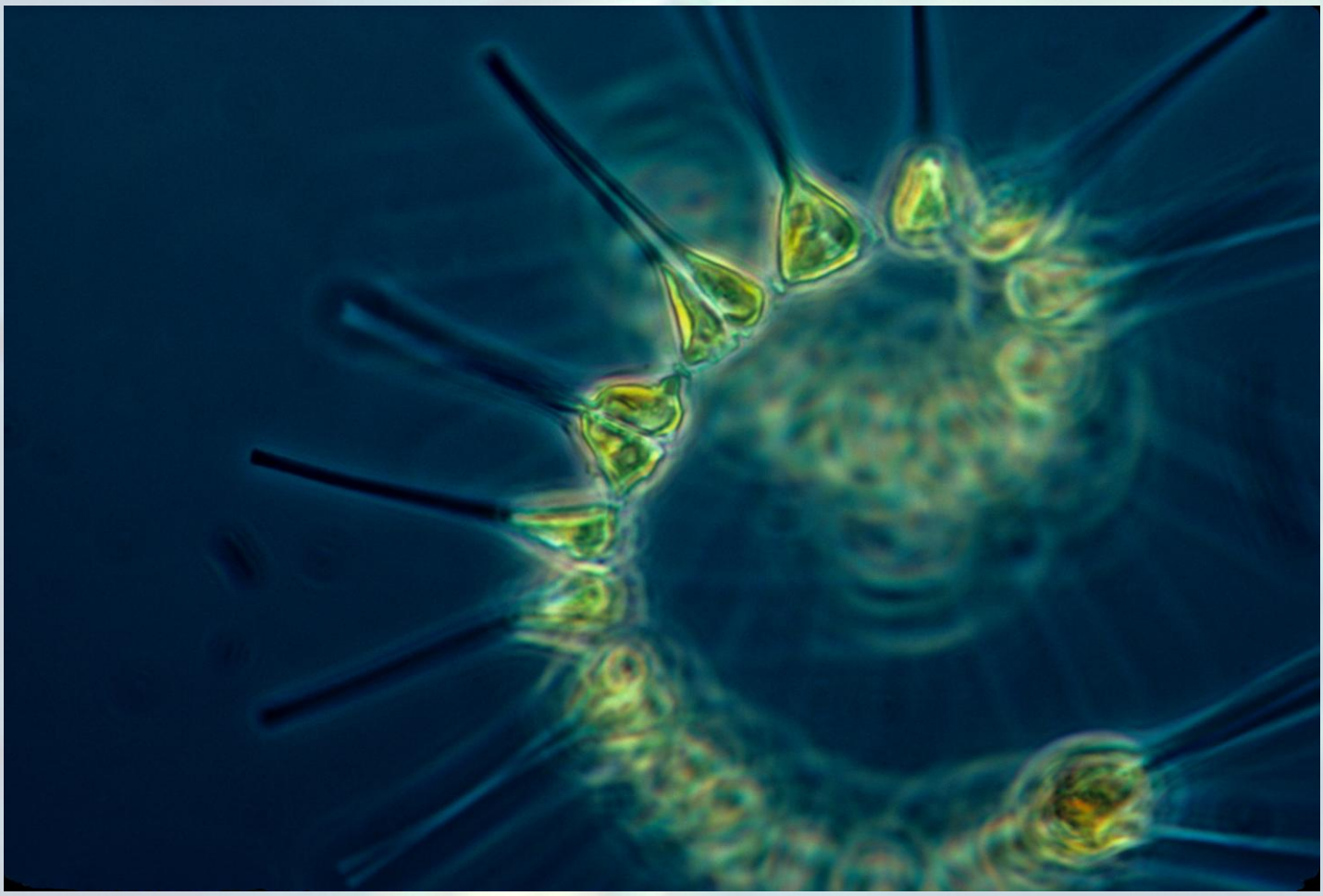
The Villablanca Connection

UNIT 4:

UNICELLULAR LIVING BEINGS



“We forget that microorganisms rule the world. Now we're looking and finding things we didn't know were there.”
Tara O’Toole

Unit 4: Unicellular living beings.
Biology and Geology 1º ESO
Villablanca Connection

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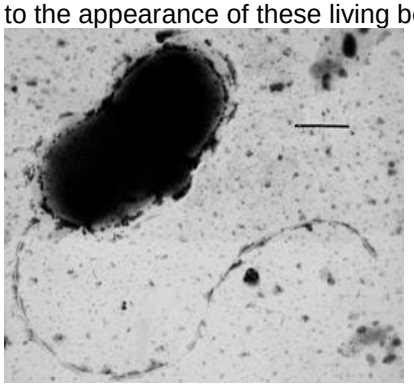
Unit 4: UNICELLULAR LIVING BEINGS.

1. Introduction.

As we studied in the previous unit there are many different types of unicellular organisms. In fact the unicellular organisms that we can find on the Earth belong to three different kingdoms. All the living beings classified into the Monera kingdom are prokaryotic unicellular organisms but there are also many unicellular living things into the Protista (or Protoctista) and the Fungi kingdoms. There are a lot of differences between them and we are going to learn some of them in this unit.
To make things a little bit more complicated you have to remember that “unicellular” and “microscopic” are not synonyms because although all unicellular organisms are microscopic not all the microscopic organisms are unicellular. There are a lot of multicellular organisms that can only be seen using a microscope. So, make your mind clear and remember that in this unit we are going to study the unicellular organisms of the Monera, Protista and Fungi kingdoms.
The part of the biology that studies microorganisms is called microbiology.

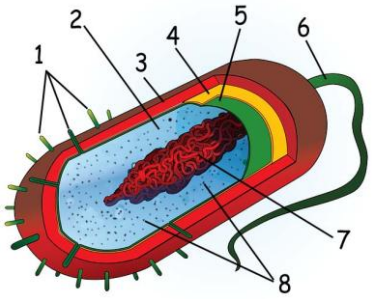
2. The Monera kingdom.

By now it is quite sure that you know that all the organisms in this kingdom are prokaryotes. They are the only ones with a prokaryotic cell so you already have an accurate idea of how they are. Of course, you also know that the only representatives of this kingdom are the bacteria and the cyanobacteria. Just in case, let us have another look to the appearance of these living beings:



The bar represents 0,5 µm

Desulfovibrio vulgaris



Structure of a bacterium


Cyanobacteria forming a colony.

2.1. Vital functions of bacteria and cyanobacteria.

2.1.1. Nutrition.

Cyanobacteria are autotrophs. They perform photosynthesis and produce the organic matter that they use in growing and obtaining the energy they need. They are only found in environments where there is light enough for this autotrophic nutrition. Although most of them live in aquatic environments, some of them find enough water in damp soils or the bark of some plants. There are also some species of cyanobacteria living inside of the body of certain fungi with which they establish a close interspecific relationship called symbiosis. These fungus-cyanobacteria organisms are known as lichens.
On the other hand, some **bacteria** are autotrophs but most of them are heterotrophs because they have to obtain organic matter from other organisms. They can do that feeding in different ways:

- **Saprophytes**. These bacteria live on decomposing organic remains like dead leaves or dead animals. They turn the organic matter into inorganic matter that can be used again by the plants,They are very important decomposer members of the ecosystems.
- **Parasites**. These bacteria feed on other organisms harming them and causing infectious diseases.
- **Symbionts**. They form very close associations with other species of living beings producing a mutual benefit. It is the case of the bacteria that live inside our intestine feeding on what we eat and producing some vitamins and ecological protection to us. There are also symbiotic bacteria living inside some plants helping them to obtain the nitrogen they need and feeding on the sugar that the plant produces.

2.1.2. Interaction.

Cyanobacteria cannot move. They usually float in the water o live attached to a surface. They detect the conditions of the environment and grow and reproduce, when the conditions are favorable, or form resistance structures when the conditions become adverse.
Some bacteria do not move, but others swim by means of the flagella or slide over surfaces. They detect many different stimuli and respond in the appropriate way that guarantees their survival. Bacteria have colonized almost every environment in this planet so they are found everywhere: floating in the air, living inside other organisms, swimming in the oceans and the rivers, etc. There are even bacteria living in the boiling waters of the geysers and the dark inners of the rocks.

2.1.3. Reproduction.

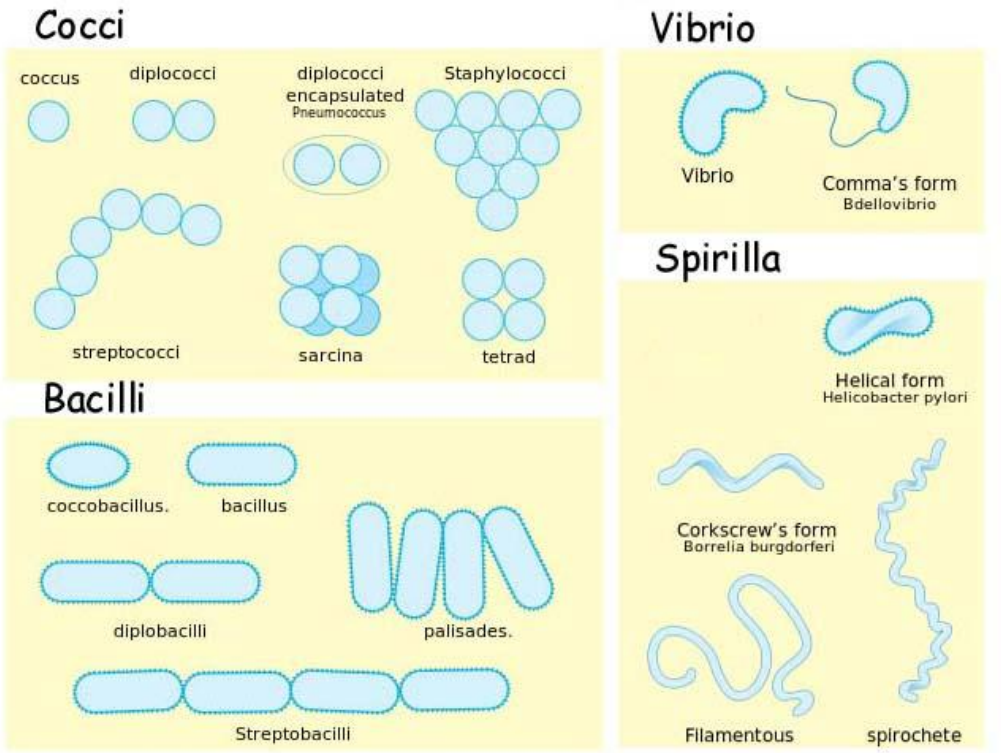
Bacteria and cyanobacteria reproduce asexually by means of **binary fission**. That means that a single cell divides its body into two daughter cells. Sometimes the daughter cells separate and sometimes they remain together. When this happens and successive cells divisions take place there can be formed groups of many millions of individuals called **colonies**. When these colonies are big enough they can be seen even without a microscope.

2.2 Classification of bacteria according their shape

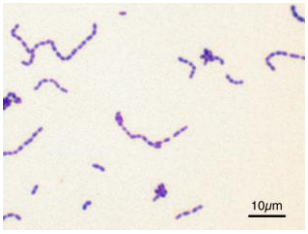
There are four basic forms of the bacteria:

- **Coccus** (pl. cocci) → They have a spherical shape.
- **Bacillus** (pl. bacilli) → They look like little rods or like the pills we usually take when we are ill.
- **Vibrio** (pl. vibrio) → They are slightly bent and remind the aspect of a comma.
- **Spirillum** (pl. spirilla) → They are spiral-shaped, sometimes remembering a corkscrew or a twisted filament.

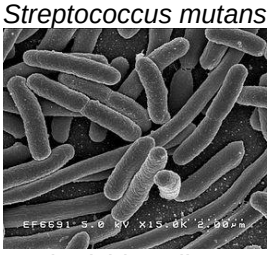
These basic forms may combine one another so you had better have a look to this drawing to understand the classification:



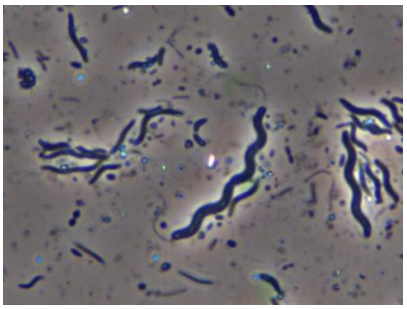
Here you have some real bacteria in order that you can see how they adjust to the classification:



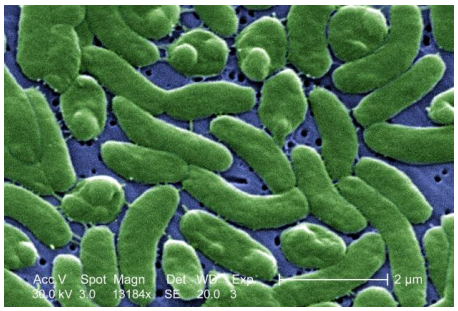
Streptococcus mutans



Escherichia coli



Spirillum sp.



Vibrio vulnificus

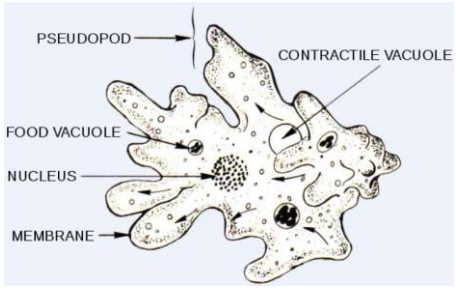
3. Microorganisms of the Protista kingdom.

The Protista kingdom groups together very different kinds of eukaryotic living beings but, basically, there are two big types: the protozoa and the algae. Protozoa are always unicellular, but in the algae group we can find both unicellular and multicellular representatives. We will save the multicellular algae for the next unit and now we will focus only in the unicellular ones, but let us consider protozoa in the first place.

3.1. Protozoa.

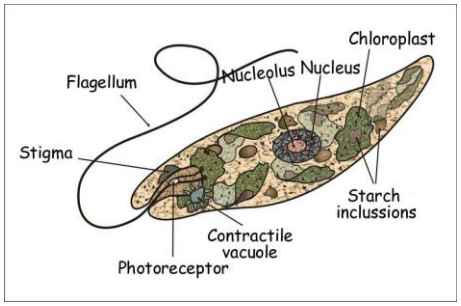
Protozoa are unicellular eukaryotic organisms. They do not have usually a cellulose cellular wall, and the plasmatic membrane can remain uncovered, but in some cases they can produce a hard cover made of quartz or limestone. They are mostly heterotrophs, but some species have chloroplasts and can perform photosynthesis so they have autotrophic nutrition. Most of them live on aquatic environments like freshwater ponds, rivers and also in the oceans. Some of them can live in the ground, if it is humid, and there are some species that live inside other living beings either as parasites or symbionts.
Protozoa are classified into four main groups:

- **Amoeboids** → They can move by stretching out parts of their body called pseudopodia (=pseudopods). They can also engulf particles of food using the pseudopods in a process called phagocytosis. They are very common in freshwater like ponds and swimming-pools. Example: *Entamoeba histolytica*.
- **Flagellated** → They can move using one or more flagella. Most are heterotrophs (like *Peranema sp*.) but some are autotrophs (like *Euglena sp*.)
- **Ciliated** → Their body is covered with cilia that are used like oars to row through the water. They are very abundant in freshwater and there are also some species that can live inside other living beings in symbiosis with them. One of the more common is *Paramecium sp*. and a real beautiful one is *Stentor sp*. Some can live attached to a substrate and use the cilia to impulse the bacteria and other particles of food inside of their body like *Vorticella sp*.
- **Sporozoans** →They are parasites and can enter inside the cells of their host where they often reproduce. An example is *Plasmodium sp.* that causes the malaria in humans, one of the illnesses that kill more human beings in the world.



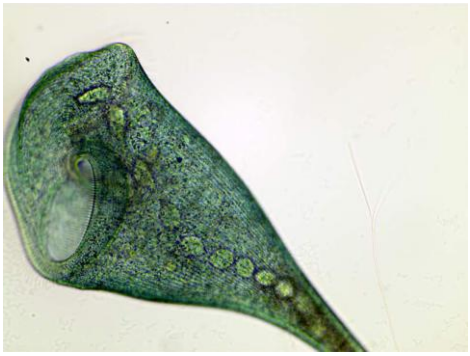
Amoeba sp.

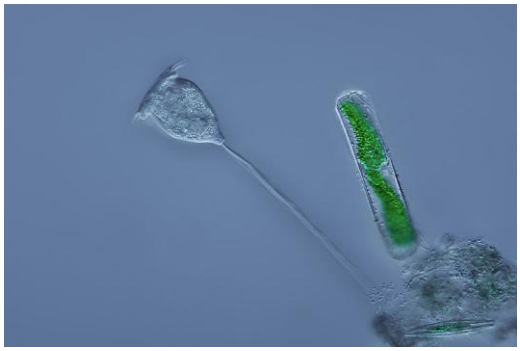

Peranema sp.

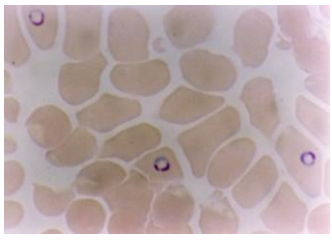


Euglena sp.


Paramecium caudatum

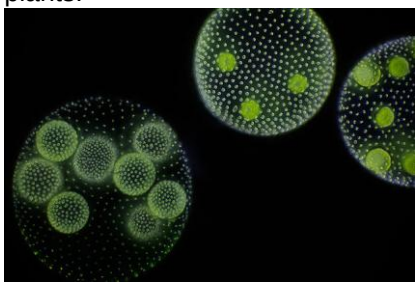

Stentor coeruleus


Vorticella sp.

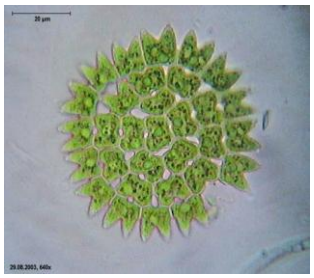

Plasmodium falciparum inside of human red blood cells.

3.2 Unicellular algae

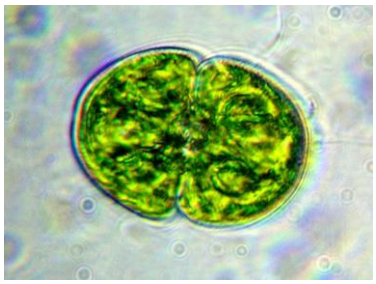
Although the more known species of algae are multicellular there are many unicellular species. Algae are eukaryotic organisms with a cellulose cell wall and they seldom move because they do not have cilia, flagella or other locomotive mechanisms. Many unicellular algae form colonies and are believed to be the ancestors of the plants.



Volvox sp.

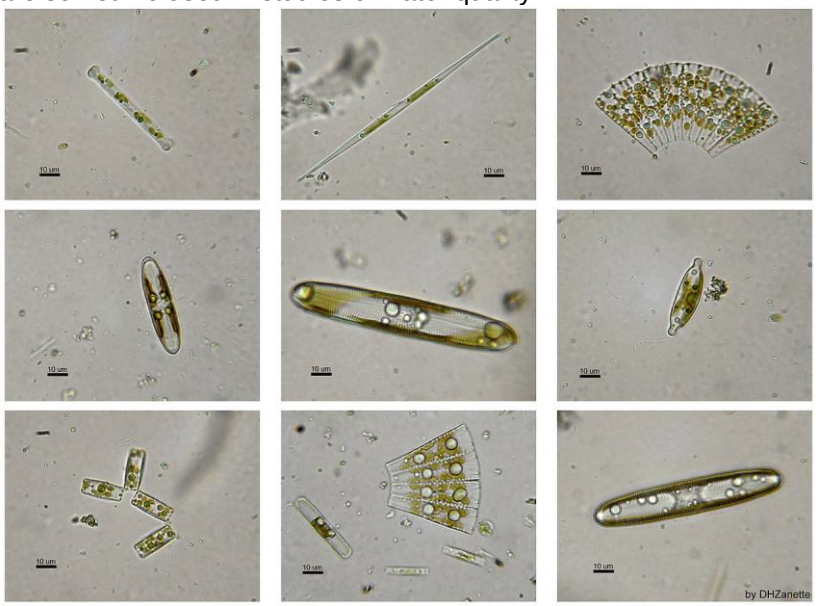


Pediastrum sp.



Cosmarium sp.

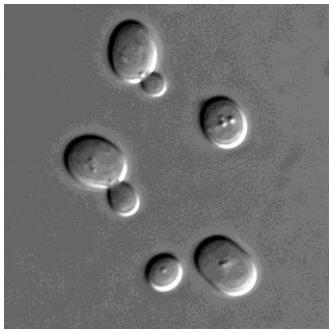
Unicellular algae are an important component of the phytoplankton and they are in the base of the food chains in all freshwater and oceanic ecosystems. They also play an important role as essential contributors to the amount of oxygen present in the atmosphere thanks to the photosynthetic process.
There are many different types of unicellular algae. One of the most representative group is the group of the diatoms.
Diatoms are unicellular or colonial algae with a cell wall impregnated by silicon forming a frustule made of two valves that fit together like a shoebox and its lid.
Diatoms are a widespread group and can be found in the oceans, in freshwater, in soils and on damp surfaces and are sometime used in studies of water quality.



Different types of diatoms

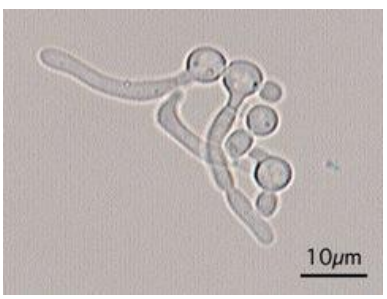
4. Microorganisms of the Fungi kingdom.

Fungi are eukaryotic heterotrophic organisms with a cell wall that is **not** made of cellulose. Yeast are unicellular fungi with a lot of interest to us because some are beneficial (*Saccharomyces cerevisiae*) and others are harmful (like *Candida sp*.).



Saccharomyces cerevisiae.

The buds can be observed very well.

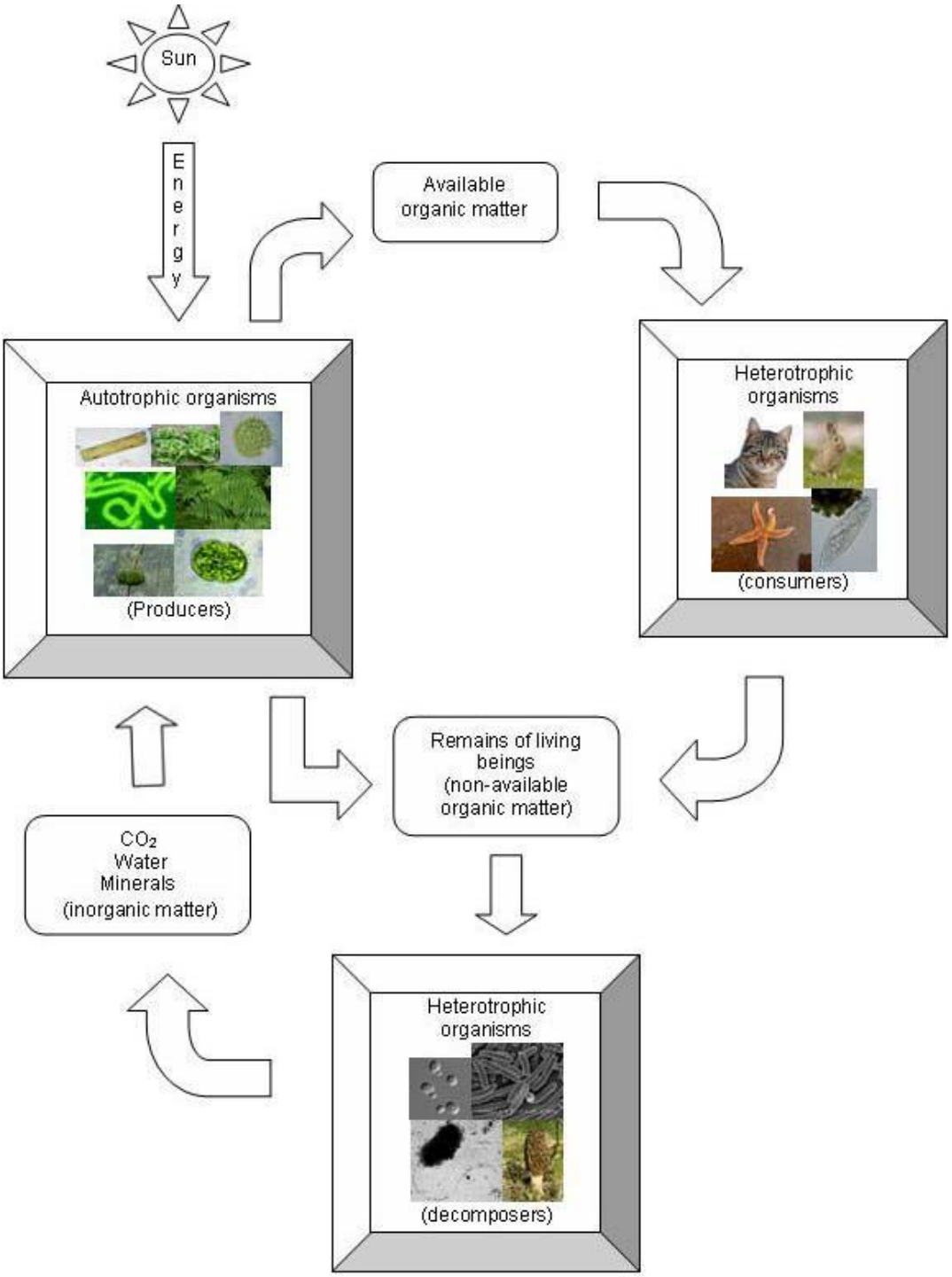


Candida albicans

Saccharomyces cerevisiae is a very useful yeast that is used both in industrial and artisan processes. It is the responsible of the production of wine, beer and bread. It reproduces by "budding" producing a "bud" that will become a small daughter cell.
On the other hand, *Candida sp*. produces several infections in humans especially in the mouth and the reproductive organs.

5. Microorganisms and biosphere.

Most of the living beings in this planet are in fact unicellular and microscopic organisms. Their importance in the systems that support life cannot be exaggerated. Unicellular algae, some protozoa and many bacteria can perform **photosynthesis** and provide the ecosystems with organic materials and energy. They are also the main responsible for the oxygen of the atmosphere and the oceans. Many others bacteria, unicellular fungi and protozoa are **decomposers** and recycle the matter in the ecosystems breaking down the remains of the living beings into inorganic substances that are this way available again for autotrophic organisms.



6. Microorganisms and People.

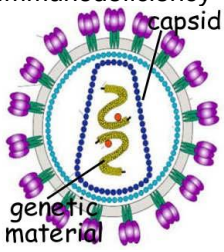
Most of the species of microorganisms are completely **harmless** to humans. They live surrounding us without bothering us, totally unnoticed. They are **innocuous** microorganisms.
A very important group of microorgansims is very useful to humans. Some of them help us with our digestive processes or the proper functioning of our immune system, like the bacteria in our intestine. Some of them are used to produce food like bread, cheese, yogurt or wine and have a great economic importance. They are **beneficial** microorganisms.
And there is also a small group of microorganisms that cause infectious diseases to the human beings. They are **pathogenic** microorganisms.

SOME ILLNESSES CAUSED BY MICROORGANISMS			
ILLNESS	**NAME OF THE MICROORGANISM**	**TYPE OF THE MICROORGANISM**	**SOME SYMPTOMS**
botulism	*Clostridium botulinum*	bacterium	double vision, weakness
salmonellosis	*Salmonella enterica*	bacterium	diarrhoea, vomits, fever
malaria	*Plasmodium sp.*	protozoon	fever, weakness
criptococcosis	*Cryptococcus neoformans*	fungus	pulmonary damage

SOME BENEFITS OF THE MICROORGANISMS			
PRODUCT	**NAME OF THE MICROORGANISM**	**TYPE OF THE MICROORGANISM**	**INDUSTRY**
penicillin	*Penicillium chrysogenum*	fungus	Pharmaceutical industry
beer	*Saccharomyces cerevisiae*	fungus	food industry
vinegar	*Acetobacter sp.*	bacterium	food industry
lipase	*Pseudomonas sp.*	bacterium	chemical industry
biodiesel	*Chlorella sp*	alga	energy industry
activated mud	*Euplotes sp.*	protozoon	wastewater treatment

7. A word for viruses.

Yes, they are not considered living things, and that is the reason why they are not classified into any kingdom. But we cannot ignore them because they are closely related to the vital processes as they need to enter a living cell in order to reproduce. In doing so, they sometimes kill the cell that they have used to reproduce and that can be a problem for the living being that has been infected.
We believe there are millions of different viruses; most of them have not been studied yet. There are viruses that infect plants, there are viruses that infect animals and there are even viruses that infect bacteria. Viruses are usually very specific in the type of cells that they can infect, so we can say that most of viruses are harmless to the human beings. But some of them produce very dangerous diseases and virologists and doctors are doing their best to preserve human health researching for new vaccines and treatments.
Viruses are not made by cells and they are really small: there is room for thousands of them in a single bacterium. So they can be observed only with an electron microscope. This is the typical structure of the HIV (=Human Immunodeficiency Virus, the virus that produces AIDS):



Viruses do not perform the nutrition or interaction functions and they only can reproduce inside a host cell. The newly produced viruses leave the cell (sometimes killing it) and infect new host cells. A virus outside of a cell is called a *virion* and it is considered a non-living particle.
Nowadays some researchers are taking advantage of the capacity of the viruses to enter in certain types of cells and are studying the way in which we could use them to transport useful substances, like medicines, inside of the cells that need them. Humans are also using certain viruses to produce vaccines and to stimulate the immune system. In that sense we can say that some viruses are beneficial to us.

Activity 43.
How do we call the microorganisms whose cell has not a nucleus?

Activity 44.
Complete the following sentences:
a) Bacteria belong to the _____ kingdom.
b) The cells of the protozoa are _____ cells.
c) Inside the Protista kingdom we can find the algae and the _____.
d) Microbiology is the part of the _____ that studies _____.

Activity 45.
Draw a bacterium and label its components.

Activity 46.
Escherichia coli and other bacteria live in our intestine helping us to digest food and providing us with some vitamins. In exchange they live protected and well nourished. Are these bacteria parasites, saprophytes or symbionts?

Activity 47.
Describe how bacteria reproduce by binary fission.

Activity 48.
Draw the different types of bacteria.

Activity 49.
How can protozoa move?

Activity 50.
Which of the following characteristics refer to protozoa?
a) they are prokaryotes
b) they can be multicellular
c) most of them are heterotrophic
d) they usually cannot move
e) they can be pathogenic

Activity 51.
Which of the following characteristics apply to bacteria?
a) they are present everywhere
b) they can be multicellular
c) they reproduce by binary fission
d) some are autotrophs
e) they have chloroplasts
f) they are prokaryotes

Activity 52.
What would be the consequence in the cycle of the matter if decomposer organisms disappear?

Activity 53.
a) What is the plankton?
b) What is the phytoplankton?
c) What is the zooplankton?

Activity 54.
What is the name of the microorganism that is used to produce wine? In which kingdom is it classified?

Activity 55.
Which organism can reproduce by budding?

Activity 56.
Name two different protozoa with cilia.

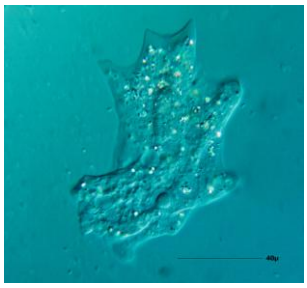
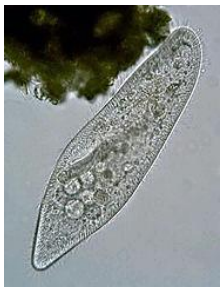
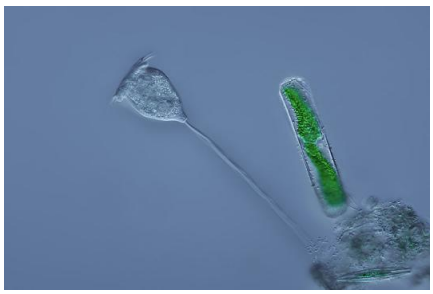
Activity 57.
The name of one of the microorganisms that is used in the production of yogurt is *Streptococus thermophilus*. In which kingdom is it classified and what can you say about its shape?

Activity 58.
Remember the differences between the eukaryotic animal-like cell and the eukaryotic plant-like cell and fill this table:

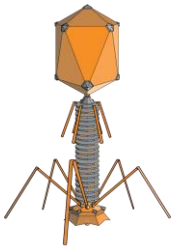
	Eukaryotic animal cell	Eukaryotic plant cell
Type of nutrition		
Substances they need		

Activity 59.
Define the following terms:
a) unicellular algae
b) protoctist organism
c) microorganism
d) heterotrophic nutrition

Activity 60.
Name the structures used by these microorganisms to move:


Activity 61.
The parasite in the picture attacks bacteria and reproduce into them producing so many descendants that the bacterial cells literally burst. What is the name of this parasite and in which kingdom is it classified?



Activity 62.
What is the meaning of “pathogenic”?

Activity 63.
Name four different products produced by microorganisms with industrial interest.

Activity 64.
Name four different illnesses produced by microorganisms.

Activity 65.
Match each term in A series with one term in B series.
A: Virus, Yeast, Paramecium, Linnaeus, DNA and Photosynthesis.
B: Protozoon, Binomial system, AIDS, chloroplasts, unicellular fungus and genetic material.

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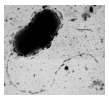 Transmission electron micrograph of bacterium; *Desulfovibrio vulgaris* bar = 0.5 microns.
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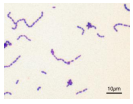
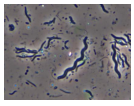
 "Streptococcus mutans Gram" by Y tambe - Y tambe's file. Licensed under CC BY-SA 3.0 via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Streptococcus_mutans_Gram.jpg#/media/File:Streptococcus_mutans_Gram.jpg

 Wolframm Adlassnig/I, the copyright holder of this work, release this work into the **public domain**. This applies worldwide. In some countries this may not be legally possible; if so:
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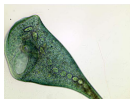 By Flupke59. Licensed under the Creative Commons Attribution-Share Alike 3.0 Unported. Taken from http://commons.wikimedia.org/wiki/File:Stentor_coeruleus_extended.jpg

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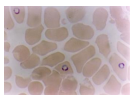 This work has been released into the **public domain** by its author, **Ernst Hempelmann**. This applies worldwide. In some countries this may not be legally possible; if so:
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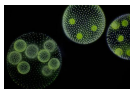
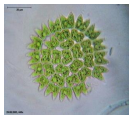
 By Frank Fox (http://www.mikro-foto.de). Licensed under the Creative Commons Attribution-Share Alike. Taken from http://commons.wikimedia.org/wiki/File:Mikrofoto.de-volvox-4.jpg

 By Dr. Ralf Wagner. Permission is granted to copy, distribute and/or modify this document under the terms of the **GNU Free Documentation License**.

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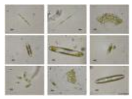 This work has been released into the **public domain** by its author, **Dhzanette at the English Wikipedia project**. This applies worldwide. In case this is not legally possible:
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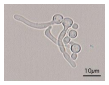 By Y tambe. This file is licensed under the Creative Commons Attribution-Share Alike 3.0 Unported.

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