Cells and Tissues

- Cellular transport mechanisms

Cell Physiology: Membrane Transport

- Membrane transport—movement of substances into and out of the cell
- Two basic methods of transport
  - Passive transport
    - No energy is required
    - Osmosis (movement of water)
    - Diffusion (movement of solutes)
    - Facilitated diffusion (movement through a protein gate)
  - Active transport
    - Cell must provide metabolic energy (ATP)

Solutions and Transport

- Solution—homogeneous mixture of two or more components
  - Solvent—dissolving medium; typically water in the body
  - Solutes—components in smaller quantities within a solution
- Intracellular fluid—nucleoplasm and cytosol
- Interstitial fluid—fluid on the exterior of the cell

Selective Permeability

- The plasma membrane allows some materials to pass while excluding others
- This permeability influences movement both into and out of the cell

Passive Transport Processes

- Diffusion
  - Particles tend to distribute themselves evenly within a solution
  - Movement is from high concentration to low concentration, or down a concentration gradient
Passive Transport Processes

- Types of diffusion
  - Simple diffusion
    - An unassisted process
    - Solutes are lipid-soluble materials or small enough to pass through membrane pores

- Osmosis—simple diffusion of water
  - Highly polar water molecules easily cross the plasma membrane through aquaporins

- Facilitated diffusion
  - Substances require a protein carrier for passive transport
  - Transports lipid-insoluble and large substances
Passive Transport Processes

Filtration
- Water and solutes are forced through a membrane by fluid, or hydrostatic pressure
- A pressure gradient must exist
- Solute-containing fluid is pushed from a high-pressure area to a lower pressure area

Active Transport Processes

- Substances are transported that are unable to pass by diffusion
  - Substances may be too large
  - Substances may not be able to dissolve in the fat core of the membrane
  - Substances may have to move against a concentration gradient
  - ATP is used for transport

Two common forms of active transport
- Active transport (solute pumping)
- Vesicular transport
  - Exocytosis
  - Endocytosis
    - Phagocytosis
    - Pinocytosis

Active transport (solute pumping)
- Amino acids, some sugars, and ions are transported by protein carriers called solute pumps
- ATP energizes protein carriers
- In most cases, substances are moved against concentration gradients
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Loss of phosphate restores the original conformation of the pump protein. $K^+$ is released to the cytoplasm and $Na^+$ sites are ready to bind $Na^+$ again; the cycle repeats.

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Active Transport Processes
- Vesicular transport
  - Exocytosis
    - Moves materials out of the cell
    - Material is carried in a membranous vesicle
    - Vesicle migrates to plasma membrane
    - Vesicle combines with plasma membrane
    - Material is emptied to the outside

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Active Transport Processes: Exocytosis

Slide 19
Active Transport Processes: Exocytosis

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Active Transport Processes
- Vesicular transport (continued)
  - Endocytosis
    - Extracellular substances are engulfed by being enclosed in a membranous vesicle
  - Types of endocytosis
    - Phagocytosis—“cell eating”
    - Pinocytosis—“cell drinking”
Active Transport Processes: Endocytosis

(a) Vesicle containing ingested material
(b) Vesicle fusing with lysosome for digestion
(c) Release of contents to cytoplasm
(d) Vesicle transport to plasma membrane and exocytosis of vesicle contents

Pit

Ingested substance

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