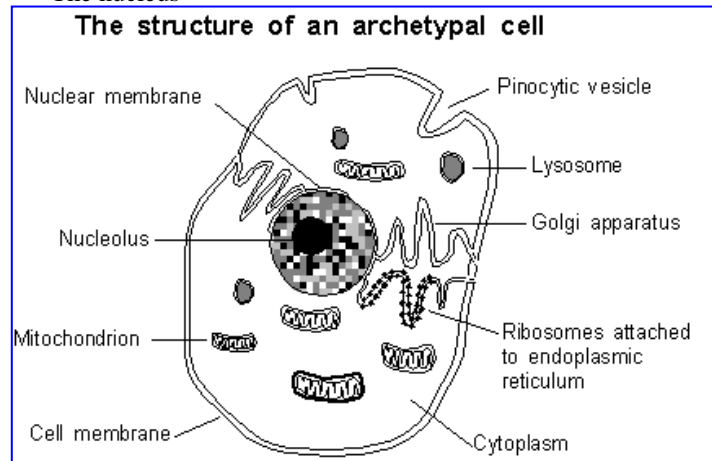


CELLS

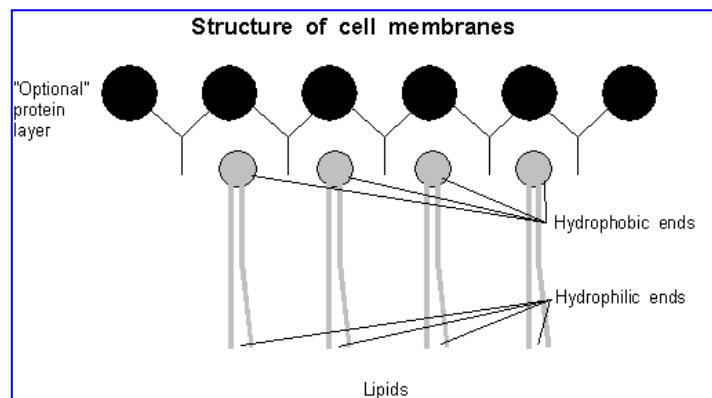
The cell is the fundamental building block of all living organisms. In humans there are about 250 different types of cell but all have the same basic structure. The cell comprises three main regions:

- The cell membrane
- The cytoplasm which contains organelles
- The nucleus



The outer cell membrane
The outer cell membranes are made from two parallel layers of phospholipids which have their hydrophilic (water loving) ends pointing outwards and their hydrophobic (water hating) ends pointing inwards. This bilayer accounts for the membrane stability, flexibility, and lipid permeability. The outer cell membranes possess specialized proteins which function as:

- Pumps
- Channels (which may exhibit selectivity or “gating”)
- Receptors
- Enzymes
- Structural proteins



Cell membranes can be selectively or partially permeable. Some cells have convoluted surfaces which increase the effective surface area. Transport systems can control the entry or exit of substances into or out of the cell. Pinocytotic vesicles can be used to transport substances out of the cell (exocytosis) or into the cell (endocytosis).

The outermost layer of the cell (glycocalyx) of an animal cell is

carbohydrate and in part bonded to the cell membrane and, being on the outermost surface of the cell, can interact with other cells and be immunologically recognized.

Cilia

Some cells have cilia on their surface. Cilia are hair-like projections which project from the surface of certain cells (for example from bronchial epithelium). Interestingly cilia have the same basic structure throughout most of the animal kingdom with a double axial strand in the centre surrounded by nine double fibres. Each cilia has a granule at the base. A flagellum, possessed by some bacteria but not by human cells, is in effect a single larger and longer cilia.

The cytoplasm is the watery substance which functions like an intracellular viscous gel which contains various structures (organelles) and microtubules.

Microtubules

Cells contain many membranes, some of which are tubular and serve for structure, transportation, or for surfaces on which synthesis of various compounds can occur. The concept of the cytoplasm as a “diffuse soup” in which a nucleus and organelles are randomly situated is far from the truth. Centrioles

are found outside the nuclei of many cells and are the focus of microtubule activity during cell division. Some cells have internal contractile microtubular strands by which they can alter their shape.

Endoplasmic reticulum

The endoplasmic reticulum (=netlike) is a double layered inner extension (invagination) of the cell membrane, which provides a large surface area on which a large number of biological processes can occur. The *rough* endoplasmic reticulum bears the ribosomes, on which protein synthesis occurs, whereas the *smooth* endoplasmic reticulum is more tubular and synthesizes membrane phospholipids and some proteins.

Mitochondria

These are the powerhouses of the cell in that they carry the respiratory enzymes which make adenosine triphosphate from adenosine diphosphate and phosphate. The mitochondria have a two-layered outer membrane from which internal projections (cristae) project into the cell. In general the number of mitochondria within a cell reflects its energy flux - heart muscles have numerous mitochondria. It appears that mitochondria were originally intracellular parasites that became both totally dependent on the host cell and essential for the host cell viability. Indeed mitochondria have their own deoxyribonucleic acid and, unusually, are inherited via the female line.

Lysosomes

Lysosomes are spherical bodies which serve to contain powerful digestive enzymes which would otherwise attack the cell. Lysosomes also contain some of the cells excretory products.

Storage granules

These contain fats or glycogen.

Ribosomes and microsomes

These are the sites of protein synthesis.

The Golgi apparatus

It is thought that these bodies, which are prominent in secretory cells, serve to process and store secretory products and direct large molecule transport within cells.

Although all cells (except the germ cells) contain the same genetic material various aspects of individual cells are allowed to develop whilst other aspects are suppressed, so that tissues and organs can develop. Certain cells develop special functions and thus differential stimulation and suppression of the various areas of the genetic blueprint must occur.

The Nucleus (=kernel)

Each "proper" cell contains a nucleus (the red blood *corpuscles* in the blood usually have no nucleus, hence they are not usually called cells). The nucleus is the cell director and contains most of the hereditary material as chromosomes (each nucleus contains about six feet of deoxyribonucleic acid). Chromosomes remain in the nucleus but most of the processes they control occur outwith the nucleus. When the cell is metabolically active and not dividing (in interphase) the nucleus is surrounded by a two-layered nuclear membrane which is continuous with the endoplasmic reticulum. When the cell is dividing metabolism is much reduced, the nuclear membrane disappears, and the chromosomes duplicate and separate. Each nucleus contains a nucleolus where nucleoprotein particles are assembled prior to migration into the cytoplasm where they eventually form the ribosomes.