***LAB-3- The cell***

The **cell** is the basic structural, functional, and biological unit of all known [living](https://en.wikipedia.org/wiki/Life) [organisms](https://en.wikipedia.org/wiki/Organism). Cells are the smallest unit of life that can [replicate](https://en.wikipedia.org/wiki/Cell_division) independently. The study of cells is called [cell biology](https://en.wikipedia.org/wiki/Cell_biology).

Cells consist of [cytoplasm](https://en.wikipedia.org/wiki/Cytoplasm) enclosed within a [membrane](https://en.wikipedia.org/wiki/Cell_membrane), which contains many [biomolecules](https://en.wikipedia.org/wiki/Biomolecule) such as [proteins](https://en.wikipedia.org/wiki/Proteins) and [nucleic acids](https://en.wikipedia.org/wiki/Nucleic_acids).

**Organisms can be classified as**

1. [**unicellular**](https://en.wikipedia.org/wiki/Unicellular) (consisting of a single cell; including [bacteria](https://en.wikipedia.org/wiki/Bacteria))
2. [**multicellular**](https://en.wikipedia.org/wiki/Multicellular) (including [plants](https://en.wikipedia.org/wiki/Plant) and [animals](https://en.wikipedia.org/wiki/Animal))

\* Prokaryotes are [single-celled organisms](https://en.wikipedia.org/wiki/Unicellular_organism), while eukaryotes can be either single-celled or [multicellular](https://en.wikipedia.org/wiki/Multicellular_organism).

\* **Cells are of two types:**

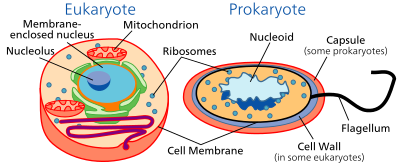
***A- Prokaryotic cells***

They are simpler and smaller than eukaryotic cells, and lack membrane-bound organelles such as the [nucleus](https://en.wikipedia.org/wiki/Cell_nucleus). Prokaryotes include two of the [domains of life](https://en.wikipedia.org/wiki/Domain_(biology)), [bacteria](https://en.wikipedia.org/wiki/Bacteria) and [archaea](https://en.wikipedia.org/wiki/Archaea). The DNA of a prokaryotic cell consists of a single chromosome that is indirect contact with the [cytoplasm](https://en.wikipedia.org/wiki/Cytoplasm). The nuclear region in the cytoplasm is called the [nucleoid](https://en.wikipedia.org/wiki/Nucleoid). Most [prokaryotes](https://en.wikipedia.org/wiki/Prokaryotes) are the smallest of all organisms ranging from 0.5 to 5.0 µm in diameter.

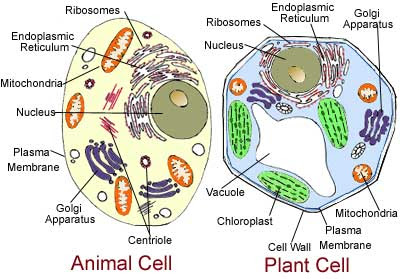
***B- Eukaryotic cells***

These cells are about fifteen times wider than a typical prokaryote and can be as much as a thousand times greater in volume. The main distinguishing feature of eukaryotes as compared to prokaryotes is the presence of membrane-bound [organelles](https://en.wikipedia.org/wiki/Organelle) .Eukaryotes include fungi, animals and plants cells.

|  |  |  |
| --- | --- | --- |
| ***Comparison of features of prokaryotic and eukaryotic cells*** | | |
|  | **Prokaryotes** | **Eukaryotes** |
| **Typical organisms** | [bacteria](https://en.wikipedia.org/wiki/Bacterium) | [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/%CE%9Cm) | ~ 10–100 [µm](https://en.wikipedia.org/wiki/%CE%9Cm) |
| **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/proten synthesis** | coupled in the [cytoplam](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 |
| [**Cell movement**](https://en.wikipedia.org/wiki/Chemotaxis) | [flagella](https://en.wikipedia.org/wiki/Flagellum) made of [flagellin](https://en.wikipedia.org/wiki/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) and [filopodia](https://en.wikipedia.org/wiki/Filopodia)  containing [actin](https://en.wikipedia.org/wiki/Actin) |
| [**Mitochondria**](https://en.wikipedia.org/wiki/Mitochondrium) | 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 |

[](https://en.wikipedia.org/wiki/File:Celltypes.svg)

***Structure of a typical***[***prokaryotic***](https://en.wikipedia.org/wiki/Prokaryotic) ***and eukaryotic cell***

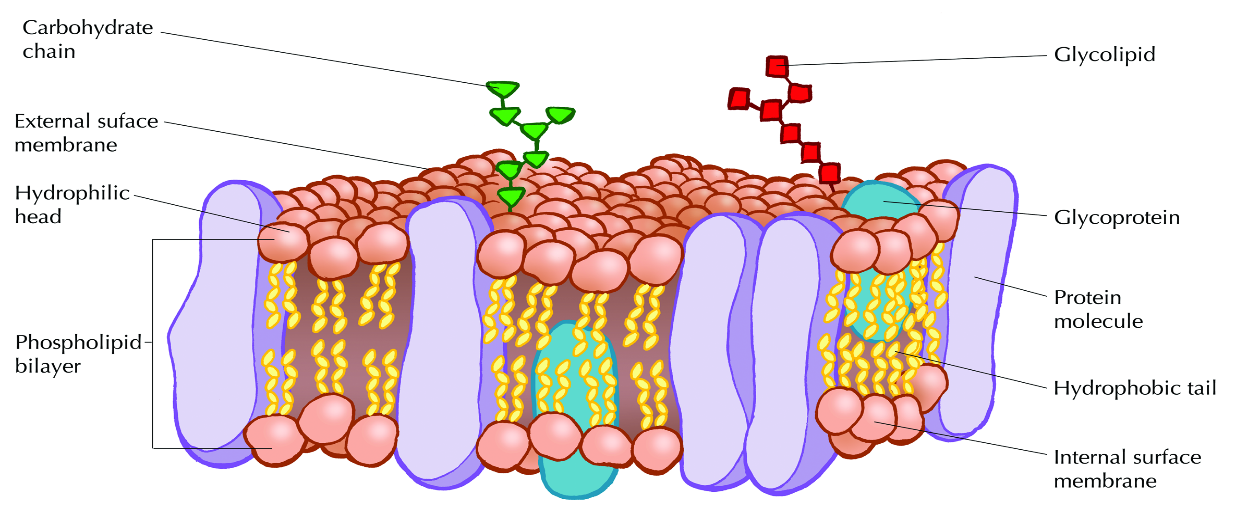


***Structure of a typical animal and***[***plant cell***](https://en.wikipedia.org/wiki/Plant_cell)

***Anatomy of the cell***

1. **Cell membrane**

There are semi – permeable membrane surrounding the cell. It helps in holding the cell together and allows entry and exits of nutrients into the cell.

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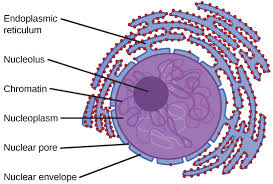
***Cell membrane***

1. **Cytoplasm**

A jelly types double membrane organelles, which are present in the inner region of the cell. It helps by keeping the cell in stable and protects the cell organelles by separating them from each other.

1. **Nucleus**

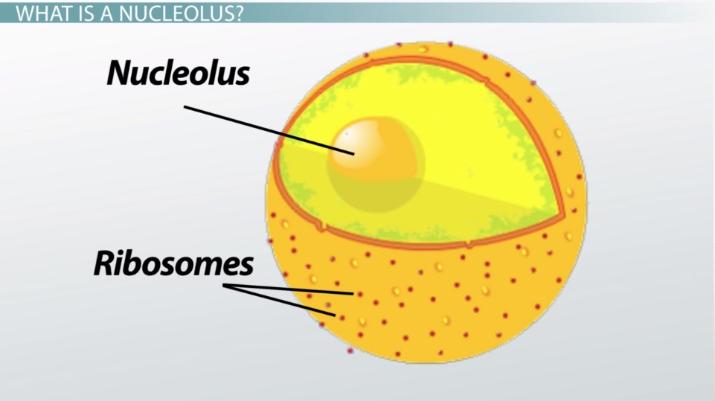
The largest organelle in the cell, which contains DNA and other cells hereditary information. The main role of nucleus in the cell is it controls all cellular activities.

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***Nucleus***

1. **Nucleolus**

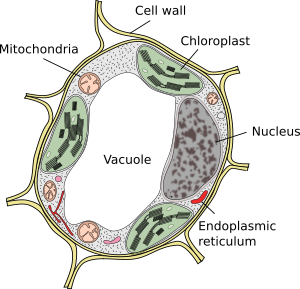
is a round body located inside the nucleus of a eukaryotic cell. It is not surrounded by a membrane but sits in the nucleus. The nucleolus makes ribosomal subunits from proteins and ribosomal RNA, also known as rRNA.



***Nucleolus***

1. **Vacuoles**

They are the fluid sacs, which are present in less numbers in animal cell compared to plant cells. The main function of this membrane is to store food and other waste materials.

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***Vacuoles***

**\*\*Examine vacuoles in:**

**A. Onion leaf**

1. Cut a red onion and remove a fleshy leaf.

2. Snap the leaf backward and remove the thin piece of the inner epidermis that formed at the break point. This tissue will be as thin and flexible as plastic wrap.

3. When you obtained your piece of onion, prepare a wet-mound slide by adding a drop of water on the middle of a clean slide. Then add cover slide and examine the tissue. The preparation should be one cell thick.

4. Stain the onion tissue by placing one drop of neutral red at the edge of the cover slip for 5-15 min.

5. Carefully focus to distinguish the vacuoles surrounded by the stained cytoplasm.

**B. Rose leaf**

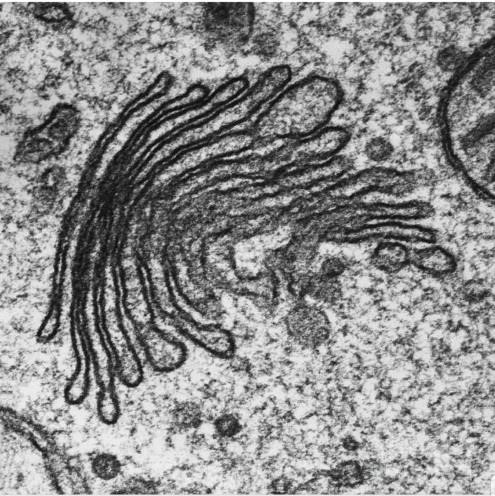
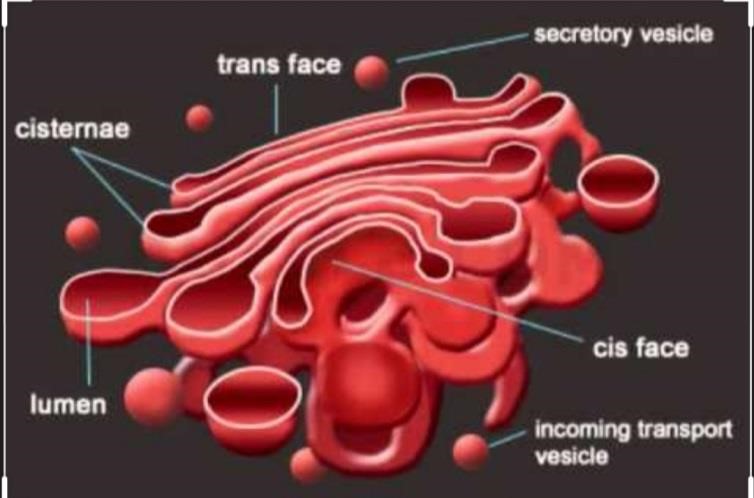
1. Snap a thin tissue from the toothed margin of a red leaf of rose plant using sharp lancet.

2. Mount it on a slide and add a cover slip.

3. Carefully focus to distinguish the colourless vacuoles near the margin. If you search far from the toothed margin, you can see red colour vacuoles because they contain anthocyanin in their cell sap**.**

1. **Golgi Bodies or Golgi complex**

The sac like structures, which are present in a cell to manufacture store, packing and shipping the selected particles throughout the cell.



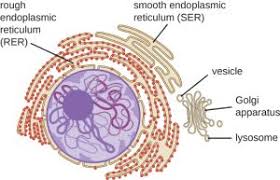
***Golgi Bodies Ribosome***

It is present in the cytoplasm. They are the site of protein synthesis, which are composed of ribosomal RNA and proteins.

1. **Endoplasmic reticulum**

The network of membrane, which helps in transporting materials around the cell and also helps in the synthesis of lipids and proteins. It forms a connection between nuclear envelope and the cell membrane of the cell. There are two types of ER:

1. **rough endoplasmic reticulum** **(RER)** The outer ([cytosolic](https://en.wikipedia.org/wiki/Cytosol)) face of the rough endoplasmic reticulum is studded with [ribosomes](https://en.wikipedia.org/wiki/Ribosome) that are the sites of [protein synthesis](https://en.wikipedia.org/wiki/Protein_synthesis).
2. **smooth endoplasmic reticulum (SER).** The smooth endoplasmic reticulum lacks ribosomes and functions in [lipid](https://en.wikipedia.org/wiki/Lipid) synthesis but not [metabolism](https://en.wikipedia.org/wiki/Metabolism), the production of [steroid hormones](https://en.wikipedia.org/wiki/Steroid_hormone), and [detoxification](https://en.wikipedia.org/wiki/Detoxification).

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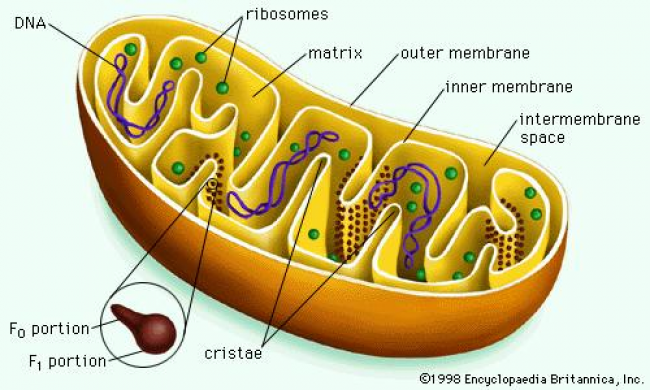
***Endoplasmic reticulum***

1. **Ribosomes**

Ribosomes are small particles which are found individually in the cytoplasm and also line the membranes of the rough endoplasmic reticulum.  Ribosomes produce protein.  They could be thought of as "factories"  in the cell.

1. **Mitochondria**

They are rod shaped organelles, plays an important role in releasing energy and they are powerhouse of the cell.

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***Mitochondria***

**\*\*Examine mitochondria in onion cells:**

**Procedure**

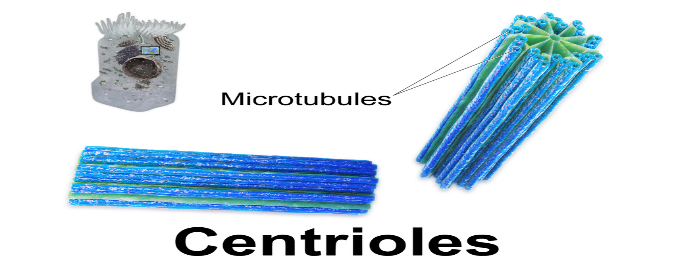
1. On a clean glass, add 2-3 drops of Iodine
2. Prepare a thin piece of onion epidermis and mount it in the staining solution:
3. Add the cover slip.

1. Search the periphery of the cells to locate stained mitochondria, they are small about 1mm in diameter.
2. Also examine slides for mitochondria in onion root tips and liver cells, the mitochondria will appear as black points around the nucleus.
3. **Lysosomes**

A lysosome is a membrane-bound [organelle](https://en.wikipedia.org/wiki/Organelle) found in many animal [cells](https://en.wikipedia.org/wiki/Cell_(biology)). They are spherical [vesicles](https://en.wikipedia.org/wiki/Vesicle_(biology_and_chemistry)) that contain [hydrolytic](https://en.wikipedia.org/wiki/Hydrolysis) [enzymes](https://en.wikipedia.org/wiki/Enzyme) that can break down many kinds of [biomolecules](https://en.wikipedia.org/wiki/Biomolecule).

1. **Centriole**

In [cell biology](https://en.wikipedia.org/wiki/Cell_biology) a centriole is a cylindrical [organelle](https://en.wikipedia.org/wiki/Organelle) composed mainly of a protein called [tubulin](https://en.wikipedia.org/wiki/Tubulin). The main function of centrioles is to produce [cilia](https://en.wikipedia.org/wiki/Cilium) during [interphase](https://en.wikipedia.org/wiki/Interphase) and the [aster](https://en.wikipedia.org/wiki/Aster_(cell_biology)) and the [spindle](https://en.wikipedia.org/wiki/Spindle_apparatus) during cell division.

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1. **Plastids ( in plants only)**

Its found in the [cells](https://en.wikipedia.org/wiki/Cell_(biology)) of [plants](https://en.wikipedia.org/wiki/Plants), [algae](https://en.wikipedia.org/wiki/Algae), and some other [eukaryotic](https://en.wikipedia.org/wiki/Eukaryotic) organisms. Plastids are the site of manufacture and storage of important chemical compounds used by the cells of [autotrophic](https://en.wikipedia.org/wiki/Autotroph) [eukaryotes](https://en.wikipedia.org/wiki/Eukaryote). They often contain [pigments](https://en.wikipedia.org/wiki/Biological_pigment) used in [photosynthesis](https://en.wikipedia.org/wiki/Photosynthesis), and the types of pigments in a plastid determine the cell's color.

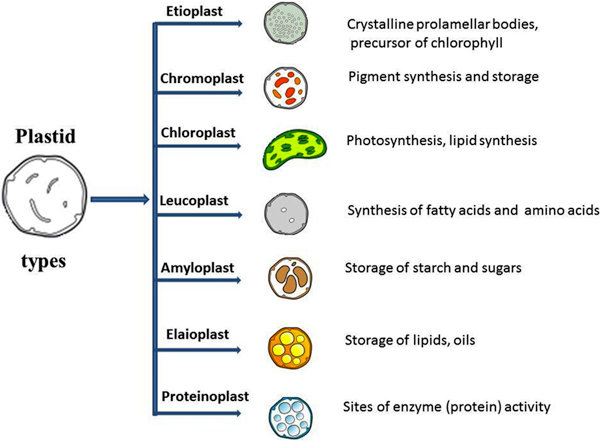
\*In [plants](https://en.wikipedia.org/wiki/Plant), plastids may [differentiate](https://en.wikipedia.org/wiki/Cellular_differentiation) into several forms :

1- [Chloroplasts](https://en.wikipedia.org/wiki/Chloroplast)

2- [Chromoplasts](https://en.wikipedia.org/wiki/Chromoplast)

3- [Leucoplasts](https://en.wikipedia.org/wiki/Leucoplast)

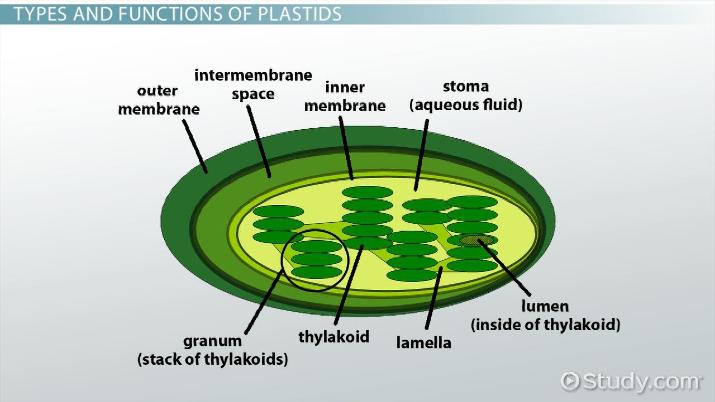
* 1. [Amyloplasts](https://en.wikipedia.org/wiki/Amyloplast)
  2. [Elaioplasts](https://en.wikipedia.org/wiki/Elaioplast)
  3. [Proteinoplasts](https://en.wikipedia.org/wiki/Proteinoplast)



***Types Of Plastids***

The plastids have a double membrane envelope consisting of the outer and inner membrane (phospholipid layers). The space within the double membranes is covered with an aqueous matrix known as **stroma**. This aqueous matrix contains various enzymes and proteins that are essential for cellular processes

\*\*Some of the other components of a chloroplast include:

* Grana - Thylakoids arranged in stacks (one on top of another)
* Peripheral reticulum - Membranous tubules arising from the inner membrane
* Chloroplast DNA
* Ribosome
* 

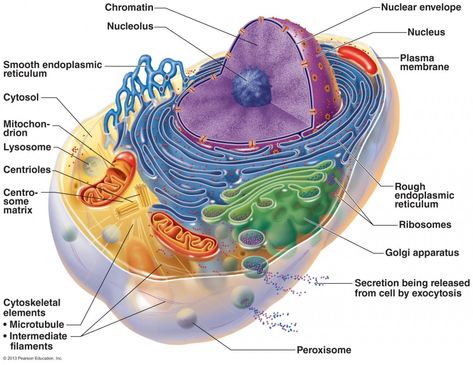
***Plastids***

1. **Vesicle**

It is a structure [within](https://en.wikipedia.org/wiki/Intracellular) or [outside](https://en.wikipedia.org/wiki/Extracellular) a [cell](https://en.wikipedia.org/wiki/Cell_(biology)), consisting of liquid or cytoplasm enclosed by a [lipid bilayer](https://en.wikipedia.org/wiki/Lipid_bilayer). Vesicles form naturally during the processes of secretion ([exocytosis](https://en.wikipedia.org/wiki/Exocytosis)), uptake ([endocytosis](https://en.wikipedia.org/wiki/Endocytosis)) and transport of materials within the plasma membrane.

1. **Cilia and Flagella**

Both cilia and flagella are hair-like organelles which extend from the surface of many animal cells.  the structure is identical in both, except that flagella are longer and whip like and cilia are shorter.  There are usually only a few flagella on a cell, while cilia may cover the entire surface of a cell. The function of cilia and flagella include locomotion for one-celled organisms and to move substances over cell surfaces in multi-celled organisms.



***Anatomy of the cell***