**Prof. Dr. Younis A. Alkhafaji**

**Lecture -1- Biology**

**Biology** is the science that studies living organisms and how they interact with one another and their environment, including their physical and [chemical structure](https://en.wikipedia.org/wiki/Biochemistry), [function](https://en.wikipedia.org/wiki/Physiology), [development](https://en.wikipedia.org/wiki/Developmental_biology) or [evolution](https://en.wikipedia.org/wiki/Evolution).

The term [***biology***](https://en.wiktionary.org/wiki/biology)is derived from the [Greek](https://en.wikipedia.org/wiki/Greek_Language) word [βίος](https://en.wiktionary.org/wiki/%CE%B2%CE%AF%CE%BF%CF%82), *bios*, "[life](https://en.wikipedia.org/wiki/Life)" and the suffix [-λογία](https://en.wiktionary.org/wiki/-%CE%BB%CE%BF%CE%B3%CE%AF%CE%B1), *-logia*, "study of.

functional, and biological unit of all known [living](https://en.wikipedia.org/wiki/Life) [organisms](https://en.wikipedia.org/wiki/Organism). A cell is the smallest unit of [life](https://en.wikipedia.org/wiki/Life#Cells) that can [replicate](https://en.wikipedia.org/wiki/Cell_division) independently, and cells are often called the "building blocks of life". The study of cells is called [cell biology](https://en.wikipedia.org/wiki/Cell_biology) or cytology.

**Cell biology or Cytology**, (from the [Greek](https://en.wikipedia.org/wiki/Greek_language), *kytos*, "vessel") is a branch of [biology](https://en.wikipedia.org/wiki/Biology) that studies the different structures and functions of the [cell](https://en.wikipedia.org/wiki/Cell_(biology)) and focuses mainly on the idea of the cell **as** the basic unit of life.

Cell biology explains the structure, organization of the [organelles](https://en.wikipedia.org/wiki/Organelle) they contain, their [physiological](https://en.wikipedia.org/wiki/Physiology) properties, [metabolic](https://en.wikipedia.org/wiki/Metabolic_pathway) processes, [Signaling pathways](https://en.wikipedia.org/wiki/Signaling_pathway),.

**Organisms can be classified as**

* [**unicellular**](https://en.wikipedia.org/wiki/Unicellular)**(consisting of a single cell; including**[**bacteria**](https://en.wikipedia.org/wiki/Bacteria)**)**

**and**

* [**multicellular**](https://en.wikipedia.org/wiki/Multicellular)**(including**[**plants**](https://en.wikipedia.org/wiki/Plant)**and**[**animals**](https://en.wikipedia.org/wiki/Animal)**). While the number of cells in plants and animals varies from species to species, humans contain more than 10**[**trillion**](https://en.wikipedia.org/wiki/10%5E12)**(1012) cells.**

[**Cell theory**](https://en.wikipedia.org/wiki/Cell_theory)

Robert Hooke discovered the cell in (1665) described the cella (open spaces) of plant tissues.

The cell theory is a widely accepted explanation of the relationship between cells and living things. **The cell theory states:**

1. All organisms are composed of cells.
2. Cell is the structural and functional unit of life.
3. Cells arise from pre-existing cells.

The cells vary considerably, in shape and size. Nerve cells of animals have long extensions. They can be several feet in length. Muscle cells are elongated in shape. Egg of the ostrich is the largest cell (75 mm). Some plant cells have thick walls. There is also wide variation in the number of cells in different organisms.

**Cell types**

There are two distinctive types of cells

1. **Prokaryotic cells**: Prokaryotes lack a nucleus (though they do have circular DNA) and other membrane-bound organelles (though they do contain ribosomes).

Bacteria and Archaea are two domains of prokaryotes.

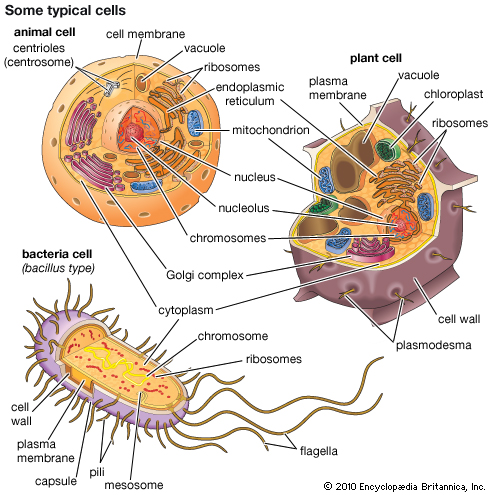
1. **Eukaryotic cells**: Eukaryotes, have distinct nuclei bound by a nuclear membrane and membrane-bound organelles (mitochondria, chloroplasts, lysosomes, rough and smooth endoplasmic reticulum, vacuoles). In addition, they possess organized chromosomes which store genetic material.

Protists, fungi, animals, and plants all consist of eukaryotic cells.

(“**Protist**” is an informal term referring to a group of mostly **unicellular** eukaryotes) .

|  |  |  |
| --- | --- | --- |
| **Table 1: Comparison of features of prokaryotic and eukaryotic cells** | | |
| **Object** | **Prokaryotes** | **Eukaryotes** |
| **Typical organisms** | [**bacteria**](https://en.wikipedia.org/wiki/Bacterium)**, [archaea](https://en.wikipedia.org/wiki/Archaea" \o "Archaea)** | [**protists**](https://en.wikipedia.org/wiki/Protist)**,**[**fungi**](https://en.wikipedia.org/wiki/Fungus)**,**[**plants**](https://en.wikipedia.org/wiki/Plant)**,**[**animals**](https://en.wikipedia.org/wiki/Animal) |
| **Typical size** | **~ 1–5**[**µm**](https://en.wikipedia.org/wiki/Micrometre) | **~ 10–100 µm** |
| **Type of**[**nucleus**](https://en.wikipedia.org/wiki/Cell_nucleus) | [**nucleoid region**](https://en.wikipedia.org/wiki/Nucleoid_region)**; no true nucleus** | **true nucleus with double membrane** |
| **DNA** | **circular (usually)** | **linear molecules (**[**chromosomes**](https://en.wikipedia.org/wiki/Chromosome)**) with**[**histone**](https://en.wikipedia.org/wiki/Histone)[**proteins**](https://en.wikipedia.org/wiki/Protein) |
| **RNA/protein synthesis** | **coupled in the**[**cytoplasm**](https://en.wikipedia.org/wiki/Cytoplasm) | [**RNA synthesis**](https://en.wikipedia.org/wiki/Transcription_(genetics))**in the nucleus** [**protein synthesis**](https://en.wikipedia.org/wiki/Translation_(biology))**in the cytoplasm** |
| [**Ribosomes**](https://en.wikipedia.org/wiki/Ribosome) | [**50S**](https://en.wikipedia.org/wiki/50S)**and**[**30S**](https://en.wikipedia.org/wiki/30S) | [**60S**](https://en.wikipedia.org/wiki/60S)**and**[**40S**](https://en.wikipedia.org/wiki/40S) |
| **Cytoplasmic structure** | **very few structures** | **highly structured by [endomembranes](https://en.wikipedia.org/wiki/Endomembrane_system" \o "Endomembrane system) and a**[**cytoskeleton**](https://en.wikipedia.org/wiki/Cytoskeleton) |
| [**Cell movement**](https://en.wikipedia.org/wiki/Chemotaxis) | [**flagella**](https://en.wikipedia.org/wiki/Flagellum)**made of [flagellin](https://en.wikipedia.org/wiki/Flagellin" \o "Flagellin)** | **Flagella and**[**cilia**](https://en.wikipedia.org/wiki/Cilium)**containing** [**microtubules**](https://en.wikipedia.org/wiki/Microtubule)**; [lamellipodia](https://en.wikipedia.org/wiki/Lamellipodia" \o "Lamellipodia) and [filopodia](https://en.wikipedia.org/wiki/Filopodia" \o "Filopodia) containing**[**actin**](https://en.wikipedia.org/wiki/Actin) |
| [**Mitochondria**](https://en.wikipedia.org/wiki/Mitochondrion) | **none** | **one to several thousand** |
| [**Chloroplasts**](https://en.wikipedia.org/wiki/Chloroplast) | **none** | **in**[**algae**](https://en.wikipedia.org/wiki/Algae)**and**[**plants**](https://en.wikipedia.org/wiki/Plant) |
| **Organization** | **usually single cells** | **single cells, colonies, higher multicellular organisms with specialized cells** |
| [**Cell division**](https://en.wikipedia.org/wiki/Cell_division) | [**binary fission**](https://en.wikipedia.org/wiki/Binary_fission)**(simple division)** | [**mitosis**](https://en.wikipedia.org/wiki/Mitosis)**(fission or budding)** [**meiosis**](https://en.wikipedia.org/wiki/Meiosis) |
| [**Chromosomes**](https://en.wikipedia.org/wiki/Chromosome) | **single chromosome** | **more than one chromosome** |
| [**Membranes**](https://en.wikipedia.org/wiki/Membrane) | [**cell membrane**](https://en.wikipedia.org/wiki/Cell_membrane) | **Cell membrane and membrane-bound organelles** |

** Table 2: Comparison between plant and animal cells**



**Figure 1:** typical cells Animal, plant and plant cells contain membrane-bound organelles, including a distinct nucleus. In contrast, bacterial cells do not contain organelles.

|  |  |  |
| --- | --- | --- |
| **Skin cells** | **Keratinocytes Melanocytes Merkel cells Langerhans cells** | |
| **Bone cells** | **Osteoblasts Osteocytes** | |
| **Muscle cells** | **Skeletal Cardiac Smooth** | |
| **Blood cells** | **Red blood cells** | **Erythrocytes** |
| **White blood cells** | **Granulocytes (neutrophils, eosinophils, basophils) A granulocytes (monocytes, lymphocytes)** |
| **Platelets** |  |
| **Sex cells** | **Sperm cell Ova** | |
| **Epithelial cells** | **Lining body cavities** | |
| **Endothelial** | **Lining blood vessels** | |

**Cell types in the human body**