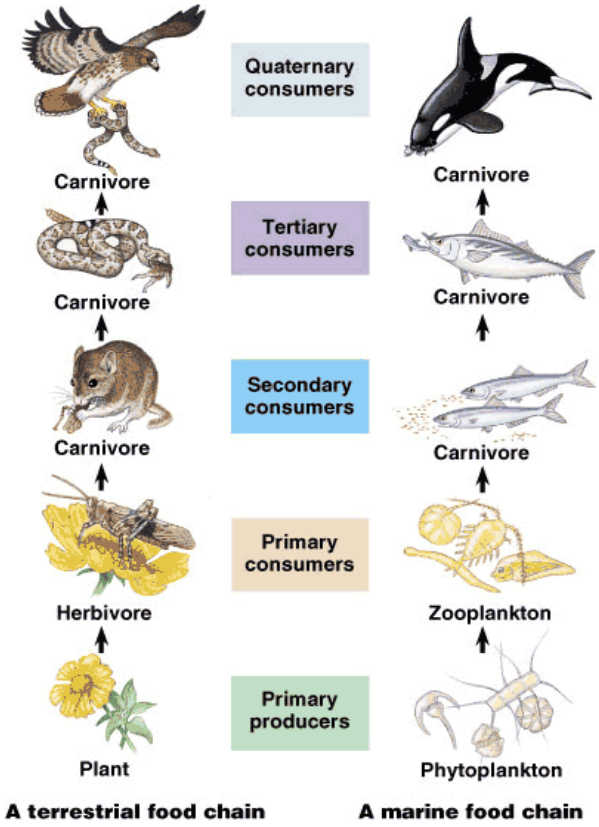
These are **heterotrophic organisms**: animals, fungi and some bacteria.
They obtain matter and energy by feeding off other living things or decomposing organic matter.

They are divided into:

- Primary consumers
They are **herbivores**, which feed on the producers.

- Secondary consumers
They are **carnivores**, which feed on the primary consumers.

- Tertiary consumers
They are also **carnivores**, which feed on the secondary consumers.



Carnivors can be:
- **Predators**. They hunt other animals (e.g. lions, eagles, etc)
- **Scavengers**. They feed on carcasses (e.g. hyenas, vultures, etc)

Some secondary and tertiary consumers are **omnivores** and also feed on producers (e.g. bears, wild boars, humans, etc).

Other consumers are **detritivores**, such as earthworms or many insects that feed on plant or animal organic remains that are in the soil.

- Decomposers

They are **heterotrophic organisms**. They are bacteria and fungi which decompose the organic remains (carcasses, excrements, etc.) of other living beings and transform them into inorganic matter useful for producers.

b) Food chains and food webs

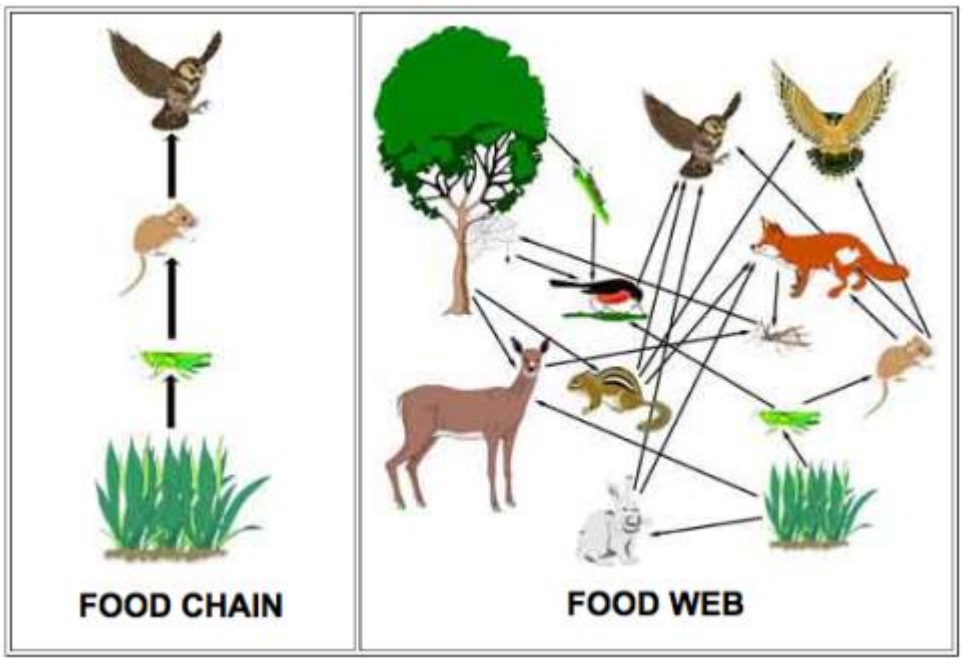
The **food chain** or **trophic chain** is the linear graphic representation of the feeding relationships between organisms at different trophic levels in an ecosystem.

Each organism feeds on the one below it in the food chain and in turns is eaten by the organism above it. It is represented by arrows. The tip of the arrow points to the eater and the other end points to the organism that is eaten.

There are food chains in both terrestrial and aquatic ecosystems.

Usually trophic relationships are extremely complex. Normally a consumer feed on more than one species from the previous level in a food chain, and then in turns is eaten by a variety of species from a higher level. So food chains are interrelated in different ways.

A **food web** or **trophic web** is a graphical representation of the feeding relationships between species in an ecosystem, which combines several interrelated food chains.

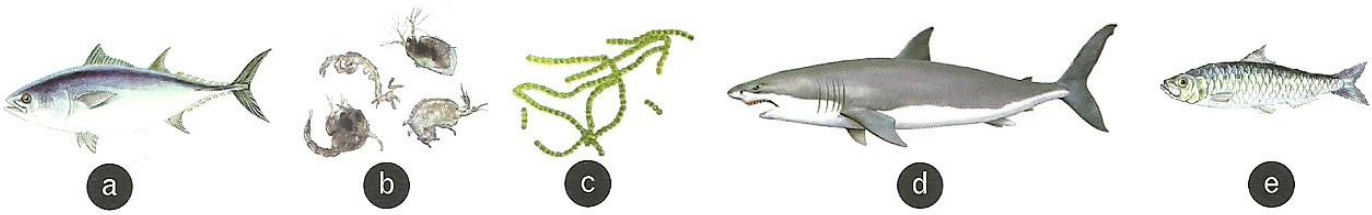


READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:
Remember: you must make complete sentences.

4.1. Which graphic representation gives us more information about the ecosystem, the food web or the food chain? Why?

4.2. Put the following living beings in order to represent a food chain, and identify the producers and the different types of consumers. What types of organisms are not represented?



4.3. Why cannot be considered scavengers or detritivores as decomposers?

5. Matter and energy in the ecosystem.

In ecosystems, matter and energy are transmitted though the food relationships between organisms. However, matter and energy behave in a different way. While energy enters, flows through the ecosystem in one way and finally is lost, matter describe a cycle, passing from a trophic level to other and it never losses.

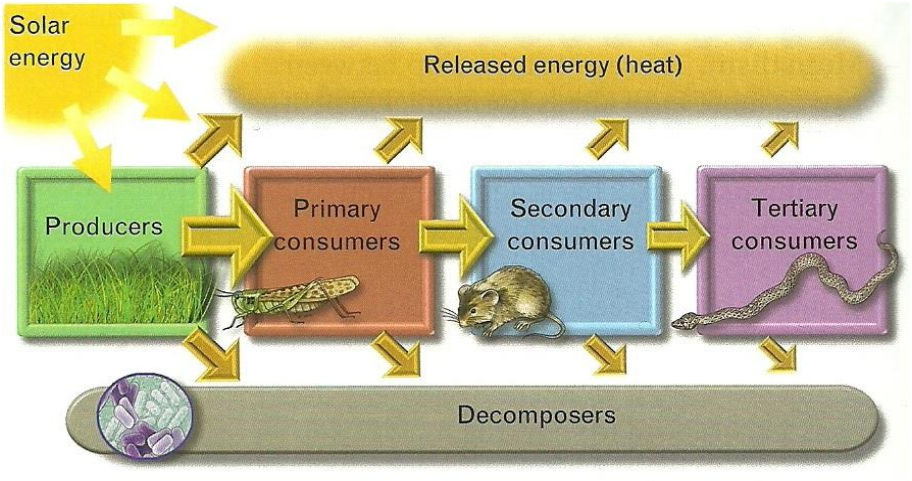
a) Flow of energy trough the ecosystem

Energy enters to the ecosystem during **photosynthesis**. Thanks to this reaction producers transform the *electromagnetic energy* of sunlight into *chemical energy* that is stored in the **chemical bonds** of organic matter. In this way, energy can pass from a trophic level to another. Consumers
obtain the energy from the food they eat and decomposers from the organic matter they decompose.

Producers, consumers and decomposers, use:
- A part of the energy to make their own bodies (to repair tissues and to grow).
- Other part is used to perform vital functions and to stay alive (movement, breathing, etc).
- Other part is lost as heat.

Only the energy stored in the tissues can pass to the following trophic level.

The energy **flows in one direction** through the ecosystem and it is finally lost.

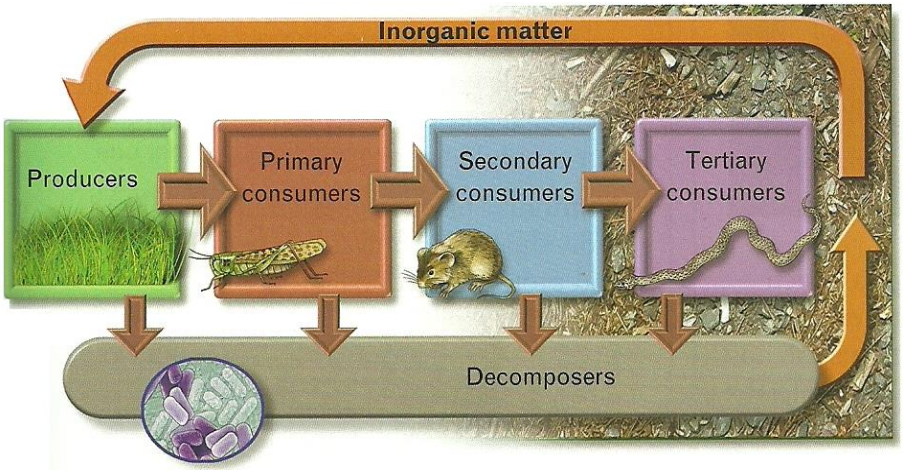


b) Cycle of matter in the ecosystem

Matter flows through the ecosystem describing a cycle.

Producers take in inorganic matter form the environment, changing it into organic matter. Consumers obtain this organic matter from producers and other consumers by eating. Finally organic matter finishes in the decomposers' level where it is transformed into inorganic matter. That is how it is returned to the inert environment and put at disposal of producers again.

Matter flows in a **close cycle** trough the ecosystem. It does not lose and can be reused many times.



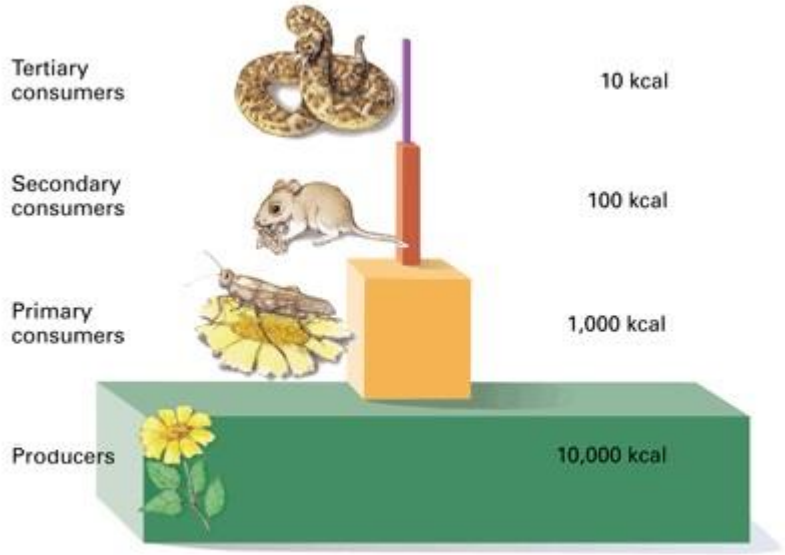
READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:
Remember: you must make complete sentences.

5.1. What is the difference between the behavior of matter and energy in the ecosystems?

5.2. Why it is said that decomposers close the cycle of matter in the ecosystem?

5.3. A trophic pyramid is a way to represent graphically the amount of matter or energy that exists in each trophic level in an ecosystem. If you observe the example, each level stores less energy than the previous one. Could you give an explanation to this?



6. Ecological niche and habitat.

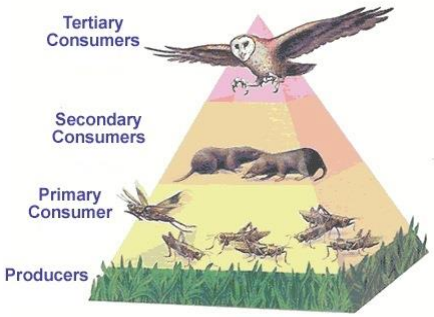
In the ecosystems, living beings occupy a habitat and an ecological niche. These two concepts are closely related but they are different.

- The **habitat** is the typical physical place where a species lives. This place provides the most favourable natural conditions the species needs to survive and develop: temperature, humidity, food, etc.

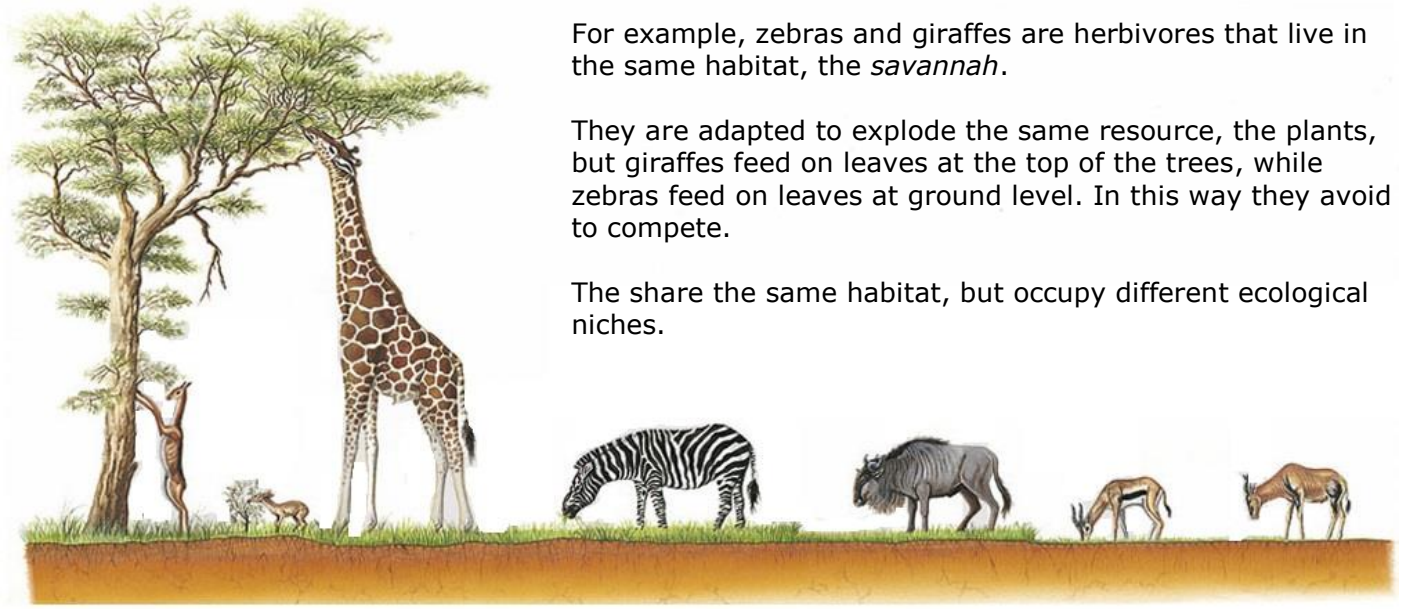
- An **ecological niche** is the role a species plays in an ecosystem. It describes how an organism lives in an ecosystem: where it finds shelter, how it obtains food, how it finds mate, etc.

If we compare the habitat to a person's *house*, then the niche would be the person's *profession*.

The same habitat has several niches. So a barn owl and a mouse live in the same habitat, the *steppe*, but they occupy different niches. Mice are herbivores, while barn owls are carnivores.



However, it is possible that two species occupy the same niche, but this situation cannot be permanent. If two species would have exactly the same needs (eat the same food, require the same temperature, and so on) they will compete with each other and the species which adapt best will exclude the other one. To avoid it the species develop adaptations aimed for minimise competition.



For example, zebras and giraffes are herbivores that live in the same habitat, the *savannah*.

They are adapted to explode the same resource, the plants, but giraffes feed on leaves at the top of the trees, while zebras feed on leaves at ground level. In this way they avoid to compete.

The share the same habitat, but occupy different ecological niches.

READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:
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6.1. Complete these chart:

	Habitat	Ecological niche
African elephant		
Unicellular algae		
Iberian lynx		
Decomposer bacteria		

6.2. Why is it impossible that two species share the same habitat? Could they share the same ecological niche? Why?