Chapter – 6: Cell – Structure and Functions

Cell

- Basic structural and functional unit – all living organisms
- Building blocks of our body
- Brick – make buildings – cell – make bodies

Discovery of cell

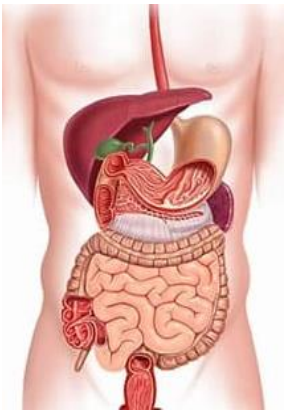
- Robert Hooke – 1665 – used simple microscope – bark of tree
- Honeycomb-like structure – compartments or boxes – seperated by a wall
- Hooke named these compartments – cell
- Hooke observed – dead cells
- Living cells – observed after – improved microscope

Cell theory

- 1838 – Schleiden and Schwann – German biologists – presented cell theory – further expanded by Virchow
- Major points of cell theory
    - All living things – made up of cells – basic structural and functional unit
    - New cells – arise by division – pre-existing
    - Organization of cells – decides – structure and function

Levels of organization

- Multicellular organisms – different cells – different functions
- Unicellular organisms – single cell – all functions



- Multicellular – many kinds of cells – organized on different levels –
    - Cells
        - Smallest unit
        - Many cells – same type – form **tissue**
    - Tissues
        - Group of cells – similar function
        - Lining of the skin – epithelial tissue
    - Organs
        - Tissues – combine together – perform specialized functions

        - Stomach, heart, kidney
    - Organ systems
        - Various organs – work together – perform specific function
        - Digestive system, respiratory system, nervous system
    - Organism
        - Various organ system – combine together
- Consider – human body
- Various organ systems – digestive system, reproductive system, circulatory system,
- Digestive system – organs – stomach, intestine – made of epithelial tissue – made of millions of cells

Variations in cells

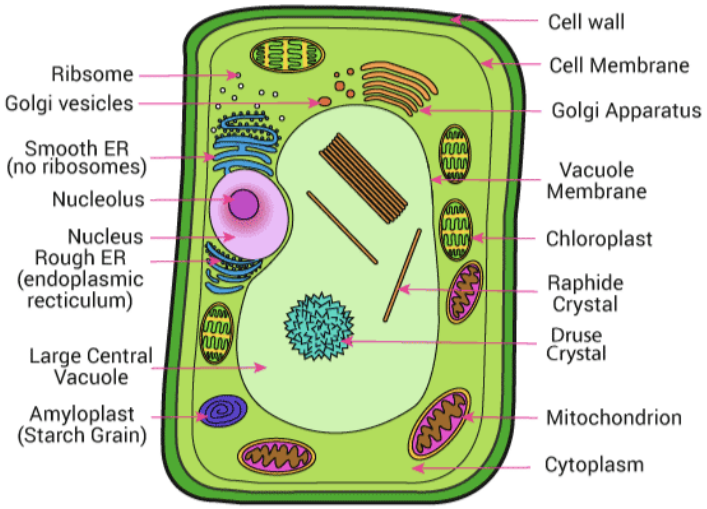
- Millions of living organisms – different shape and size – different types of cells
- Variations based on –
    - Number of cells
        - Different organisms – varying number of cells
        - Human body – about 100 trillion cells – different shapes and sizes
        - Classified as –
            - Unicellular
                - Single cell – all functions
                - Death of one cell – death of organism
                - No levels of organization
                - Amoeba, paramecium, bacteria
            - Multicellular
                - Many cells – different cells – different functions
                - Death of one cell – does not lead to death of organism
                - Various levels of organization
                - Man, cow, dog, tree
    - Shape of cells
        - Different cells – different shapes – according to function
            - Skin – thin, flat, rectangular cells – no intercellular space – act as protective covering
            - Neurons (nerve cells) – elongated (stretched), branched, thin thread-like – transmit message quickly – form of electrical signal
        - Some cells – change shape – amoeba – no definite shape
        - Keeps changing shape – projections of various size – pseudopodia (false feet)
        - Human body – white blood cells – change shape
    - Size of cells
        - Plant and animals cells – different sizes
        - Most cell – small – cannot be seen with naked eye – use microscope
        - Nerve cell – longest cell in living things
        - Variation in cell size
            - Egg of ostrich – largest cell in world – 170 mm x 130 mm
            - Neuron – longest cell in human body – 100 µm
            - RBC – smallest cell in human body – 7-9 µm

- PPLO (Pleuro Pneumonia Like Organism) – smallest cell in world – (0.1-0.5 µm)

- Division of labour
  - Multicellular organisms – stomach digest food, heart pumps blood
  - Unicellular organisms – cell organelles – mitochondria, ribosomes
  - Cell – perform various functions – cell organelles

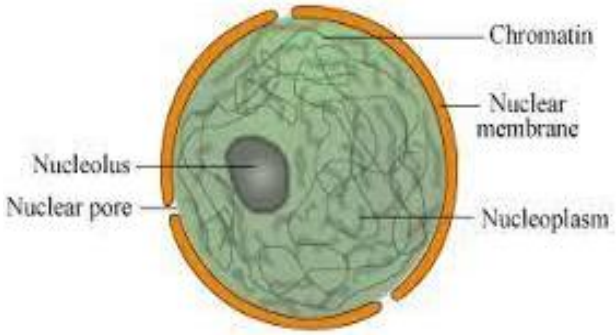
Structure of cell

- Cells – multicellular organisms – vary – shape and size
- Plant and animal cells – lots of differences – similar structure
- Cells enclosed in **cell membrane** – in case of plant cells – **cell wall**
- Inside the cell – nucleus and jelly-like substance – **cytoplasm** – many small structures inside cytoplasm – **cell organelles**



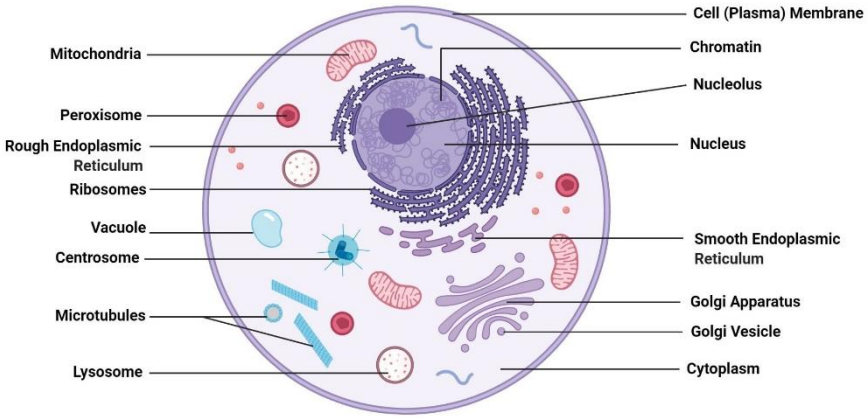
- **Cell wall**
  - Plants – cannot move – cannot protect themselves from weather
  - Extra covering – cell wall
  - Outermost layer
  - Thick, non-elastic, rigid, non-living membrane (porous sheet – containing holes) – made of cellulose (complex carbohydrate)
  - Fully permeable – aloe entry and exit of all things
  - Provide – protection and shape
- **Cell membrane**
  - Present in both – plant and animal cells – plasma membrane
  - Thin, elastic, delicate living membrane – made of lipids, proteins – separates from its surroundings
  - Selectively permeable – allow entry and exit of specific materials
  - Provide – shape and protection
- **Nucleus**
  - Spherical / oval structure – **brain of the cell**
  - Covered by nuclear membrane – separate it from cytoplasm
  - Another smaller, round structure – **nucleolus**
  - Network of thread-like structure – **chromatin** – within nucleus
  - Chromatin – condensed – appear like fibres – **chromosomes**

- Genetic / hereditary information – carried by **genes** – located in chromosomes
- Physical characters – height, colour of eyes, shape of nose – defined by genes
- Human gene pool – 30,000-40,000 genes
- Nucleus with cytoplasm – **protoplasm** – living part of cell



- **Cytoplasm**
  - Transparent, jelly-like part – occupies space between cell membrane and nuclear membrane
  - Organelles – necessary for cell function – present here
- **Cell organelles**
  - Mitochondria (mitochondrion)
    - Produce energy – various functions
    - **Powerhouse of the cell**
    - Oval or rod-shaped
  - Endoplasmic reticulum
    - Network of tubules – transportation of materials – cell to nucleus and vice-versa
    - Synthesize (create) – proteins and lipids
  - Golgi bodies
    - Secrete – proteins and enzymes (chemicals – cellular functions)
  - Ribosomes
    - Synthesize – proteins
  - Vacuoles
    - Fluid-filled structure – enclosed by membrane
    - Store substances – food, water, waste
    - Plant cells – larger vacuoles
  - Lysosomes
    - Small structure – filled with digestive enzymes
    - **Suicide bags of the cell**
    - Burst – disturbance of cell – destroy cell
  - Chloroplasts
    - Only in plant cells
    - Chloroplast – chlorophyll – green pigment – photosynthesis
    - **Kitchen of the cell**
    - Plant cells – coloured organelles – **chromoplasts** – impart colour to flower and fruit
  - Centrosomes
    - Found near nucleus

- Initiate – cell division
- Only in animal cells



- Difference between plant and animal cells
  - Plant cell –
    - Cell wall – outermost covering
    - Contain chloroplasts – photosynthesis
    - 1 or 2 big vacuoles
    - Centrosomes – absent
  - Animal cell –
    - Cell membrane – outermost covering
    - Chloroplasts absent – no photosynthesis
    - Few smaller vacuoles
    - Centrosomes - present

Types of cell

- Prokaryotic cell –
  - Nucleus – not well defined – not surrounded by membrane
  - Single chromosome – not surrounded by nuclear membrane
  - Bacteria and blue-green algae – **prokaryotes**
  - Cell division – fast (20 minutes)
- Eukaryotic cell –
  - Nucleus – well defined – surrounded by nuclear membrane
  - Cell organelles – double membrane
  - All organisms – eukaryotes – except bacteria and cyanobacteria
  - Cell division – slow (hours)

Cell division

- Growth – multiplication of cells – **cell division**
- Cell matures – stops growing – divides – 2 new cells – **daughter cells**
- Repair and healing of wounds
- Starts with division of nuclear material
- Nucleus divides – cell membrane divides – cell divides
- Process – controlled and organized – Multiplication – uncontrolled – leads to tumour or cancer