Ch 8 CELL MEMBRANE

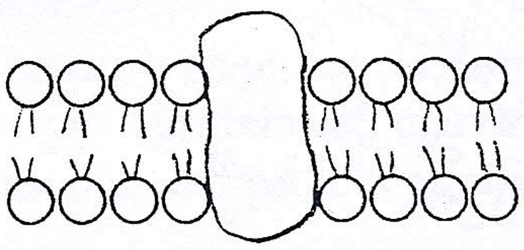
- Selectively Permeable Barrier
- Communicating with Adjacent Cells
- Maintains a Consistent Internal Environment

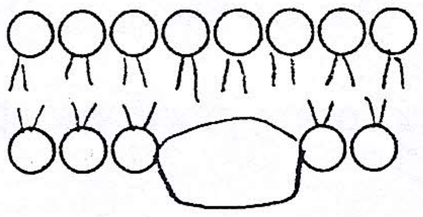
LIPIDS (phospholipids, cholesterol)
PROTEINS (integral, peripheral)
CARBOHYDRATES (glycolipids, glycoproteins)

Fluid Mosaic Model

Fluid : Lipids move laterally, rarely "flip flop"
Cholesterols help stablize membrane at 37°C (body temp) and they help make the membrane less fluid (restrains phospholipid movement). Also lowers the temperature required for the membranes to solidify.
Note: If a membrane solidifies, its permeability changes and the enzymes become deactivated.

Mosaic: Collage of different embedded proteins

1. Integral proteins  goes through the membrane

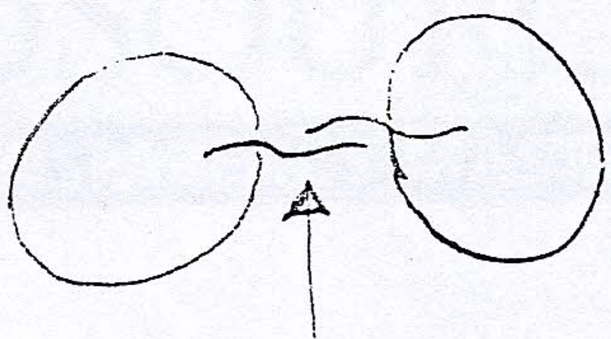
2. Peripheral Proteins  attached to membrane surface

Carbohydrates: Cell Markers
Found on exterior, Cell-Cell recognition and helps sort cells into tissues in embryos. Basis of rejecting foreign cells → transplants

Oligosaccharides oligo "few" short polysaccharide
Glycolipids → covalently bonded to lipid
Glycoproteins → covalently bonded to protein

The carbohydrate of some glycolipids changes when a cell becomes cancerous. This change may allow white blood cells to target the cancer cells for destruction.

Cell adhesion involves recognition proteins. Ex: Take a sponge → strain thru a fine mesh screen. In a few hours → cells reaggregate into a sponge



Cell Adhesion

Protein binding between same proteins – homotypic
Protein binding between two different proteins – heterotypic

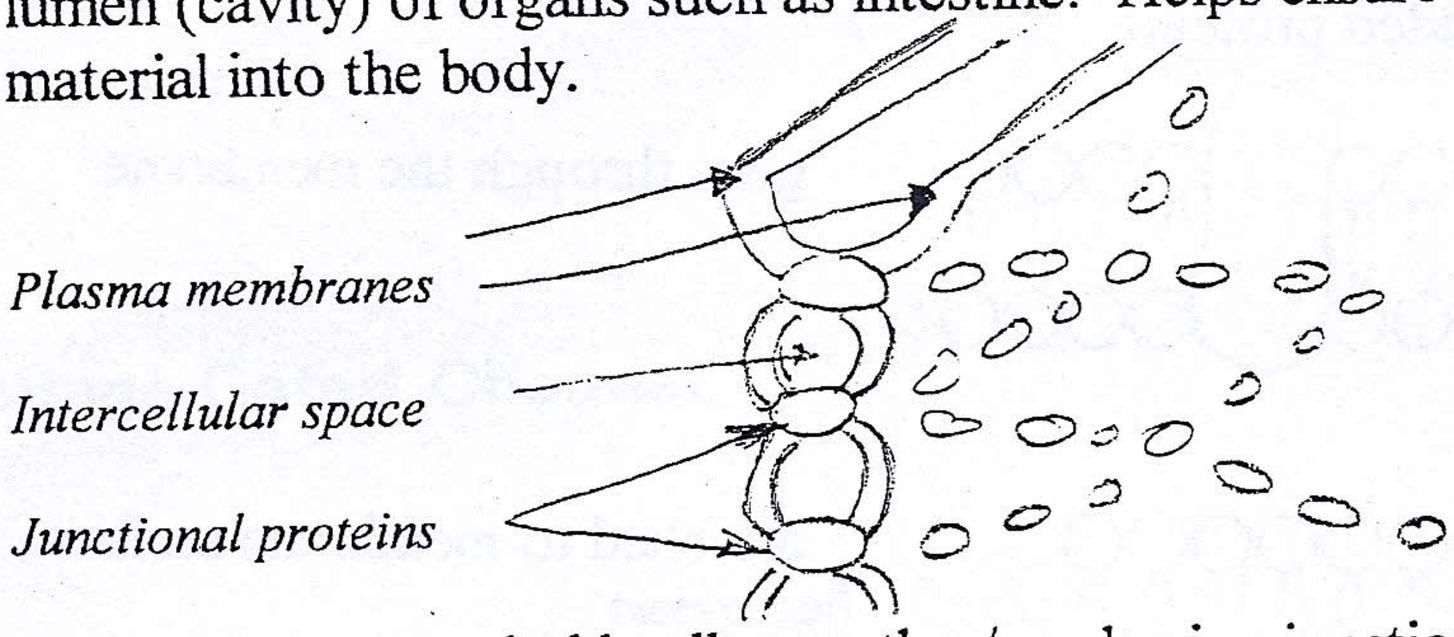
Ex: When mammalian sperm meets the egg, different proteins on the two types of cells have complimentary binding surfaces.

<u>Intracellular Junctions</u> The many cells of an animal or plant are integrated into one functional organism. Neighboring cells often adhere, interact, and communicate thru special patches of direct physical contact.

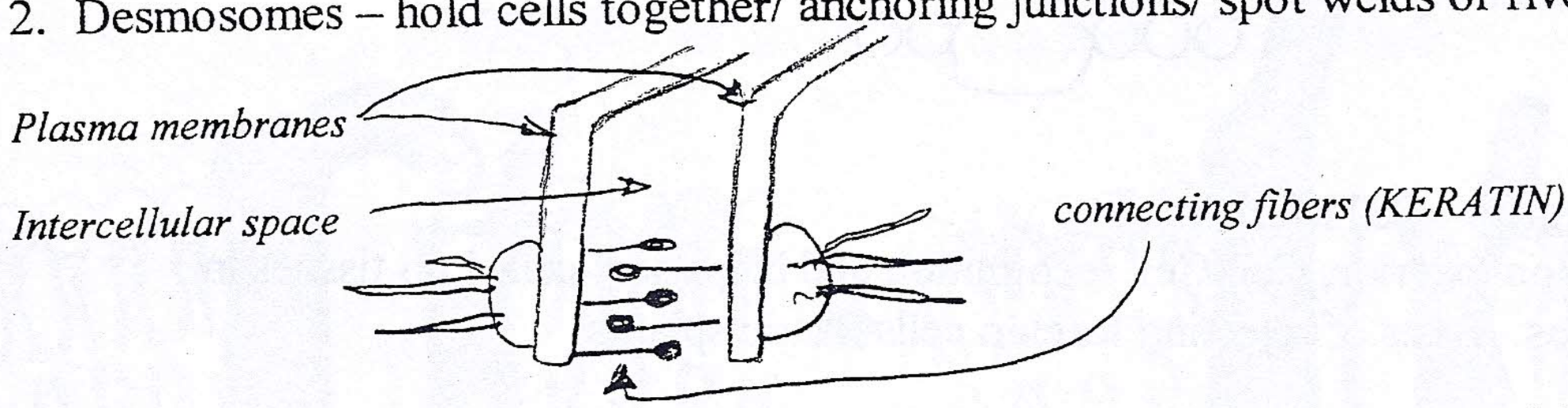
The walls of plants are perforated with channels called <u>plasmodesmata</u> through which strands of cytoplasm connect living contents of adjacent cells.

In animals, 3 types of intracellular junctions:

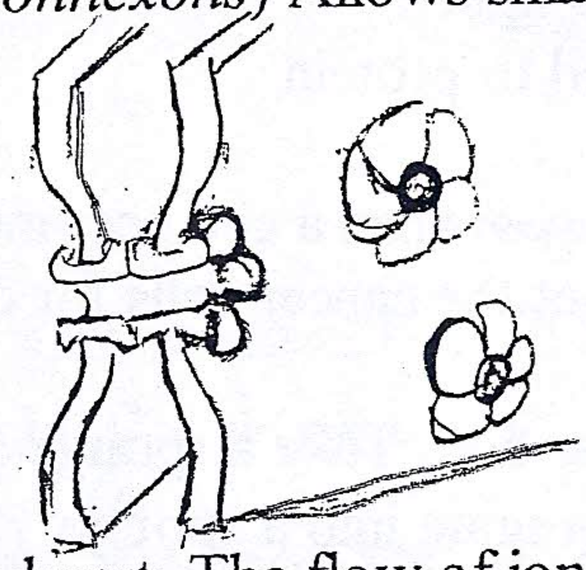
1. Tight Junctions – seals tissues and prevents leaks found in the region surrounding the lumen (cavity) of organs such as intestine. Helps ensure the directional movement of material into the body.



2. Desmosomes – hold cells together/ anchoring junctions/ spot welds or rivets



3. Gap Junctions – cytoplasmic channels between neighboring cells – special proteins surrounding each pore (*connexons*) Allows small signal molecules or ions to pass between cells.

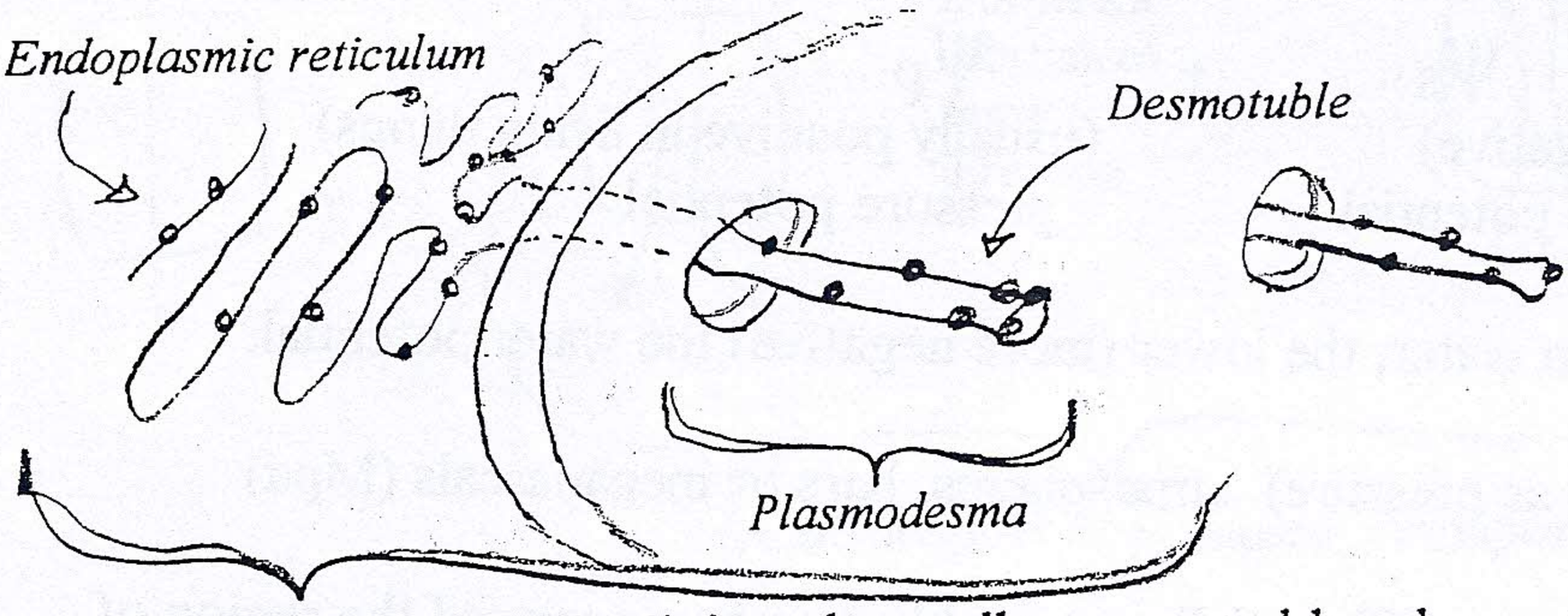


Channels facilitate communication between cells

Ex: Muscle tissue of the heart. The flow of ions through gap junctions coordinates the contractions of the cells

Animal embryos have lots of gap junctions for cell-cell communication essential for development.

Plasmodesmata → plants have these instead of gap junctions. Fused plasma membrane-lined channels through cell walls (no protein)



Symplast – all the living plant cells connected by plasmodesmata. Plants rely on rapid diffusion through plasmodesmata.

Proteins in the Membrane:

- Do enzymatic activity (metabolic pathways)
- Join cells
- Signal Transduction – accepts chemical messengers such as hormones
- Cell-cell Recognition – glycoprotein cell markers recognized by other cells
- Transport – protein channels and protein pumps

TRANSPORT 7 ways substances can get into or leave the cell

1) BULK FLOW
2) DIFFUSION
3) OSMOSIS
4) FACILITATED DIFFUSION
5) ACTIVE TRANSPORT
6) EXOCYTOSIS
7) ENDOCYTOSIS (3 types: phagocytosis, pinocytosis, receptormediated cytosis)

BULK FLOW – the movement of water in one direction due to a difference in pressure between two locations.

DIFFUSION – movement of molecules from high to low concentration, requires **no energy**.

How fast diffusion occurs depends on:

a. Diameter of molecules or ions
b. Temperature of the solution
c. Electrical charge, if any, of the diffusing material

d. Concentration Gradient (> gradient, the more rapid the diffusion)

OSMOSIS – movernent of water through a semipermeable membrane from an area of high water potential to an area of lower water potential until an equilibrium is reached. **No energy.** Greek letter psi ψ

$$\underset{\text{water potential}}{\psi} = \underset{\text{(negative) solute potential}}{\psi_s} + \underset{\text{(usually positive in living things) pressure potential}}{\psi_p}$$

The more solute dissolved in water, the lower (more negative) the water potential.

Water potential units (same as pressure) atmospheres, bars or megapascals (Mpa)

☆Water always moves across a differentially permeable membrane toward the region of more negative water potential (p698 Figure 36.3)

Osmoregulation- control of water balance

3 types of Osmotic Environments: p139 Figure 8.11

1. Isotonic or isosmotic Same [ ] in and on the outside of cell. Water flows in and out equally
2. Hypertonic or hyperosmotic – outside of cell has higher solute [ ] Water leaves cell
3. Hypotonic or hyperosmotic – cell has higher solute [ ] inside. Water enters cell. Cell swells, cell may lysis. Causes *turgor pressure* in plants.

FACILITATED DIFFUSION – **no energy**, occurs through transport proteins

Types of transport proteins:

1) Uniport: carries a single molecule across membrane
2) Symport: 2 different molecules at the same time in the same direction
3) Antiport: exchanges 2 molecules by moving them in opposite directions

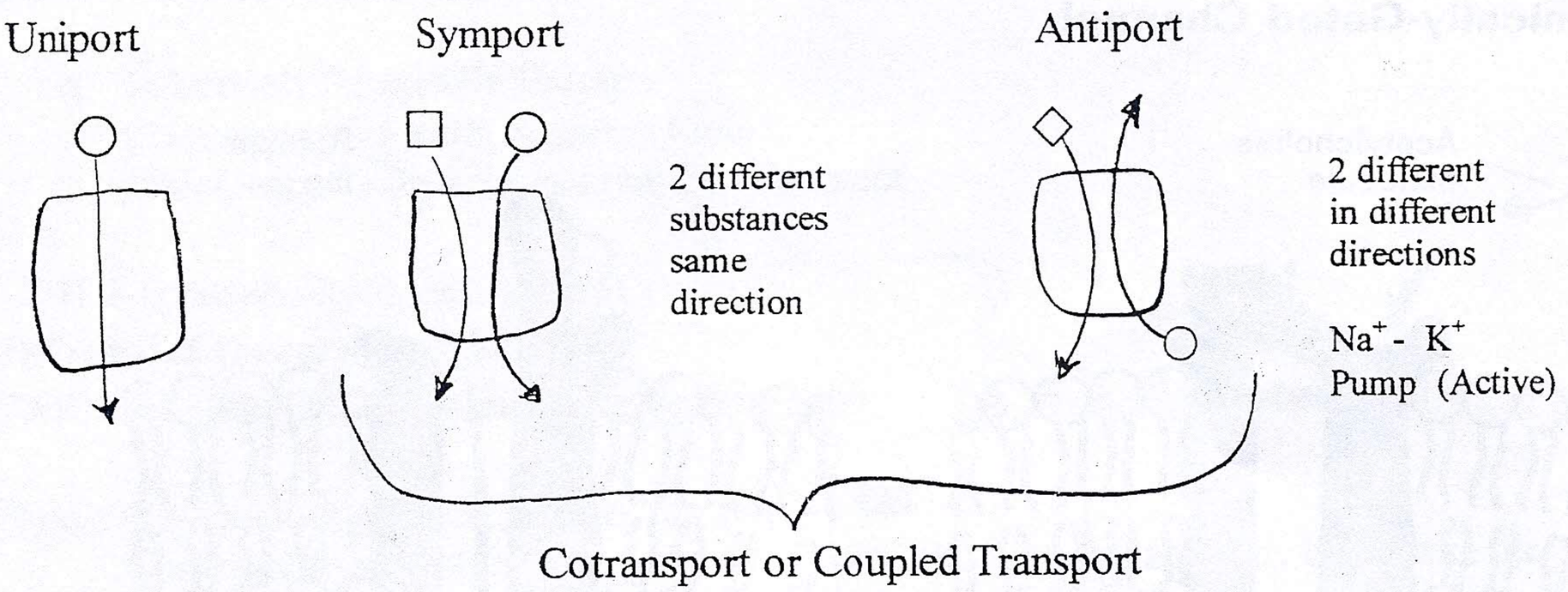
Gated Channels – a stimulus (electrical or chemical) causes them to open or close

ACTIVE TRANSPORT – **requires energy** and transport proteins. **Against** the [ ] **gradient**.

Ex: Sodium – Potassium Pump

Electrogenic pump – generates voltage across a membrane ex: Proton pump

Cotransport - H^+ pumped out, as the outside H^+ difuse back in, they "escort" other substances into the cell.



EXOCYTOSIS – transport vesicle budded from the Golgi apparatus is moved by the cytoskeleton to the plasma membrane

ENDOCYTOSIS (3 types: phagocytosis, pinocytosis, receptormediated cytosis)

1) Phagocyctosis - cell eating Vacuole later fuses with a lysosome (hydrolytic enzymes)

2) Pinocytosis – cell drinking

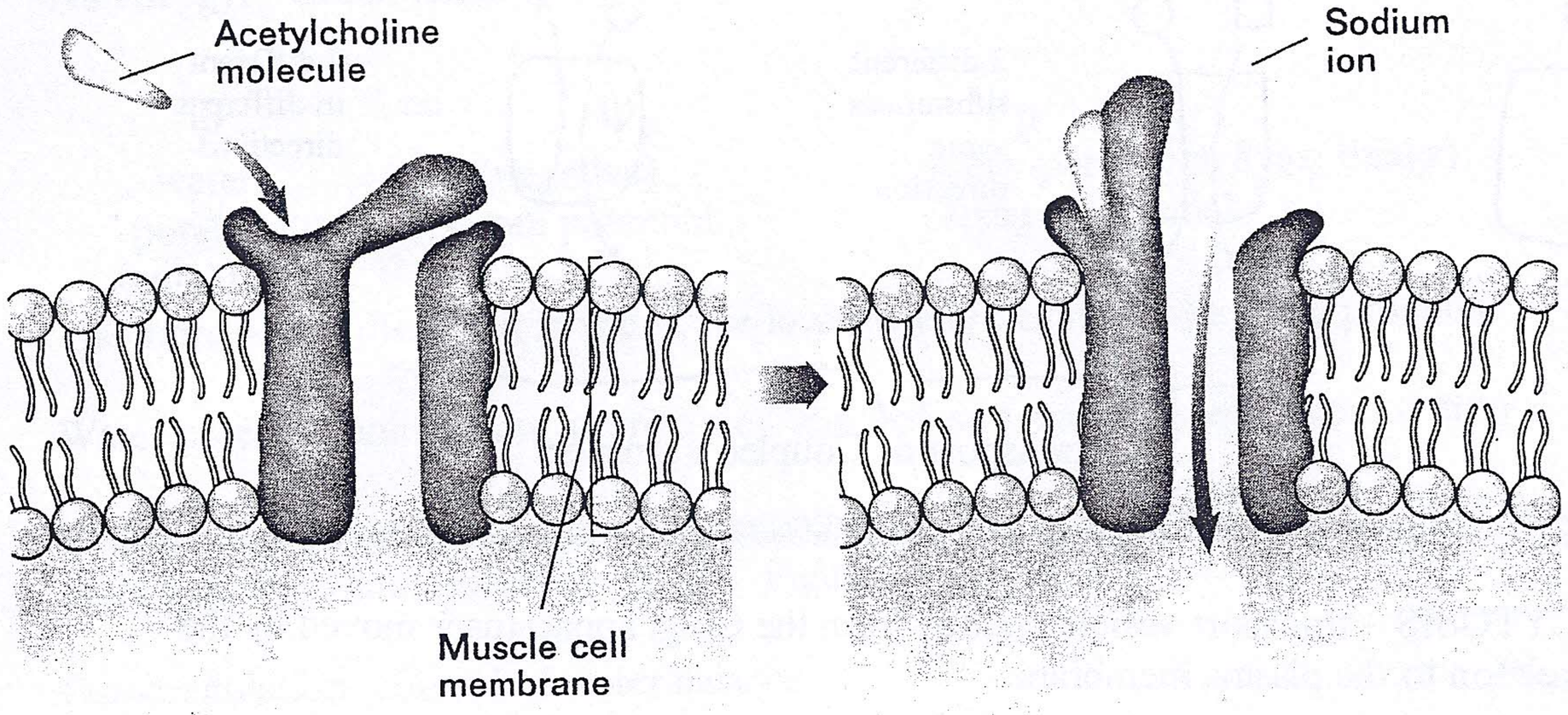
3) Receptormediated endocytosis – coated pits form vesicles when specific molecules (ligand) bind to receptors on the cell surface

   This is the way by which cholesterol is taken up by most mammalian cells. Cholesterol is synthesized in the liver, transported in the blood attached to a protein (LDL) low density lipoprotein. LDL binds to a specific receptor proteins in coated pits. After engulfed by endocyctosis, LDL particle is freed from the receptors. LDL then fuses with lysosome, digested cholesterol is made available for cell use.

HOLT
BioSources
TRANSPARENCY MASTER

Gated Channels 7A

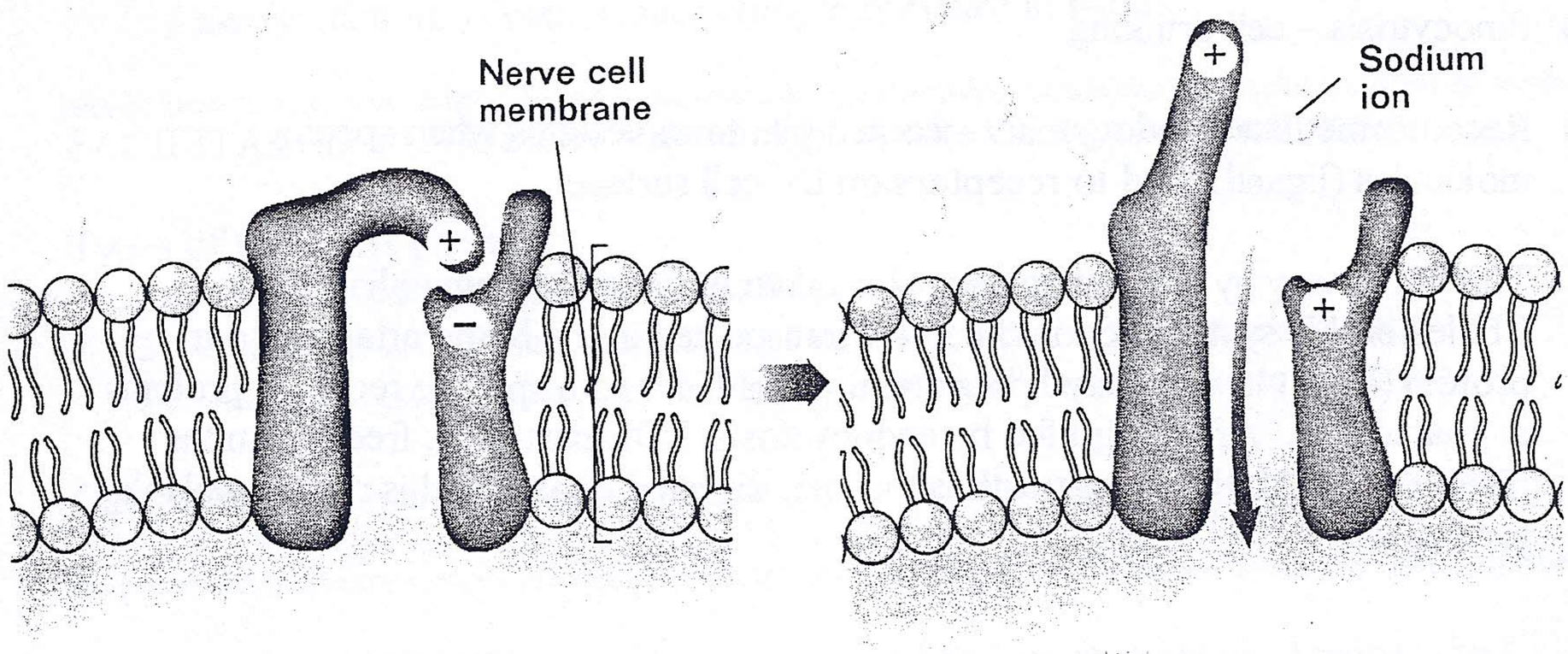
Chemically-Gated Channel



Closed channel

Open channel

Voltage-Gated Channel



Normal state (closed channel)

Nerve signal formation (open channel)

★ Many nerve cells connect to muscle cells and release acetylcholine. Acetylcholine stimulates ions to flow across a cell membrane. This action changes the membrane's voltage and causes muscle cells to contract.

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