

Biochemistry
Cell Biology
Transport

What is physiology?

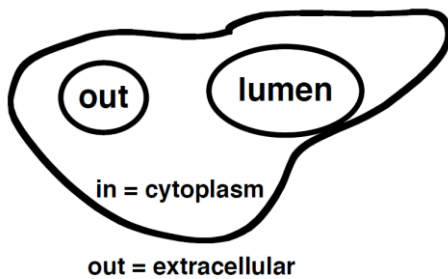
Thousands of reactions in an organism are required for life. Physiology can be considered to be the study of the principles of biological design or biological problem solving.

Goals of regulation

homeostasis-maintain proper reactions (pH, temperature, concentration)

regulation for change, stress response, control for survival

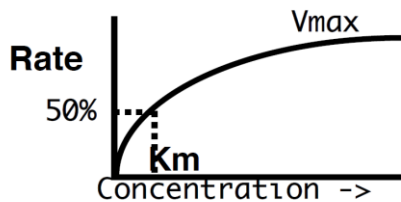
positive/negative feedback



Enzymes

basis of specificity required for life: enzyme-substrate (concentration vs. rate graph)

Lowers activation energy



Cell organelles

Plasma membrane-movement of molecules in and out of cell, cell-cell signaling, cell adhesion

Mitochondria-double membrane, generate ATP by oxidation of glucose or fatty acids

Lysosomes-acidic, degrades material internalized by cell and worn out membranes and organelles

Nuclear envelope-double membrane, outer membrane contiguous with rough ER

Nucleolus-inside nucleus, where rRNA is made

Nucleus-chromatin (DNA and proteins, site of mRNA and tRNA synthesis)

Smooth ER-synthesizes lipids and detoxifies hydrophobic compounds

Rough ER-synthesizes, processes, and sorts secreted proteins

Golgi-sorts secreted proteins

Cytoskeleton-forms networks that support cellular membranes, organize organelles, and participate in cell movement

Extracellular space-body liquids: blood, lymph, interstitial fluid

Extracellular matrix-secreted material

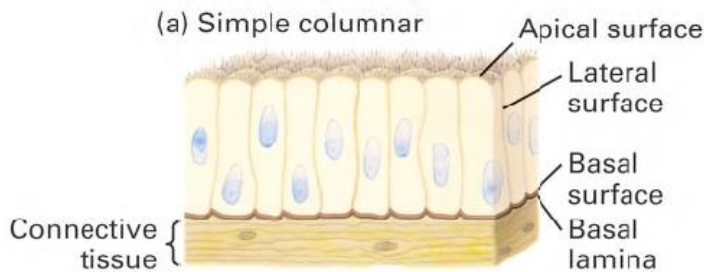
Everything in the body is polarized (visual receptors, lumen walls of organs)

Basal-faces bloodstream

Apical-other side, lumen

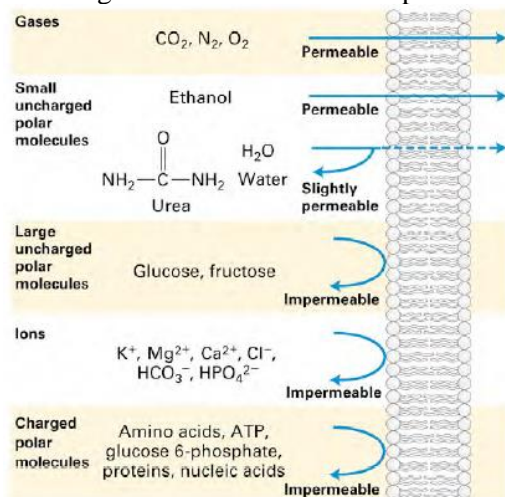
Epithelium-covers free surfaces of the body (skin, esophagus, stomach), protection, sensory reception, transport

Basal lamina-semipermeable filter and cell barrier, scaffold for repair of damage



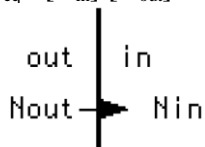
Transmembrane Transport

Most biological membranes are semipermeable.

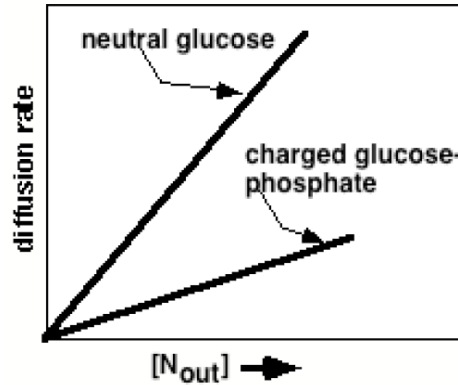


Diffusion-motion due to thermal kinetic energy, solutes move from high concentration to low concentration

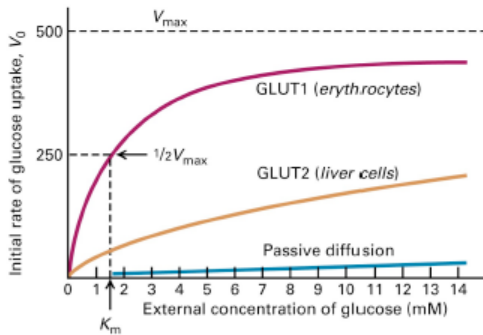
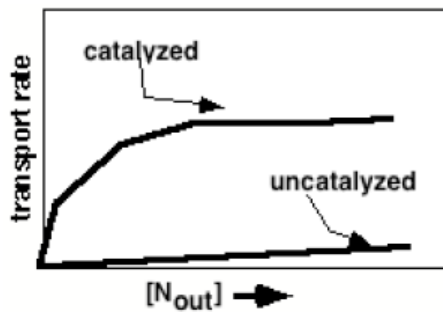
$$K_{eq} = \frac{[N_{in}]}{[N_{out}]} = 1 \text{ at equilibrium, } <1 \text{ goes in, } >1 \text{ goes out}$$



Which line represents neutral glucose? Which is charged glucose-phosphate?

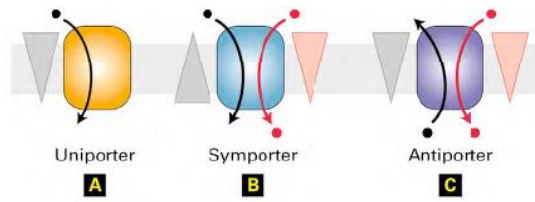


Rates too slow to sustain life.
Nature's solution: Transport proteins



Mechanisms of transport

1. Passive diffusion down conc gradient: $[N_{out}] > [N_{in}]$, not facilitated, rate depends on structure of N
2. Facilitated diffusion down gradient: $[N_{out}] > [N_{in}]$, structure of N, too slow
Osmosis: movement of a solute across a semipermeable membrane
hypertonic-higher concentration of solutes
hypotonic-lower concentration of solutes
3. Active transport against gradient: $[N_{out}] < [N_{in}]$, uses energy in the form of ATP
4. Coupled transport
 - a. Symport-same direction
 - b. Antiport (exchange)



Sources of energy for transport

1. Light driven electrochemical gradient-chloroplasts
2. Breaking “high energy bonds”: direct coupling through transporter

