Department of biology

# BOTANY (PLANT BIOLOGY)

## First stage

**(1)**

# INTRODUCTION

**By**

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# INTRODUCTION

**Biology**: is the science that studies living organisms and how they interact with one another and their environment.

## Introduction of the cells

Both living and non-living things are composed of molecules made from chemical elements such as **Carbon**, **Hydrogen**, **Oxygen**, and **Nitrogen**. The organization of these molecules into cells is one feature that distinguishes living things from all other matter. **The cell is the smallest unit of matter that can carry on all the processes of life.**

1- Every living thing - from the tiniest bacterium to the largest whale - is made of one or more cells.
2- Before the C17th, no one knew that cells existed, since they are too small to be seen with the naked eye. The invention of the microscope enabled Robert Hooke, (1665) and **Anton van Leuwenhoek** (1675) to see and draw the first 'cells', a word coined by Hooke to describe the cells in a thin slice of cork.
3- The idea that all living things are made of cells was put forward in about 1840 and in 1855 came 'Cell Theory' – i.e. 'cells only come from other cells' – contradicting the earlier theory of 'Spontaneous Generation'

## Cell Theory consists of three principles:

a- All living things are composed of one or more cells.
b- Cells are the basic units of structure and function in an organism.
c- Cells come only from the replication of existing cells.

## All living organisms share five basic characteristics:

1. **Order**. All organisms consist of one or more cells with highly ordered structures: atoms make up molecules, which construct cellular organelles, which are contained within cells. This hierarchical organization continues at higher levels in multicellular organisms and among organisms.

2. **Sensitivity**. All organisms respond to stimuli. Plants grow toward a source of light.

3. **Growth, development, and reproduction.** All organisms are capable of growing and reproducing, and they all possess hereditary molecules that are passed to their offspring, ensuring that the offspring are of the same species.

4. **Regulation.** All organisms have regulatory mechanisms that coordinate the organism's internal functions.
5. **Homeostasis**: In order to function properly, cells need to have appropriate conditions such as proper temperature, pH, and appropriate concentration of diverse chemicals. These conditions may, however, change from one moment to the next. Organisms are able to maintain internal conditions within a narrow range almost constantly, despite environmental changes, through homeostasis (literally, "steady state")—the ability of an organism to maintain constant internal conditions.

all living things were lumped together into **two kingdoms**, namely **plants** and **animals.** Animals included every living thing that moved, eat, and grew to a certain size and stopped growing. Plants included every living thing that did not move or eat and that continued to grow throughout life.
It became very difficult to group some living things into one or the other, so early in the past century the two kingdoms were expanded into **five kingdoms**:
1. Protista (the single-celled eukaryotes);
2. Fungi (fungus and related organisms);
3. Plantae (the plants);
4. Animalia (the animals);
5. Monera (the prokaryotes).

Many biologists now recognize **six distinct kingdoms**, dividing Monera into the **Eubacteria and Archeobacteria**.

## Monera (includes Eubacteria and Archeobacteria)

Individuals are single-celled, may or may not move, have a cell wall, have no chloroplasts or other organelles, and have no nucleus. Monera are usually very tiny, although one type, namely the blue-green bacteria, look like algae. They are filamentous and quite long, green, but have no visible structure inside the cells. No visible feeding mechanism. They absorb nutrients through the cell wall or produce their own by photosynthesis.

## Protista

Protists are single-celled and usually move by cilia, flagella, or by amoeboid mechanisms. There is usually no cell wall, although some forms may have a cell wall. They have organelles including a nucleus and may have chloroplasts, so some will be green and others won't be. They are small, although many are big enough to be recognized in a dissecting microscope or even with a magnifying glass. Nutrients are acquired by photosynthesis, ingestion of other organisms, or both.

## Fungi

Fungi are multicellular, with a cell wall, organelles including a nucleus, but no chloroplasts. They have no mechanisms for locomotion. Fungi range in size from microscopic to very large (such as mushrooms). Nutrients are acquired by absorption. For the most part, fungi acquire nutrients from decaying material.

## Plantae

Plants are multicellular and most don't move, although gametes of some plants move using cilia or flagella. Organelles including nucleus, chloroplasts are present, and cell walls are present. Nutrients are acquired by photosynthesis (they all require sunlight).

## Animalia:

Animals are multicellular, and move with the aid of cilia, flagella, or muscular organs based on contractile proteins. They have organelles including a nucleus, but no chloroplasts or cell walls. Animals acquire nutrients by ingestion.

Table 25.2 Characteristics of the Six Kingdoms

| | Archaebacteria and Bacteria | Protista | Plantae | Fungi | Animalia |
|---|---|---|---|---|---|
| |  |  |  |  |  |
| **Cell Wall** | Noncellulose (polysaccharide plus amino acids) | Present in some forms, various types | Cellulose and other polysaccharides | Chitin and other noncellulose polysaccharides | Absent |
| **Means of Genetic Recombination, If Present** | Conjugation, transduction, transformation | Fertilization and meiosis | Fertilization and meiosis | Fertilization and meiosis | Fertilization and meiosis |
| **Mode of Nutrition** | Autotrophic (chemosynthetic, photosynthetic) or heterotrophic | Photosynthetic or heterotrophic, or combination of both | Photosynthetic, chlorophylls *a* and *b* | Absorption | Ingestion |
| **Motility** | Bacterial flagella, gliding or nonmotile | 9 + 2 cilia and flagella; amoeboid, contractile fibrils | None in most forms; 9 + 2 cilia and flagella in gametes of some forms | Both motile and nonmotile | 9 + 2 cilia and flagella, contractile fibrils |
| **Multicellularity** | Absent | Absent in most forms | Present in all forms | Present in most forms | Present in all forms |
| **Nervous System** | None | Primitive mechanisms for conducting stimuli in some forms | A few have primitive mechanisms for conducting stimuli | None | Present (except sponges), often complex |

# Differences and similarities of prokaryotic and Eukaryotic cells

## Similarities

Despite their apparent differences, these two cell types (prokaryotic and eukaryotic) have a lot in common:

1- They perform most of the same kinds of functions, and in the same ways.
2- Both are enclosed by plasma membranes, filled with cytoplasm,
3- They cytoplasm of both cells types are loaded with small structures called ribosomes.

4- Both have DNA which carries the archived instructions for operating the cell.
5- The similarities go far beyond the visible--physiologically they are very similar in many ways. For example, the DNA in the two cell types is precisely the same kind of DNA, and the genetic code for a prokaryotic cell is exactly the same genetic code used in eukaryotic cells.
6- Some things which seem to be different aren't. For example, the prokaryotic cell has a cell wall, while some animal cells do not. However, many kinds of eukaryotic cells do have cell walls.

## Differences

Despite all of these similarities mentioned above, the differences are also clear. It's pretty obvious from these two little pictures (figure 1) that there are two general categories of difference between these two cell types: **size** and **complexity**. If we take a closer look at the comparison of these cells, we see the following differences:

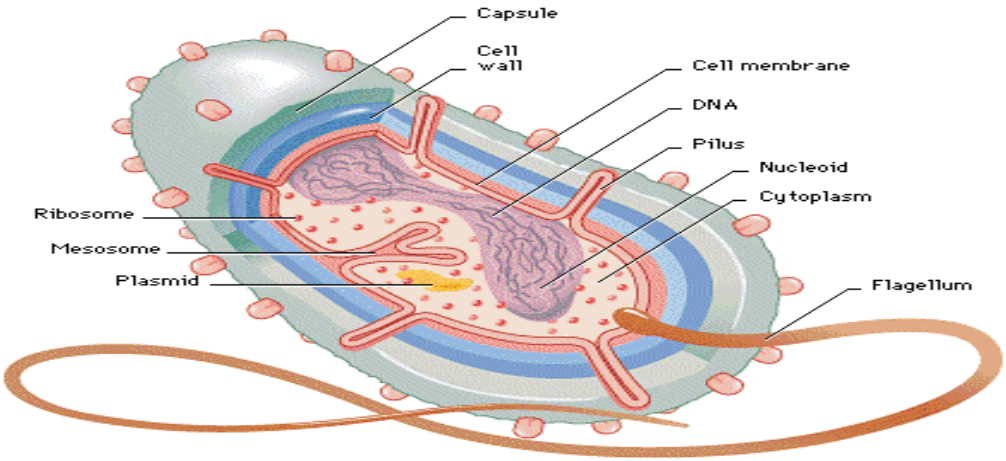
1- Eukaryotic cells are much larger and much more complex than prokaryotic cells. These two observations are not unrelated to each other.
2- Eukaryotic cells have a true nucleus, bound by a double membrane. Prokaryotic cells have no nucleus. The purpose of the nucleus is to sequester the DNA-related functions of the big eukaryotic cell into a smaller chamber, for the purpose of increased efficiency. This function is unnecessary for the prokaryotic cell, because it’s much smaller size means that all materials within the cell are relatively close together. Of course, prokaryotic cells do have DNA and DNA functions. Biologists describe the central region of the cell as its "nucleoid" (-oid=similar or imitating), because it's pretty much where the DNA is located. But note that the nucleoid is essentially an imaginary "structure." There is no physical boundary enclosing the nucleoid.
3- Eukaryotic DNA is linear; prokaryotic DNA is circular (it has no ends).
4- Eukaryotic DNA is complexed with proteins called "histones," and is organized into chromosomes; prokaryotic DNA is "naked," meaning that it has no histones associated with it, and it is not formed into chromosomes. Though many are sloppy about it, the

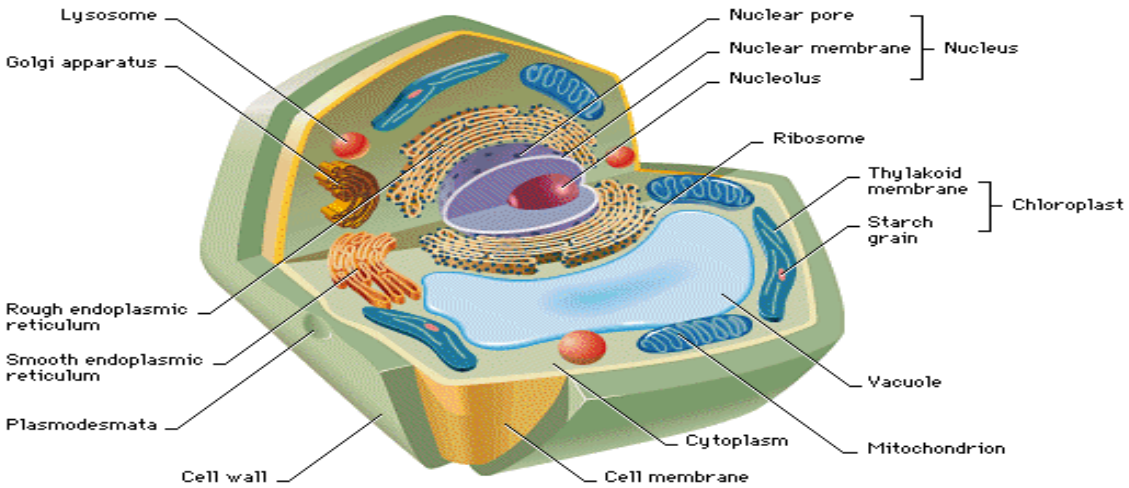
term "chromosome" does not technically apply to anything in a prokaryotic cell.

5- A eukaryotic cell contains a number of chromosomes; a prokaryotic cell contains only one circular DNA molecule and a varied assortment of much smaller circlets of DNA called "plasmids."

6- The smaller, simpler prokaryotic cell requires far fewer genes to operate than the eukaryotic cell.

7- Both cell types have many, many ribosomes, but the ribosomes of the eukaryotic cells are larger and more complex than those of the prokaryotic cell. Ribosomes are made out of special class of RNA molecules (ribosomal RNA, or rRNA) and a specific collection of different proteins. A eukaryotic ribosome is composed of five kinds of rRNA and about eighty kinds of proteins. Prokaryotic ribosomes are composed of only three kinds of rRNA and about fifty kinds of protein. The cytoplasm of eukaryotic cells is filled with a large, complex collection of organelles, many of them enclosed in their own membranes; the prokaryotic cell contains no membrane-bound organelles which are independent of the plasma membrane. This is a very significant difference, and the source of the vast majority of the greater complexity of the eukaryotic cell. There is much more space within a eukaryotic cell than within a prokaryotic cell, and many of these structures, like the nucleus, increase the efficiency of functions by confining them within smaller spaces within the huge cell, or with communication and movement within the cell.






| Eukaryotic vs. Prokaryotic Cells | | |
|---|---|---|
| **Characteristics** | **Eukaryotic Cells** | **Prokaryotic Cells** |
| **Definition** | Any cell that contains a clearly defined nucleus and membrane bound organelles | Any unicellular organism that does not contain a membrane bound nucleus or organelles |
| **Examples** | Animal, plant, fungi, and protist cells | Bacteria and Archaea |
| **Nucleus** | Present (membrane bound) | Absent (nucleoid region) |
| **Cell Size** | Large (10-100 micrometers) | Small (less than a micrometer to 5 micrometers) |
| **DNA Replication** | Highly regulated with selective origins and sequences | Replicates entire genome at once |
| **Organism Type** | Usually multicellular | Unicellular |
| **Chromosomes** | More than one | One long single loop of DNA and plasmids |
| **Ribosomes** | Large | Small |
| **Growth Rate/Generation Time** | Slower | Faster |
| **Organelles** | Present | Absent |
| **Ability to Store Hereditary Information** | All eukaryotes have this ability | All prokaryotes have this ability |
| **Cell Wall** | Simple: Present in plants and fungi | Complex: Present in all prokaryotes |
| **Plasma Membrane** | Present | Present |
| **Cytoplasm** | Present | Present |