

Biology

03.2A Cell structures

”And there shall in no wise enter into it anything that defileth, or worketh abomination, or maketh a lie: but they which are written in the Lamb’s book of life” - Revelation 21:27

Two major groups of cells

1. Prokaryotic: Organelles have no membrane boundary. No true nucleus
2. Eucaryotic: Some organelles are bound by a membrane. True nucleus

Cell Structures

1. Boundaries: Peripheral structures of cell, membrane, cell wall, capsule
2. Cytoplasm: Everything inside the cell except the nucleus
3. Nucleus: Information and control center of cell
4. Appendages: External structures usually for movement

Cell Boundaries

Plasma membrane: Discovered in 1855 by Carl Naegeli and C. Cramer

1. All cells
2. Surrounds the cell and holds protoplasm in
3. Surrounds organelles
4. Semipermeable
5. Double layer of proteins and phospholipids.
6. Self-assemblable. Hydrophilic and hydrophobic. Oil in water (demo!)
7. Unit membrane is 75µm thick. 1 µm = 1/1,000,000 meters

Cell walls: first observed in 1665 by Robert Hooke

1. Monera, plants and most fungi
2. Outside of the membrane
3. Rigid
4. Monera cell walls made of polysaccharides, lipids and proteins
5. Plants cell walls made of cellulose
6. Fungi cell walls made of chitin
7. Produced in the cell and assembled outside the membrane
8. Primary cell wall allows young plants to grow
9. Secondary cell wall forms between membrane and primary cell wall
10. Pores allow diffusion of nutrients and waste
11. Middle lamella: matrix between plant cells

Capsules and Sheaths:

1. Monera
2. Outside of cell wall
3. Polysaccharides and lipids
4. Extra protection and slimy (pneumococcus)

Cytoplasm

1. All material (molecules, organelles, protoplasm) in the cell except for the nucleus contents.
2. Cytosol refers to the solution inside the cell surrounding but not in the organelles. It is the solvent in which solutes are dissolved. The cytoplasm includes this solution and everything else.
3. Nucleoplasm is in the nucleus.
4. Mitochondria matrix is inside the mitochondria.
5. Reticuloplasm is inside the Endoplasmic reticulum.
6. Stroma is inside Chloroplasts.

Vacuoles and vesicles: First observed in 1675 by Van Leeuwenhoek

1. Membrane-bound sac
2. Storage container for a variety of substances
3. Seven kinds of vacuoles
 - a. Phagocytic vacuole: results from engulfing large particles. Cell eating.
 - b. Pinocytic vesicle: cellular drinking
 - c. Food vacuole: Results from phagocytic and pinocytic vacuoles fusing with lysosomes
 - d. Waste vacuole: Remains of food vacuole
 - e. Secretion vacuole: Carry synthesized materials to the membrane (cellulose, hormones)
 - f. Central vacuole: Fills with water to control turgor pressure
 - g. Contractile vacuole: Collects and excretes excess water in cell

Nucleus: Discovered in 1833 by Robert Brown.

1. Center of information and control in the cell
2. Nuclear envelope: double membrane with pores
3. Nuclear sap: matrix in the nucleus
4. Chromatin: DNA plus the protein coat
5. Nucleolus: Area of RNA
6. Position varies from cell to cell

Protoplasm: Discovered in 1840, by J.E. Purkinje

1. Reversible colloid matrix of proteins, carbohydrates, lipids, RNA, etc.
2. Cytoplasmic streaming moves materials in cell (sol state)

Mitochondria: First observed in 1857 by Albert von Kolliker first named 'sarcosomes'.

1. The "powerhouse" of the cell. Energy supplier
2. Respiration of sugars
3. Double-membrane-bound organelle
4. Outer membrane surrounds the organelle
5. Inner membrane has folds called cristae
6. Cristae hold enzymes in sequential position

7. Matrix contains many enzymes

Centrosome and Centrioles: Discovered by 1888 by Edouard Van Beneden

1. Made of microtubules
2. Occur in pairs at right angles
3. Near the nucleus
4. Involved in cell division

Golgi bodies (Golgi apparatus): Discovered in 1897 by Camillo Golgi

1. Made of saccules (flat, curved sacs).
2. Synthesizes complex molecules (hormones)
3. Secretion vacuoles pinch off and fuse with cell membrane

Cytoskeleton: Discovered in 1931 by Paul Wintrebert.

1. Intercellular proteins distributed inside cells help to give cell shape and movement.
2. Microtubules discovered in 1953 by De Robertis and Franchi.
3. Microfilaments/Actin discovered in 1968 by Edward David Korn
4. Intermediate filaments discovered in 1968 by Howard Holtzer et al.

Plastids: Discovered in 1937 by Cornelis Van Niel

1. Plants
2. Membrane-bound organelles
3. Leucoplasts are colorless
4. Chromoplasts are pigmented (Chloroplasts contain chlorophyll)
 - a. [Photosynthesis occurs in chloroplasts containing granum of thylakoids in stroma]

Endoplasmic Reticulum (ER): Discovered in 1945 by Albert Claude & Keith Porter.

1. Continuous membrane network in cytoplasm
2. Channels cytoplasmic streaming
3. Holds enzymes in sequential positions
4. Smooth ER has no ribosomes attached to it
5. Rough ER has ribosomes attached to it

Ribosomes: Discovered in 1955 by George Palade.

1. Non-membrane bound organelle
2. Strands of rRNA + proteins
3. Involved in protein translation and synthesis

Lysosomes: Discovered in 1955 by Christian de Duve

1. Small membrane-bound organelles
2. Contain enzymes for digesting proteins, invaders, food

Appendages

Flagella: First observed in 1675 by Van Leeuwenhoek

1. Long, tubular extension of membrane with microtubules
2. Usually one per cell, but sometimes 3, 4, or 5
3. Movement of cells

Cilia: First observed in 1675 by Van Leeuwenhoek

1. Many on the cell
2. Shorter than flagella
3. Movement of unicellular organisms
4. Moves particles in multicellular organism (Lungs)