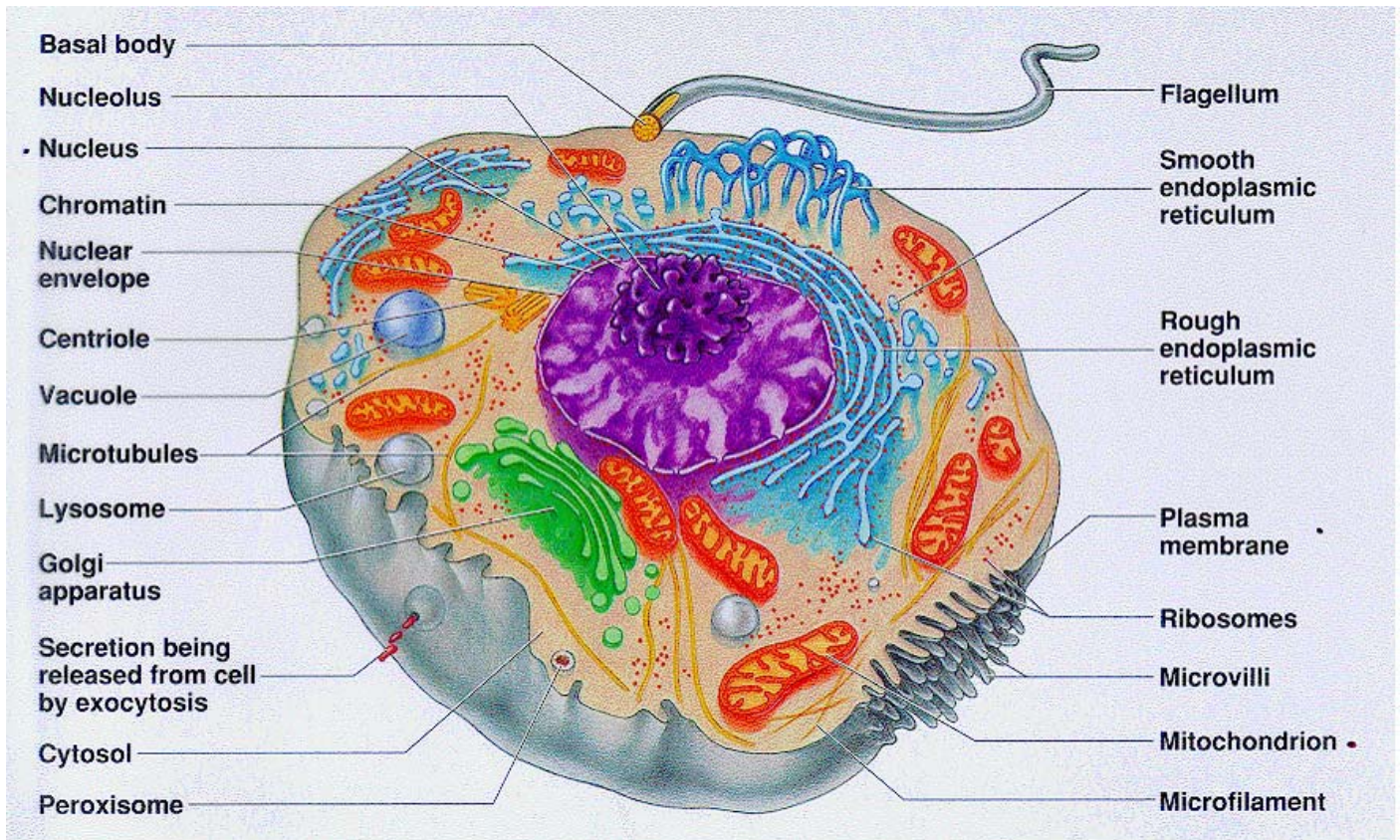


The Cell



Cell Theory

All living organisms are made up of cells and new cells are produced when live cells divide.

Light Microscope

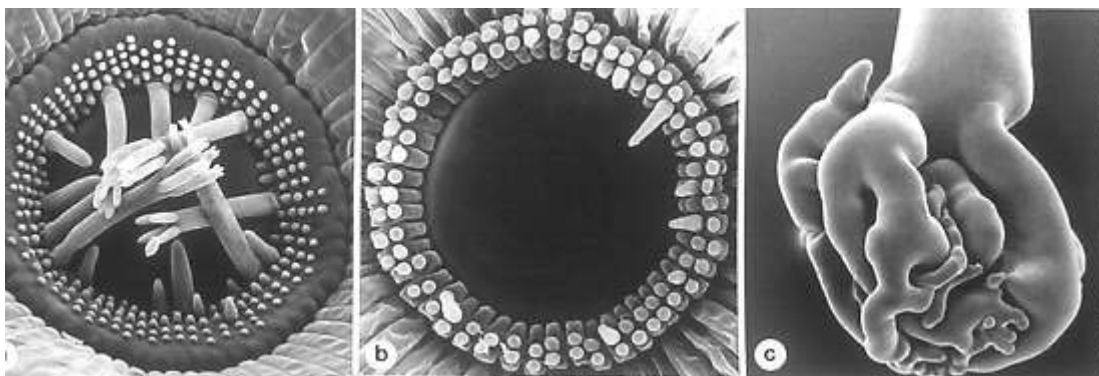
Components of animal cells: cell membrane, cytoplasm, nucleus, chromosomes.

Extra Components of plant cells: cellulose cell wall, chloroplast, vacuole.

Transmission electron microscope (TEM) (*much shorter wavelength = better resolution*) up to x 50,000+. Extra structures and details visible:

Cell membrane, mitochondrion, nuclear pores, ribosomes, chromatin, details of chloroplast mitochondrion structure, double membrane nature of nuclear envelope and outline structure of cell membranes.

Scanning electron microscope (*gives excellent 3-D surface detail*) magnification < x2000

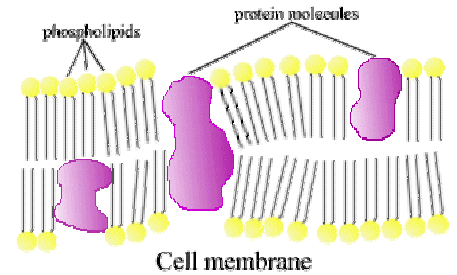


Cell

Structure

Cell Membrane

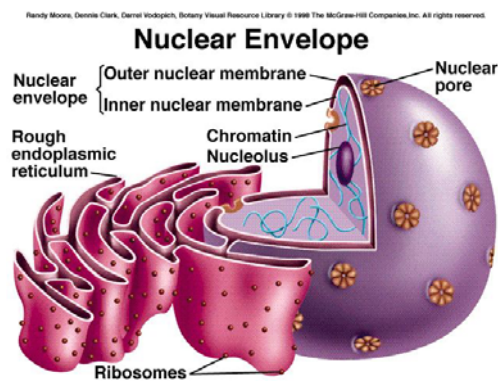
- Partially permeable: O₂ and CO₂ pass through by **simple diffusion** (*also ethanol; drugs*)
 - Glucose, amino-acids, etc. enter by **facilitated diffusion**
 - Water enters by **osmosis**
 - Na⁺, K⁺, Cl⁻ glucose etc, enter by **active transport** (*sodium pump*) – needs ATP
- Selectively permeable: controls entry and exit of specific materials.
- Keeps cell contents together allowing efficient coordination of its activity.
- Homeostasis - interior of cell maintained at optimum pH etc for efficient metabolism



Cytoplasm

- The living contents of a cell excluding the nucleus and large vacuoles.
- A complex solution in which the cell's organelles are suspended.
- Many biochemical processes take place here, e.g., glycolysis, protein synthesis.

Nucleus



- Present in **eukaryotes only** – **NOT prokaryotes** (*i.e. bacteria*).
- Contains DNA (on chromosomes), the hereditary material.
- The genes are present in the DNA.
- Passes on genes to next generation of cell (through mitosis)
- DNA (deoxyribonucleic acid) is visible as **chromatin** in active cells
- In chromosomes during mitosis and meiosis.
- Not present in a red blood cells (or bacteria!).

Nuclear Pores

- Large molecules can pass between the cytoplasm and the nucleus through these pores.
- E.g. mRNA from nucleus to cytoplasm. – and nucleotides the other way.

Chromatin

Chromatin is the very fine thread-like combinations of DNA and protein in non-dividing nuclei. The protein assists in the efficient packaging and regulation of DNA activity. A human nucleus contains 46 such fine threads of chromatin.

Chromosomes

A chromosome is a 'condensed chromatin' thread **only** visible during mitosis and meiosis. Haploid nuclei (n) have one set of chromosomes i.e. one of each kind of chromosome. Diploid nuclei (2n) have two sets of chromosomes i.e. two of each chromosome. The nuclei of human somatic (= body) cells are diploid (2n), with 46 chromosomes i.e. 23 x two sets. One set from the mother in the haploid egg cell, the other from the father's haploid sperm cell. Sex Chromosomes: the 23rd pair. Female: XX Male XY. Each chromosome has a unique set of genes. Each gene has a specific locus – it is on a particular chromosome at a specific site. Different (mutant) **forms** of a gene (A, B, O for the blood-group gene) are known as **alleles**.

Centrioles

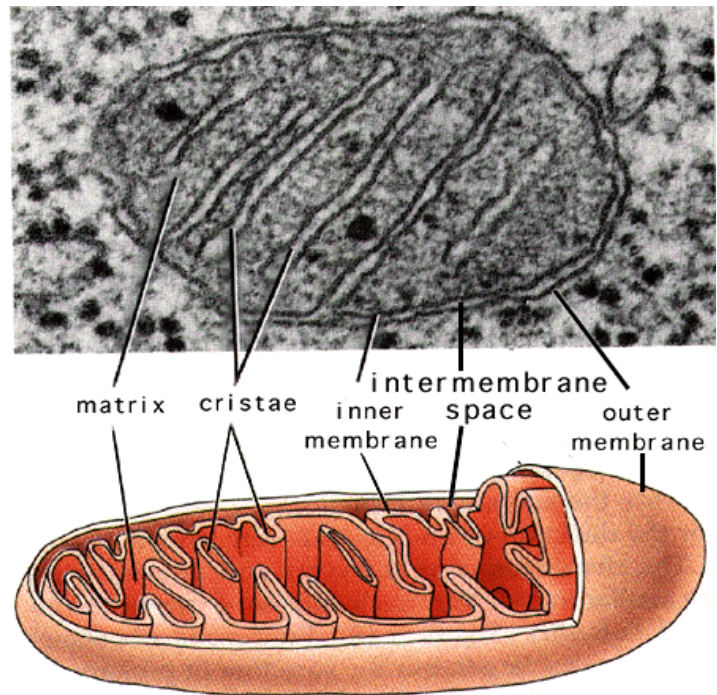
Have a '9 + 2' arrangement of protein tubes (tubulin). Two sets of tubes, each at right-angles. Divides to form **spindle** at cell division.

Lysosomes

Contain digestive enzymes for recycling macromolecules within the cell
Responsible for 'cell death' – burst to carry out '**autolysis**'

Mitochondria:

- The aerobic steps of respiration occur here – Krebs Cycle and Electron Transport System.
- 36 of the 38 ATPs from one molecule of glucose are produced in the mitochondrion.
- Liver, muscle and nerve cells are rich in mitochondria.
- Sperm cells have a 'mid-piece' containing many mitochondria
- Bone and fat cells have low numbers of mitochondria.
- Contain 70s ribosomes
- Contain ccc DNA
- Found in low numbers in plant cells



Flagellae / cilia

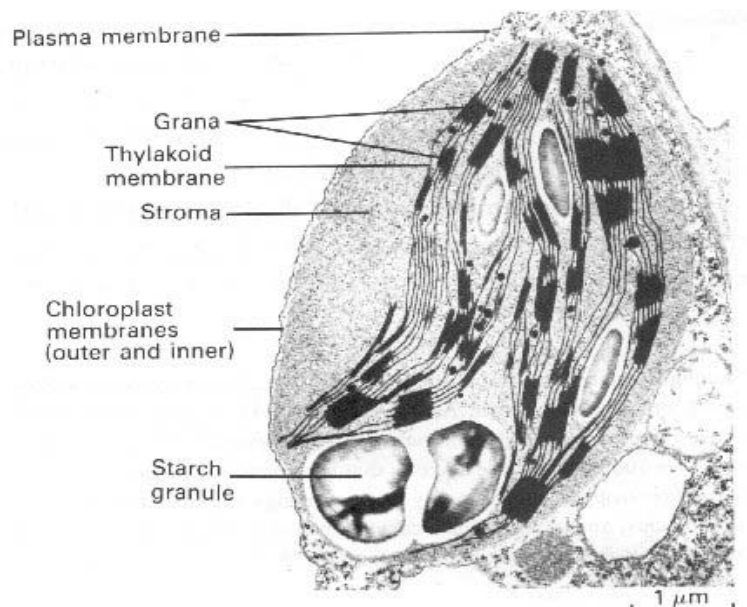
Composed of '9 + 2' protein structure; have **basal body** at base, which provides power
Flagellae, few, long; cilia many, short, synchronised beating (**metachronal rhythm**)
Responsible for cell movement (sperm) or fluid movement (trachea and Fallopian tubes)

Ribosomes:

- Composed of RNA and protein.
- Function in protein synthesis – translation of mRNA into a specific sequence of amino acids.
- 70s – prokaryotes & mitochondria and chloroplasts – 80s **all** eukaryotes

Chloroplast

- Photosynthesis is the major function of the chloroplast.
- The light stage takes place in the green internal membranes.
- The dark stage occurs in liquid part of the chloroplast.
- Starch may be stored in the chloroplast
- Contain ccc DNA
- Contain 70s ribosomes



Large Plant Cell Vacuole

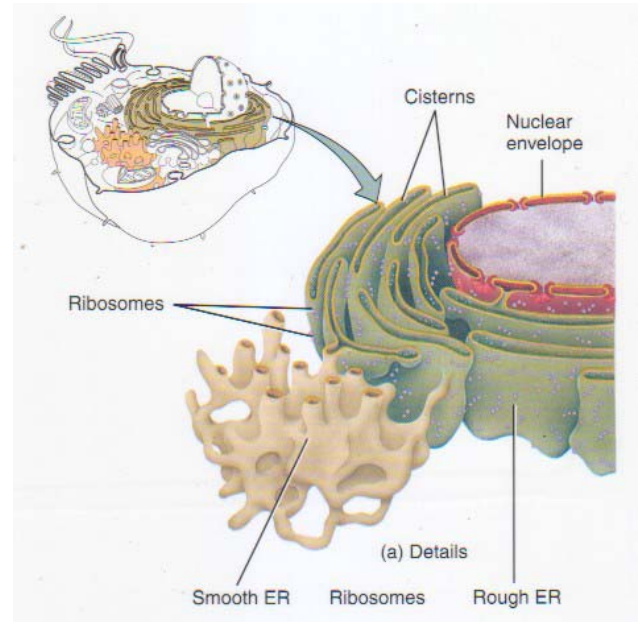
- Storage of water, food (sugar, amino acids), ions, wastes.
- Role in cell elongation during plant growth.

Plant Cell Wall

- Composed of cellulose (*1:4 β -glucose chains*)
- Permeable to water and solutes
- Protects and supports plant cells.
- Prevents plant cells bursting in more dilute solutions.
- The middle lamella of pectin glues neighbouring plant cell walls together.
- Structural role – it is the ‘plant skeleton’.

Endoplasmic reticulum

- Membrane network attached to nuclear envelope
- Transport system within the cell (both types)
- **Smooth** = site of steroid synthesis and protein modification (glycoproteins)
- **Rough** = site of protein synthesis; has 80s ribosomes attached to it



Prokaryotic Cells:

- no nucleus.
- no membrane-bound organelles such as mitochondria or chloroplasts.
- Have a **nuclear body**, with **circular (ccc)DNA**
- Have 70s ribosomes
- Have a cell wall made of **murein**
- Often have cilia or flagellae
- Have pili (allows DNA transfer = ‘bacterial sex’)
- **May** have a **capsule** (if so, then **no** cilia, flagellae)
- Smaller (c. 1.0μ)
- Store energy as glycogen
- May be either **Gram +ve** or **Gram -ve**

All prokaryotes are placed in the Kingdom Monera i.e. the bacteria.

Eukaryotic Cells:

- membrane-bound nucleus is present.
- Membrane-bound organelles such as mitochondria and chloroplasts are present.
- Contain chromosomes, with linear DNA
- Contain 80s ribosomes
- Larger (animal cells $> 8\mu$ (typical 20μ), plant cells $>50\mu$ (typical 100μ))

The Protoctista, Fungi, Plants and Animals are eukaryotic organisms.

