

Unit 1:

The basis of life



- 1. Characteristics of life**
- 2. Composition of living matter**
- 3. Cells**
- 4. Cellular nutrition**
- 5. Cellular interaction**
- 6. Cellular reproduction**

What do you remember?

- What living beings can you see in the photograph?
- What is non-living matter in the photograph?
- How are living and non-living matter different?
- What characteristics do living beings have in common?
- Which are the vital functions?
- Which is the basic unit of life?

UNIT OBJECTIVES

In this unit you will learn:

- To distinguish and to describe what a living being is.
- To enumerate the chemical composition of living matter.
- To identify the cell parts and their functions.
- To differentiate plant, animal and bacteria cells.
- To describe how cells perform their vital functions.
- To distinguish the different kinds of nutrition and reproduction.

1. Characteristics of life.

Living beings share some characteristics that allow us differentiate them from inert beings. These features are called **characteristics of life**. They are three:

- Unit of composition.

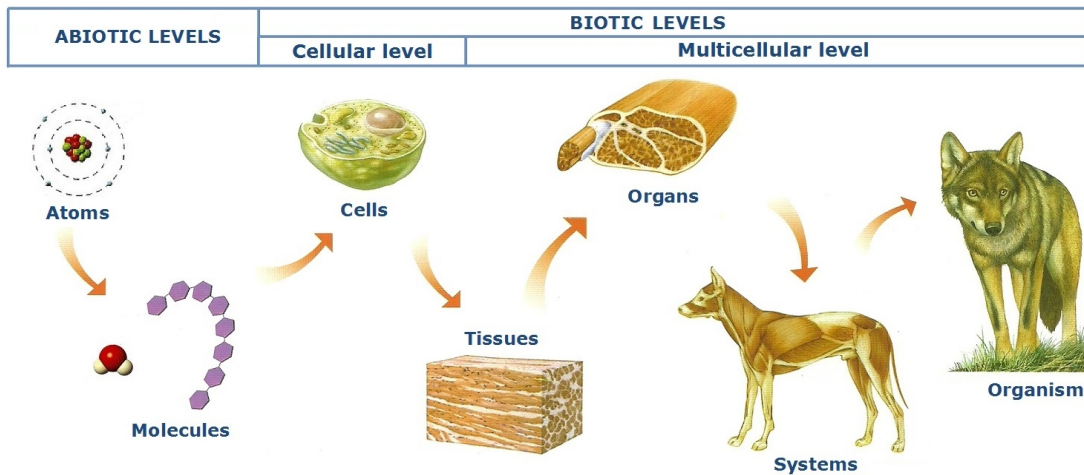
All living beings are made up by a short list of *chemical elements* which are especially abundant in them and very scarce in inert matter.

- Unit of structure.

All living beings are formed by *cells*.

The simplest ones have only one cell and the most complex have millions of millions of cells.

- **Unicellular organisms.** They are made up only by one cell that is self-sufficient.
- **Multicellular organisms.** They are made up by more than one cell and they depend to each other. These cells are organized in *levels of organization* with increasing structural complexity.



- Unit of function.

They perform the *vital functions*:

- **Nutrition** involves the exchange of energy and matter with the environment.
- **Interaction** allows them detect changes in their surrounding and react to them.
- **Reproduction** is the production of descendants and ensures the survival of the species.

READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:

Remember: you must make complete sentences.

1.1. Answer these questions:

- a. How can we classify matter from a chemical point of view?
- b. What criteria have we followed to do it?

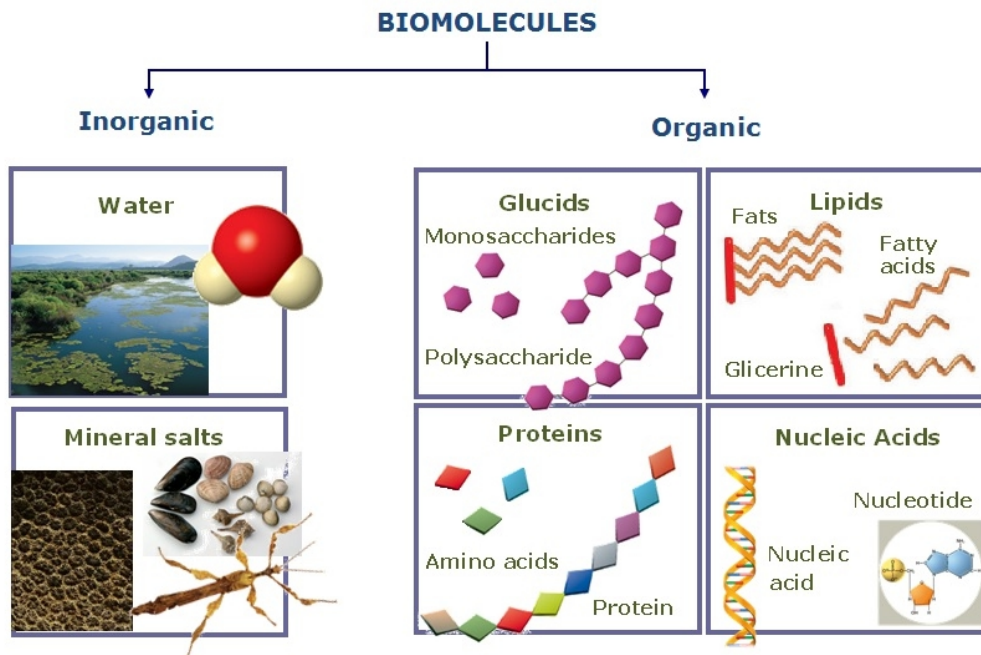
1.2. What vital function, *nutrition (N)*, *interaction (I)* or *reproduction (R)* is performed in each case?

- a. An oak tree loses its leaves in winter.....
- b. Flowers appear on a rosebush.....
- c. A gazelle runs away from a lion.....
- d. A rabbit eats grass.....
- e. An apple tree absorbs water through its roots.....
- f. A bacterium moves away from a dangerous substance.....

2. Composition of living matter

All living beings are made up of chemical elements. The most abundant ones in them are: Carbon (C), Oxygen (O), Hydrogen (H), and Nitrogen (N) that make up about 95% of all living matter. But others elements, much less abundant, are also important, such as Calcium (Ca), Sodium (Na), Chlorine (Cl), Iron (Fe), Magnesium (Mg), etc. These chemical elements that form part of living matter are called **bioelements**.

Combinations of these elements form molecules called **biomolecules**. These biomolecules can be **inorganic** and **organic**.



a) Inorganic biomolecules

They do not contain carbon. They are not exclusive of living beings, because they also form part of non-living things. The main inorganic substances are mineral salts and water.

- **Mineral salts** have various functions:

- Solid: They make up different structures, like shells, bones and teeth.
- Dissolved: They are present in internal fluids, like tears, sweat and blood.

- **Water** is the most abundant substance in living things. Water is necessary for chemical reactions and to transport all other substances.

b) Organic biomolecules

They are exclusive of living beings. They are not present in non-living matter. Carbon is their main element. There are four types:

- **Glucids** (sugars or carbohydrates).

They can be simple (monosaccharides) or complex (polysaccharides).

Polysaccharides are long chains of monosaccharides.

Their function is provide energy (e.g. glucose)

and make structures such as plant cellular wall (e.g. cellulose)

- **Lipids.**

They are a group of compounds of varied composition but all of them are insoluble in water.

They are insulating and energetic reserve substances (e.g. fats) and they also make structures, such as cell membranes (e.g. phospholipids, cholesterol) or protective covers (e.g. waxes)

- Proteins.

They are long chains of little molecules called **amino acids**.

They have several functions: transport substances (e.g. haemoglobin transport oxygen), defense against microorganisms (e.g. antibodies), help in chemical reactions (e.g. enzymes), make structures (e.g. queratine forms nails and hair), etc

- Nucleic acids.

They are also long molecules of smaller molecules called **nucleotides**.

They control the cell's activity and contain the inheritance information (e.g. DNA, RNA)

READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook.

Remember: you must make complete sentences.

2.1. About the following *chemical elements*:

C Carbon	Ca Calcium	N Nitrogen	Al Aluminium	Fe Iron	Si Silicon	Na Sodium	H Hydrogen
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- Which of them are typical of the *living matter*?
- Which are the most abundant ones in the organic matter?
- Which percentage of it do they represent?
- Which is the most representative one of the living beings?

2.2. How can we classify the biomolecules? What criteria do we have to follow?**2.3. Indicate which biomolecule perform each function:**

- Contains the inheritance information
- Give energy to the organism
- Transport other substances through the body
- Build structures, transport substances, etc
- Be reserve and insulating substances
- Regulate chemical reactions and build skeletal structures

2.4. Explain what the relationship between these couples of terms is:

- Biomolecule - Bioelement
- Monosaccharide- Polysaccharide
- Amino acid – Protein
- Nucleic acid - Nucleotide

3. Cells

Cells are the smallest unit of life. They are the structural and functional units for all living beings. That means that:

- All living things are made up of one or more cells.
- Cells carry out the functions of nutrition, interaction and reproduction.
- All cells come from other cells.

a) Structure of a cell:

Every cell has three main parts:

- Cell membrane.

It covers the whole cell. It is a thin layer of lipids that controls the substance exchange between the inside and the outside of the cell.

- Cytoplasm.

It is the inside of the cell. It is a jelly-like substance composed by water and dissolved substances. Many of the chemical reactions of the cell take place here.

It contains the **organelles**. These small structures are responsible for different functions:

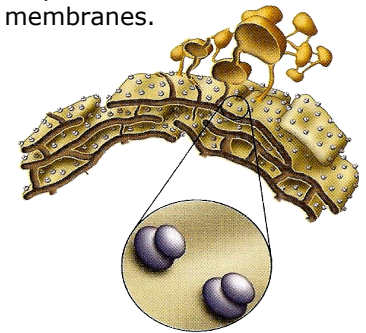


Mitochondria

They are organelles with a double membrane. Their function is *cellular respiration* that provides energy to cellular metabolism.

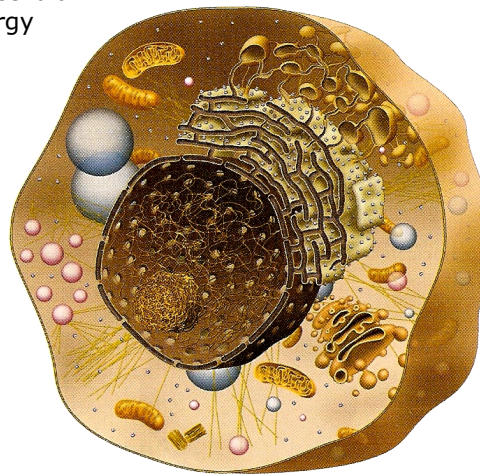
Endoplasmic reticulum

Group of membranous sacs connected which extends through the whole cytoplasm. It makes different substances, like proteins and lipids that form the cellular membranes.



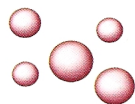
Vacuoles

They are membranous vesicles which contains different substances (water, nutrients or wastes)



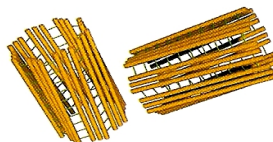
Ribosomes

They are little organelles that can be free in cytoplasm or attached to ER. Their function is to make proteins.



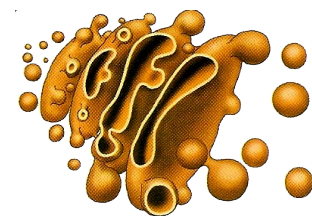
Lysosomes

They are membranous vesicles which contains digestive substances. Their function is the *cellular digestion*



Centrioles

They are two tubes of protein. They control the cell movement and the cell division.



Golgi apparatus

It is formed by membranous sacs and vesicles. It process the substances made by the ER and produces secretions and lysosomes

- Genetic material (DNA).

It forms the chromosomes. Its function is to control and to regulate how cell works. DNA also contains the hereditary information.

b) Types of cellular organization:

There are two kinds of cellular organization: Prokaryote and Eukaryote.

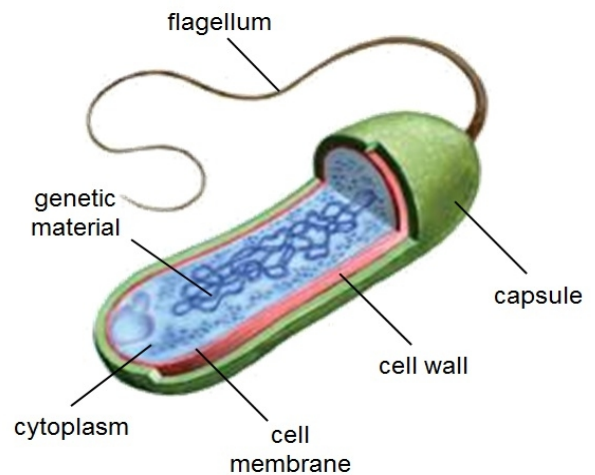
- Prokaryotic cells

They are *simple* and much *smaller* than eukaryotic cells.

Their genetic material is not separated from the cytoplasm by a nuclear membrane. They don't have a real nucleus.

They have a cell wall and flagellum that allow them to move.

They only form *unicellular* organisms. Only *bacteria* have this kind of cells. They are the oldest type of cell.



- Eukaryotic cells

They are *complex* and *bigger* than prokaryotic cells.

Their genetic material is *separated* from the cytoplasm into the nucleus.

They have many types of *organelles* that make different metabolic functions.

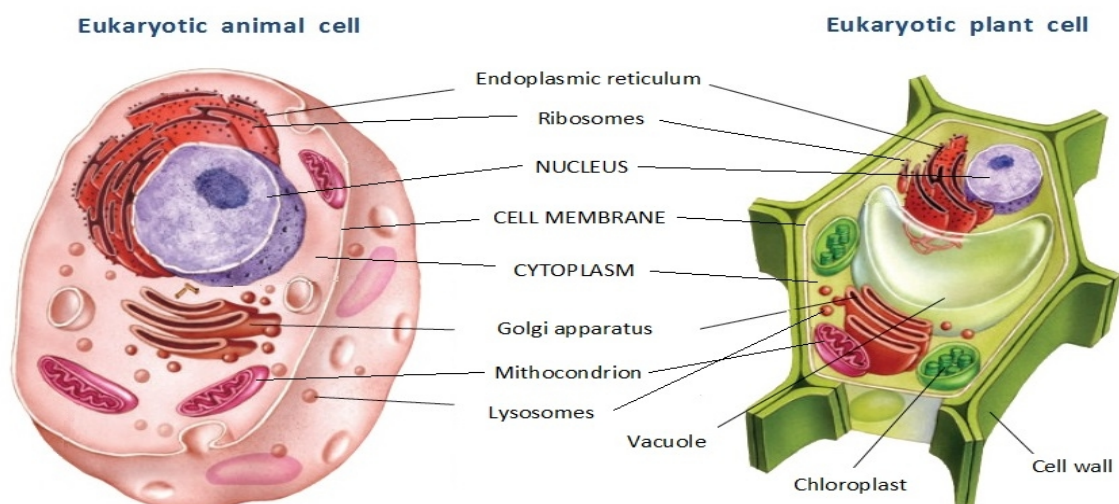
They form *unicellular* and *multicellular* organisms. They are the cells of all the other living beings (*fungi, protists, animals and plants*)

c) Types of eukaryotic cells

There are two types of eukaryotic cells: **animal cells** and **plant cells**. Plant cells can be easily distinguished from the animal cells because they have some exclusive organelles:

- They have *cell wall*, surrounding the cell membrane. It gives the cell a polyhedral shape. Its function is protecting the cell and being a skeleton structure.
- They have *chloroplasts*, which function is to make *photosynthesis*.
- They have a big *vacuole* that takes up the biggest part of the cytoplasm. (Animal cells have vacuoles too, but they are smaller and numerous) Its function is accumulating water and useless substances.

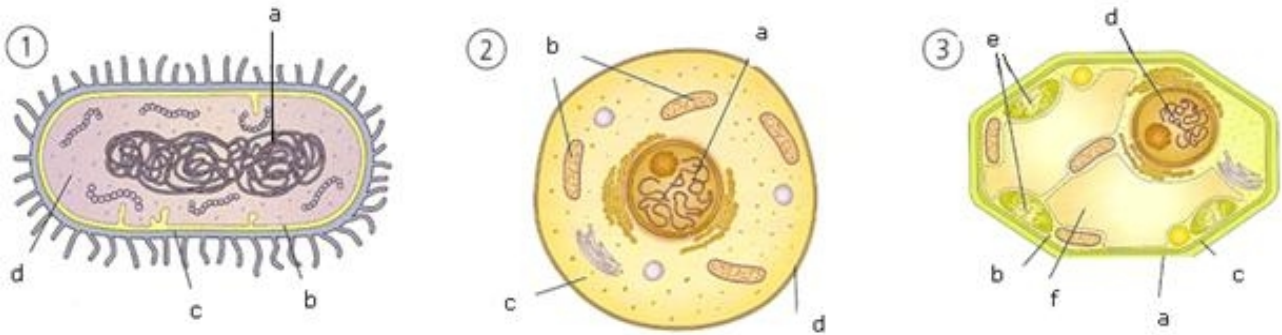
The plant cells are in *algae* and *plants* and the animal cells are in *animals* and *protozoa*.



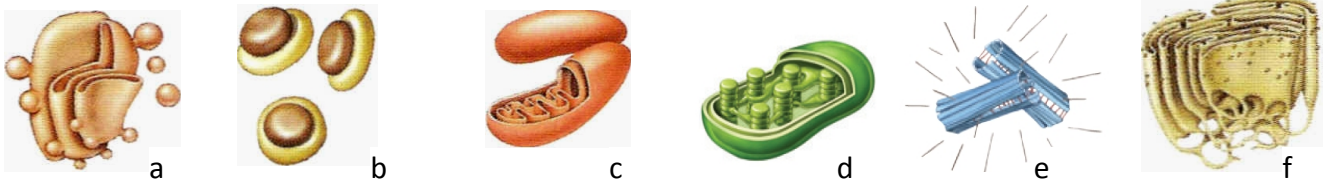
READING ACTIVITIES

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

3.1. Identify every one of the following cells and name the indicated structures:



3.2. Identify the following cell organelles. Indicate in each case, its function.



3.3. Answer these questions:

- Is there any multicellular organism made up of prokaryotic cells?
- What organelles are exclusive of plant cells?

4. Cellular nutrition

Cellular nutrition consists of all the processes in which cells obtain matter and energy to perform vital functions.

The matter which cells need to stay alive, are substances called **nutrients**. According to the type of nutrients taken in by the cell, there are two kinds of nutrition:

a) Autotrophic nutrition

It is characteristic of cells which make their own organic matter from inorganic matter.

To make it, they need energy. There are two types of autotrophic nutrition, depending on the energy source used:

- **Photosynthesis**. In this case the energy comes from the Sun. It takes place in most part of autotrophic organisms: *Plants, Algae* and some *Bacteria*.
- **Chemosynthesis**. In this case, energy comes from chemical reactions. It takes place only in some *Bacteria*.

b) Heterotrophic nutrition

It is characteristic of cells which feed on organic matter produced by other living beings.

They transform this organic matter to obtain their own nutrients and energy.

Heterotrophic nutrition takes place in *Animals, Fungi, Protozoa* and many *Bacteria*.

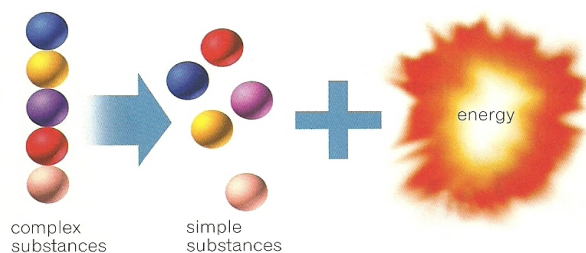
Once inside the cells nutrients are subjected to chemical reactions that are called **cellular metabolism**. There are two types of metabolic reactions: *anabolic reactions* and *catabolic reactions*

Anabolism.

This is the production of complex substances from simple substances.

It requires energy.

E.g. Photosynthesis.

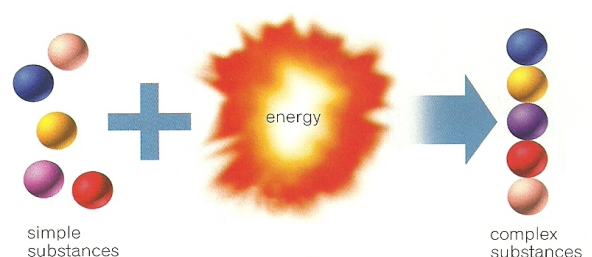


Catabolism

This is the degradation of complex substances into simple substances.

It produces energy.

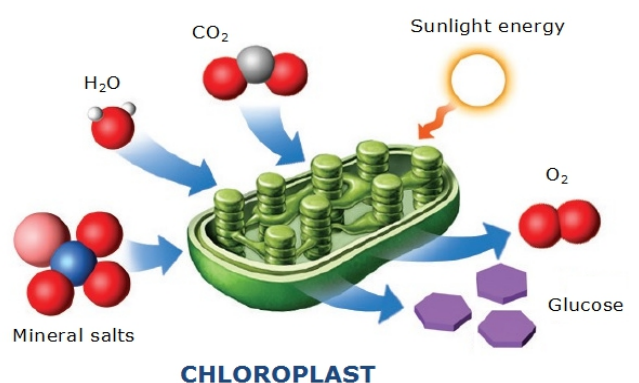
E.g. Cellular respiration



4.1. Photosynthesis

Photosynthesis is the *anabolic reaction* through which plant cells are able to elaborate *organic matter* from *inorganic matter*, using *sunlight energy*.

It takes place in **chloroplasts**. Internal membrane of the chloroplast contains a green pigment called **chlorophyll** able to catch the sunlight energy. Thanks to this energy *water* (H_2O) and *carbon dioxide* (CO_2) are transformed in organic compounds, mainly *glucose*. In addition, *oxygen* (O_2) is also produced and expelled to the outside.



From glucose and mineral salts, plant cells can synthesize other organic compounds, such as starch, lipids, etc. Part of this organic matter is stored by the cell and other part is consumed in cellular respiration in order to stay alive.

The overall reaction of photosynthesis is this:



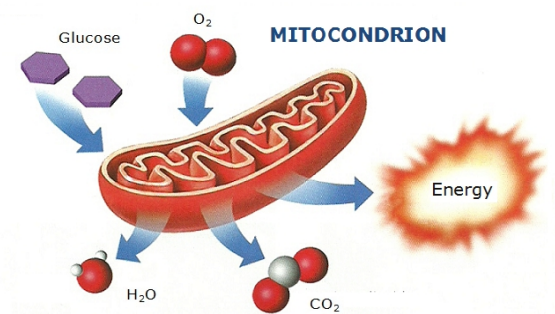
However, the real reaction takes place into two phases:

- **Light phase.** Energy of sunlight is caught by chlorophyll and changed into chemical energy.
- **Dark phase.** Inorganic matter is changed into organic matter, using the chemical energy obtained in the previous phase.

4.2. Cellular respiration

Respiration is the *catabolic reaction* through which cells of all living beings are able to obtain the *energy* stored into organic matter. This energy is used to perform vital functions.

Cellular respiration takes place in mitochondria. *Glucose* is broken down into *carbon dioxide* and *water*, with the help of *oxygen*. The chemical energy stored in the glucose is released and used to perform vital functions.



The overall reaction of respiration is this:



In absence of oxygen cells perform **fermentation**. This reaction is similar to respiration but the amount of energy obtained is lesser. Fermentation can take place in all living beings, but is especially important in yeasts and some bacteria.

READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:

Remember: you must make complete sentences.

4.1. Answer these questions:

- a. Do plant cells perform cellular respiration? Why?
- b. Why is photosynthesis an anabolic reaction?
- c. Can all the cells of a plant perform photosynthesis? Why?
- d. When do cells perform fermentation?

4.2. Indicate the difference between:

- a. Chemosynthesis – Photosynthesis
- b. Anabolism – Catabolism.

5. Cellular interaction

Interaction allows cells perceive the changes in their surrounding (**stimuli**) and act in consequence (**responses**).

- **Stimulus** is any change, chemical or physical, in the medium able to provoke a response, such as changes in light or temperature.
- **Response** is the cell reaction when a stimulus is perceived. The main ones are movements, secretion of substances and cellular division.

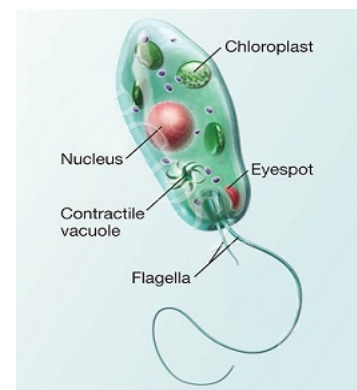
READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:

Remember: you must make complete sentences.

5.1. Euglena is a type of unicellular algae which lives in fresh water. It has a *flagellum* and a specialised organelle that allows it to detect the light, called *eyespot*.

- What kind of nutrition does Euglena have?
- Is an advantage or a disadvantage for these organisms have an eyespot? And have a flagellum? Why?
- This is an example of interaction function. Can you identify the *stimulus*? And the *response*?



6. Cellular reproduction

Cellular reproduction is the processes by which a cell (parent cell) obtains copies (daughter cells) similar or identical to it by division.

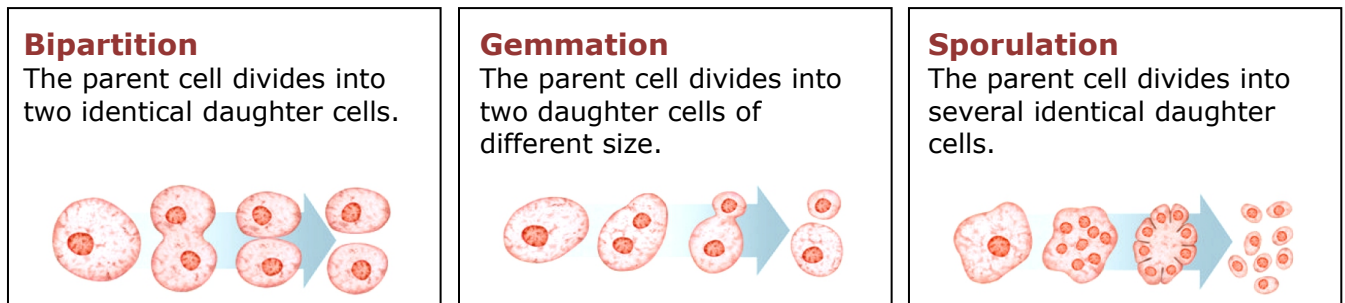
- In *unicellular organisms*, cellular division replicates an entire organism. As a result, new individuals are formed.
- In *multicellular organisms*, cellular division results in an increase in the number of cells of an organism. As a result the organism grows and repairs its damaged parts.

There are two kinds of reproduction:

a) Asexual reproduction

Daughter cells are identical to parent cell. To assure it, the genetic material is replicated before the cell division through a process called **mitosis**.

There are several ways to divide the mother cell:



b) Sexual reproduction

Daughter cells are similar, but not identical, to parent cell. To assure it, the genetic material is combined during a special cell division and distributed among the daughter cells.

This cell division is called **meiosis** and produces **gametes**. These gametes have only a half of the genetic material of the parent cell and they have to join with other gamete to form a new individual.

READING ACTIVITIES

After reading the text, copy and answer the following questions into your notebook:

Remember: you must make complete sentences.

6.1. Answer these questions:

- a. Which is the result of cellular reproduction in unicellular organisms?
- b. And in multicellular organisms?

6.2. Relate each sentence with its correspondent concept:

- a. It is a cellular division made to produce gametes.....
- b. Daughter cells do not have the same size.....
- c. Daughter cells only have a half of the genetic material of the parent cell.....
- d. Parent cell divides into two identical daughter cells.....
- e. Parent cell divides into many identical daughter cells.....
- f. Genetic material replicates before cell's division.....