

Structure and Function of Cells

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Common features of cell

- Contained genetic material (DNA)
- Surrounded by plasma membrane (selectively permeable barrier)
- Shared same basic mechanism for energy metabolism (e.g. glycolysis and oxidative metabolism)

Diversity of cell

- All cells in the body are genomic equivalent
 - Exception in lymphocytes (genetic recombination during development of immune system)
- Diversity of cell types is due to differential gene expression in different cell types

Stem Cell

- Self –renewal
- Pluripotency
- Embryonic and adult stem cell

General functions of cell

- **Basic unit** of life
- **Protection and support** through production and secretion of various kinds of molecules
- **Movement.** Various kinds occur because of specialized proteins produced in the cell
- **Communication.** Cells produce and receive electrical and chemical signals
- **Cell metabolism** and **energy release**
- **Inheritance.** Each cell contains DNA. Some cells are specialized to gametes for exchange during sexual intercourse

Basic structure of cell

I. Plasma membrane

II. Nucleus

III. Cytoplasm containing organelles

I. Plasma Membrane

Cell or Plasma membrane

- Make up of a lipid bilayer structure with combinations of carbohydrates and lipids (glycolipids) and proteins (glycoproteins) on outer surface.
- Function to separate the intracellular vs. extracellular materials
- Production of charge difference (membrane potential) across the membrane by regulation of intracellular and extracellular ion concentrations
 - Outside of membrane positively charged compared to inside because of gathering ions along outside and inside

Fluid nature of cell membrane

- Distribution of molecules within the membrane
- Phospholipids automatically reassembled if membrane is damaged
- Membranes can fuse with each other

Endocytosis and exocytosis

- Endocytosis: internalisation of substance
 - Phagocytosis
 - Pinocytosis
 - Receptor mediated endocytosis
- Exocytosis : secretion of substance e.g. digestive enzymes, mucus, milk
 - Similar to endocytosis but occurs in opposite direction

II. Nucleus

Prokaryotes and Eukaryotes

Prokaryotes:

- Bacteria
 - No nucleus
 - Circular chromosome

Eukaryotes:

- Yeast
- Fungus
- Plant
- Mammalian cells
 - Genetic materials (chromosomes) located inside nucleus

Chromatin structure and transcription

Heterochromatin

- DNA regions are not transcribed
- Highly densely packed DNA
- No RNA synthesis
- Found at centromeric region

Vs

Euchromatin

- DNA regions are transcribed
- Less densely packed DNA
- Active RNA synthesis

Nuclear Matrix

- Consist of DNA, nucleoproteins, and structural protein
- Nucleoprotein are proteins closely associated with DNA - histone and non-histones
- Lamin protein, which arranged in a lattice and help to form a nuclear cytoskeleton

III. Cytoplasm

Organelles

- Small specialized structures with particular functions
- Most have membranes that separate interior of organelles from cytoplasm
- Related to specific structure and function of the cell

Genetic system of mitochondria

- Circular DNA (maternal origin)
- Encodes some proteins involved in respiratory system
- Most of the proteins in mitochondria are imported

Function of cytoskeleton

- Mechanical support
- Cell movement
- Contraction (in muscle)
- Transport of organelles, vesicles and macromolecules
- Cell division

Movement involving microtubules

- Movement of organelles, e.g. mitochondria
- Transport of vesicles
- Movement of chromosome during cell division
- Flagellar and ciliary movement

Reference

- “Anatomy and Physiology”, Seventh Edition by *Rod R. Seeley, Trent D. Stephens, Philip Tate* published by The McGraw-Hill Companies