Microanatomy-Cytology
(cells)
Levels of Organization

least complex    most complex
Chemical level>**cellular level**>Tissue level>Organ level>Organ system level>Organism level
Cytology

- **Cytology** - the study of the structure and function of cells
- Cells are:
  - the structural “building blocks” of all life
  - smallest structural unit that performs all vital functions
- The humans body is made of 75 trillion cells
- Two main types-
  - **Reproductive cells** - sperm & ova - reproductive cells
    - Cells are produced by division of preexisting cells
  - **Somatic cell** - all other cells of the body (muscle, bones, fat, neural, skin, blood, immune cells…)
Fig 2.3
Fig 2.2

- Smooth muscle cell
- Blood cells
- Bone cell
- Oocyte
- Sperm
- Neuron in brain
- Cells lining intestinal tract
- Fat cell
plasma membrane/ phospholipid bilayer/cell membrane/ plasmalemma

- Isolates the cell from the environment
- Structural support-intercellular attachment
- The membrane regulates interaction with the environment
• The membrane selectively allows the passage of water, nutrients, gases, wastes, secretory products, ions, & gases into/out of the cell

• The structure of the plasma membrane allows for its selectivity

(Remember structure follows function!)
Membrane Structure

- The plasma membrane is made of phospholipid molecules
- Phospholipids are amiphipathic molecules
- **Amiphipathic** - opposite ends of the molecule have a different affinity for $\text{H}_2\text{O}$
• Hp-hydrophilic “loves”, interacts with water
• Hb-hydrophobic “hates”, will not interact with water
• A phospholipid bilayer has two layer of phospholipids arranged with the hb regions facing each other
Membrane structure is fluid
Proteins

• Types:
  – Integral proteins-span across the membrane
  – Peripheral proteins-on one side of the membrane

Proteins function as:
Channels thru a membrane
Receptors
Carbohydrates-sugar

- On outer surface of membrane
- Function as receptors
  - Glycolipids
  - Glycoproteins
Cholesterol

• Adds stability to a membrane
Fig 2.5

- Extracellular fluid
- Glycolipids of glycocalyx
- Phospholipid bilayer
- Integral protein with channel
- Hydrophobic tails
- Integral glycoproteins
- Cell membrane
- Gated channel
- Cholesterol
- Peripheral proteins
- Hydrophilic heads
- Cytoskeleton (Microfilaments)

Scale: 2 nm
Membrane permeability

Passive transport

• Passive transport
  – Dependant on a concentration gradient
  – Passive = requires no energy

• The cell membrane is selectively permeable

• Some material can pass thru the membrane some material can’t

• Distinction based on size, charge, shape, & solubility
- Diffusion
- Osmosis
- Filtration
- Facilitated diffusion
Diffusion

• Tendency for molecules to spread out from each other
• Molecules move from a concentrated area to a less concentrated area
• The membrane selectively restricts diffusion in & out of the cell
Fig 2.6

Lipid-soluble molecules diffuse through membrane lipids.

Cell membrane

Channel protein

Small soluble molecules and ions diffuse through membrane channels.

Large molecules that cannot diffuse through lipids cannot cross the membrane unless they are transported by a carrier mechanism.
Osmosis-diffusion of water

• Diffusion of H₂O across a membrane from a region of high [H₂O] to a region of low [H₂O]

• If an osmotic gradient exists water will diffuse until the gradient is eliminated
The difference in solute concentration and the selectively permeable membrane allows for osmosis.
• Facilitated diffusion-receptors aid in diffusion

• Filtration-hydrostatic pressure forces movement of water and solutes
Membrane permeability-
Active Transport

• Uses energy to move molecules across a membrane
• Movement of molecules from a [lower] to a [higher]
• Involves the use of proteins and energy
• Cells use energy call ATP
  – Adenosine Triphosphate
• Ion pumps
Membrane & endocytosis

• Membrane distorts its shape to move molecules

• Endocytosis-moving molecules into the cell
  • three types:
  • phagocytosis, pinocytosis, receptor mediated endocytosis
Phagocytosis

- **Pseudopodia** surround the molecule and the membranes fuse to trap the molecules in the cell
Pinocytosis

- The cell membrane forms an invagination then pinches it off trapping the molecules in the cell.
Receptor Mediated Endocytosis

- A more selective form of pinocytosis
- The vesicles contain a specific molecule in higher concentration than in pinocytosis

- The ligands bind to the receptors then the vesicle forms bringing specific molecules into the cell
The receptors make this more selective about what enters the cell.
Exocytosis

- Moving molecules out of the cell
- A vesicle fuses to the inside of the membrane releasing contents to the extracellular fluid
Intercellular attachment

- Extra Cellular Matrix
- Proteins & sugars that hold adjoining cells together
Cell Junctions

- There are three major types of cell junctions:
  - Tight junction
  - Desmosome
  - Gap junction

Fig 2.19
• **Tight junction**-holds cells together
• Does not allow molecules & water to pass between adjacent cells.
• Found near the surface of exposed tissues
• **Desmosome**-holds cells together, much stronger than tight junctions
• **Gap junction**—a channel between adjoining cells.

• Allows molecules to directly pass from one cell to another
Organelles

• The space inside of a cell is called the cytoplasm.
• Many organelles (tiny organs) are located within the cytoplasm
• Intracellular fluid is cytosol
  – Membrane regulates contents of cytosol
Cytoskeleton

At the inside boarder of cell membrane

Microfilaments

Intermediate filaments

Thick filaments

microtubules
Microvilli

Fig 2.3
Fig 2.10

Centrioles

- Microtubules
- Cell membrane
- Basal body
- (b) Glium
- Power stroke
- Return stroke
Fig 2.3

- Cilia
- Microvilli
- Secretory vesicles
- Lysosome
- Smooth endoplasmic reticulum
- Cytoskeleton
- Cell membrane
- Golgi apparatus
- Cytoplasm
- Mitochondrion
- Peroxisome
- Centrosome
- Centriole
- Rough endoplasmic reticulum
- Free ribosomes
- Nuclear envelope surrounding nucleus
- Nuclear pores
- Fixed ribosomes
- Nucleoplasm
- Nucleolus
- Chromatin
Fig 2.3

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Cilia

Microvilli

Secretory vesicles

Lysosome

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Nuclear envelope surrounding nucleus

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Rough endoplasmic reticulum

Centrosome

Centriole

Peroxisome

Cytosol
• Quiz 1-1\textsuperscript{st} two lectures, lab 1 & 3

• Lab clean up- chairs & models

• Labs 2 & 3 in 10 minutes
Microscopes

• Carry with both hands

• When finished:
  • Turn off lamp, turn intensity to zero
  • Lower & center stage
  • Put to low power objective
  • Wrap up cord
  • Place in appropriate space in cabinet
Cross sections