

Plasma membrane, compartmentation, transport and imprecisions

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SPAIN



Plasma membrane

Outline

- Plasma membrane

1. Components

2. Structure

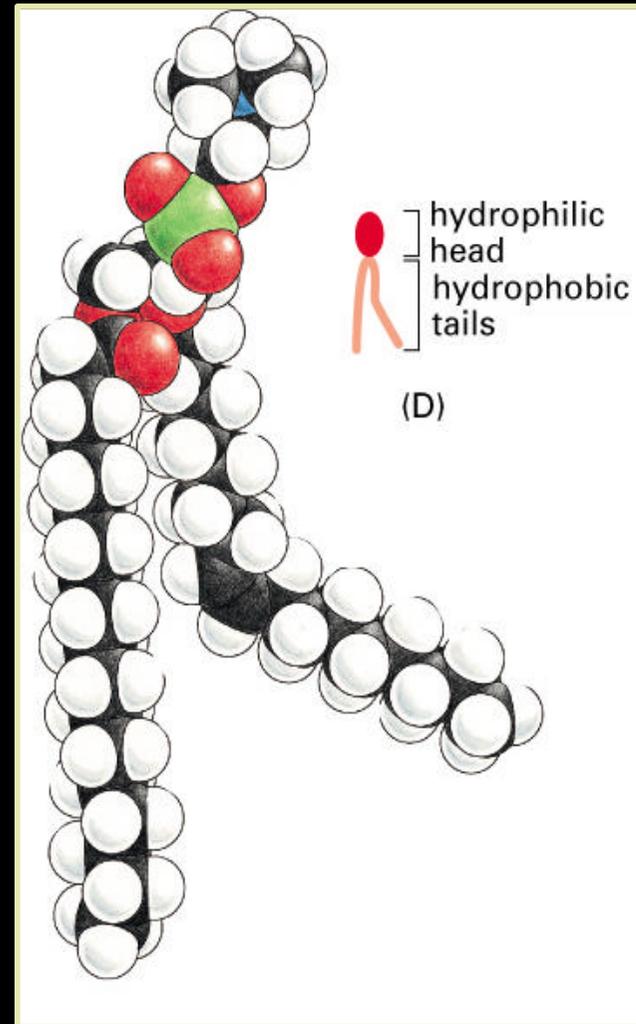
3. Properties

Components

Phospholipids

Polar head group

Fatty acid tails



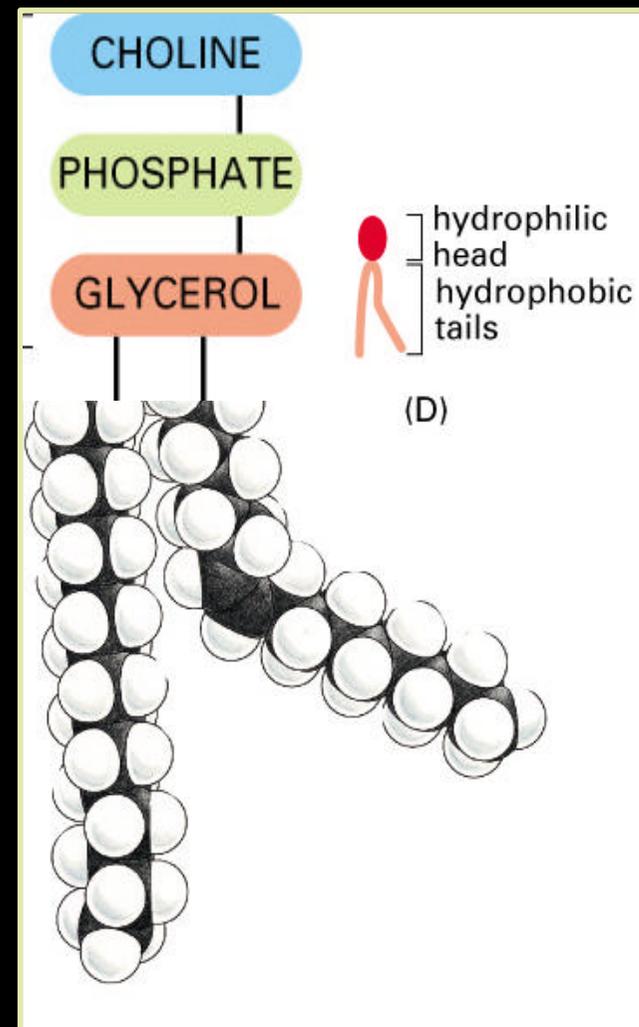
Components

Phospholipids

Polar head group

Hydrophilic

Fatty acid tails

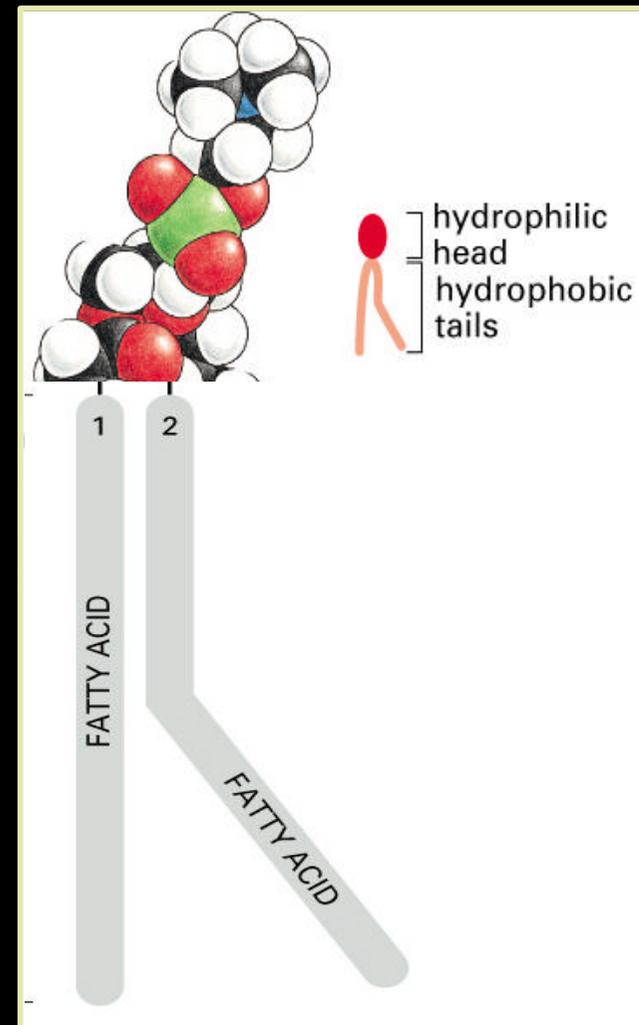
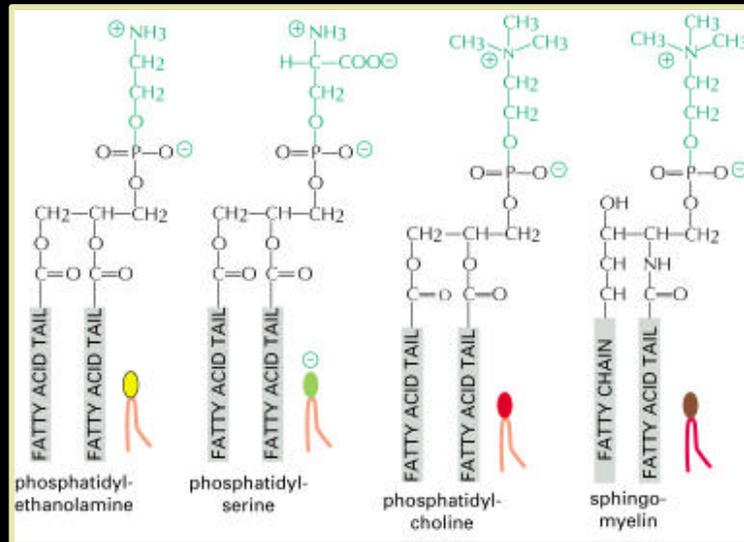


Components

Phospholipids

Polar head group

Fatty acid tails

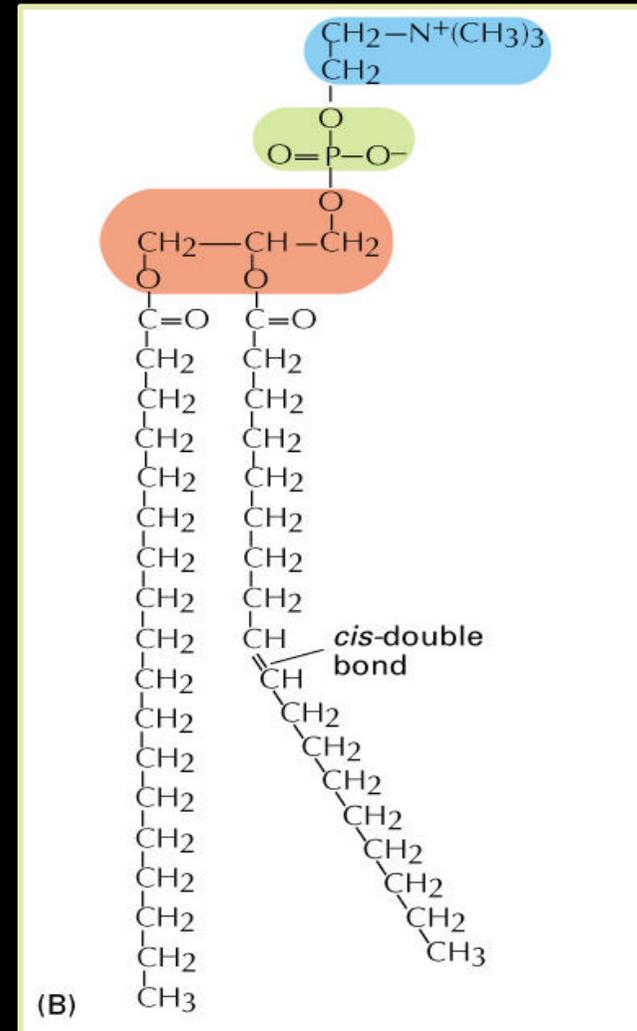
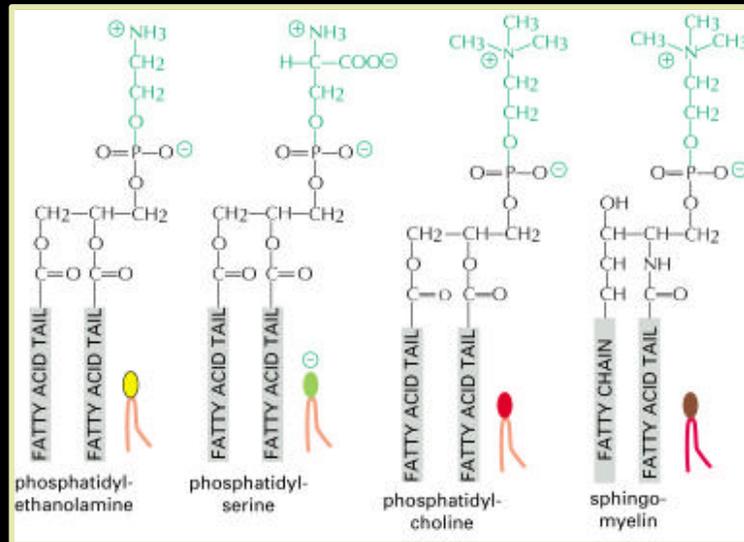


Components

Phospholipids

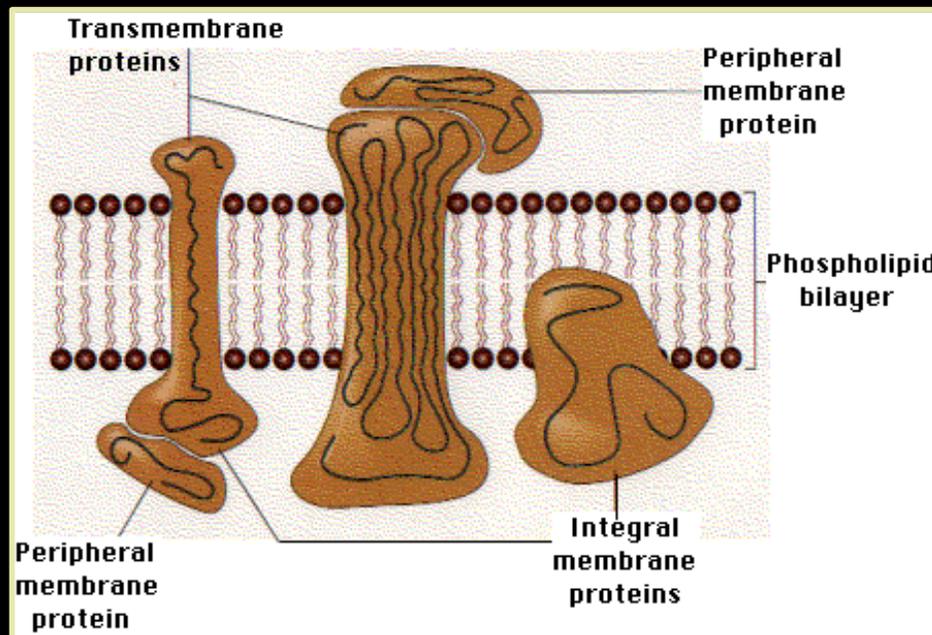
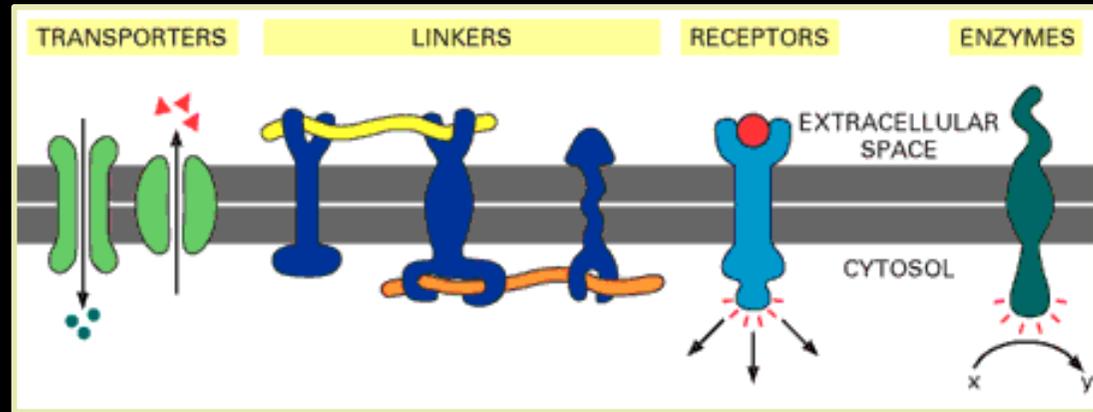
Polar head group

Fatty acid tails



Components

Proteins



50% membrane

Components

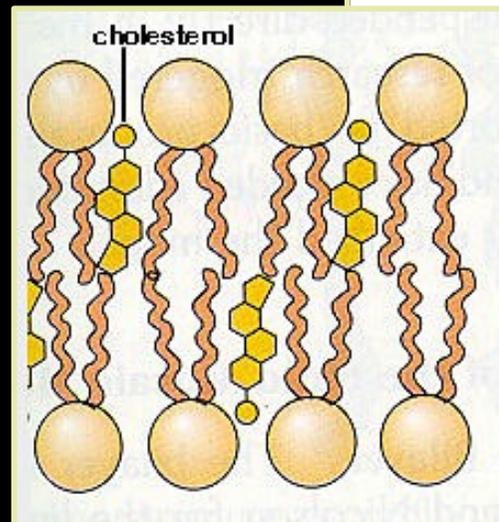
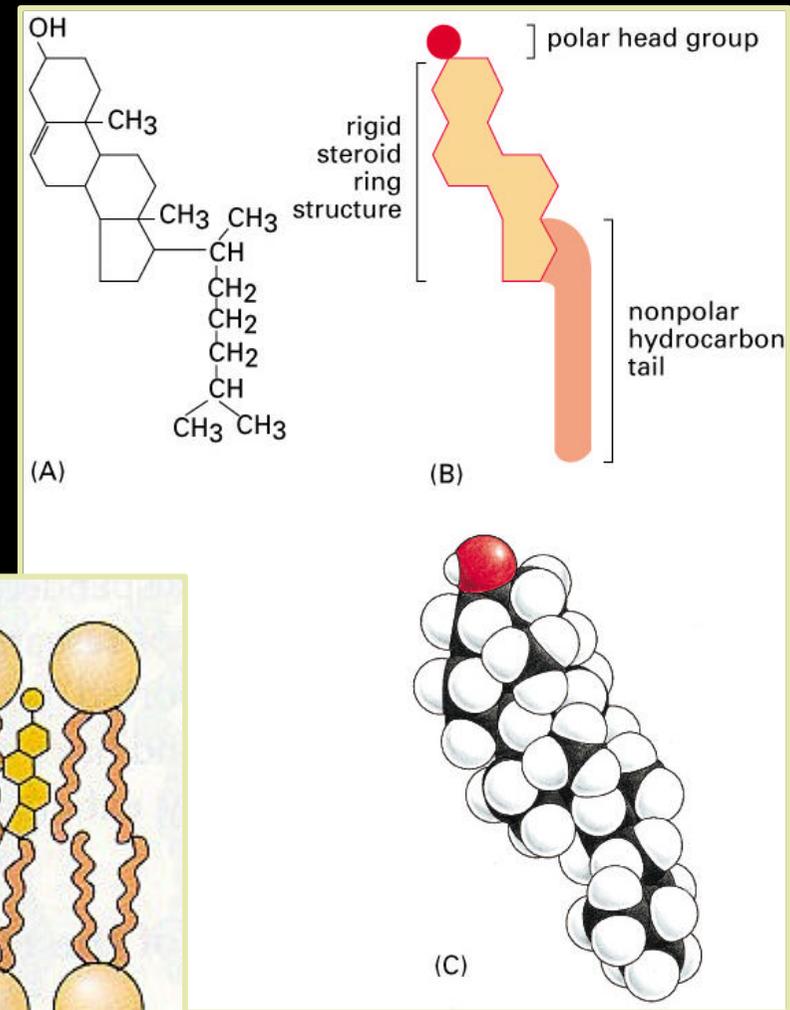
Cholesterol

Fluidity

Mechanical stability

Flexibility

Permeability



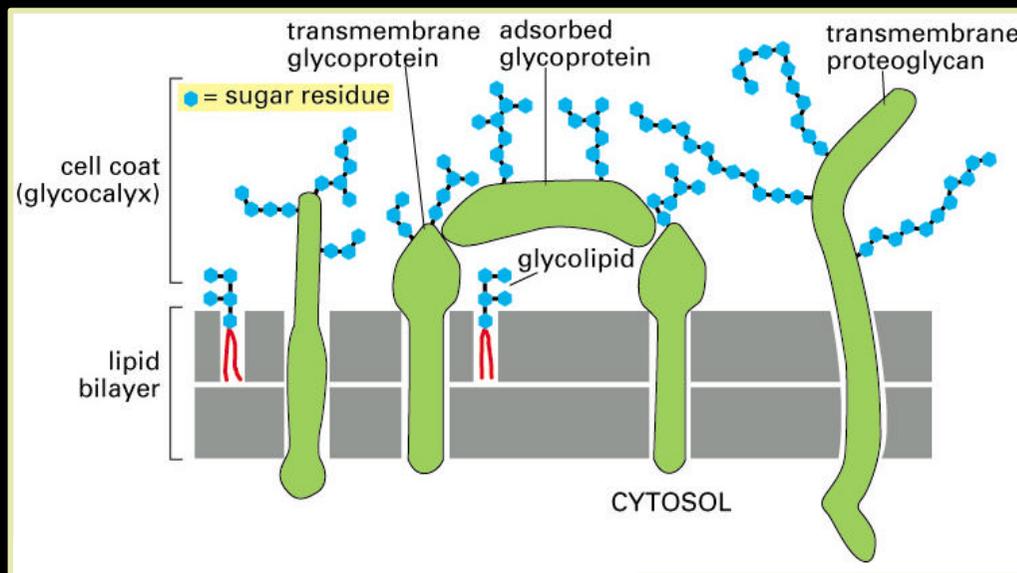
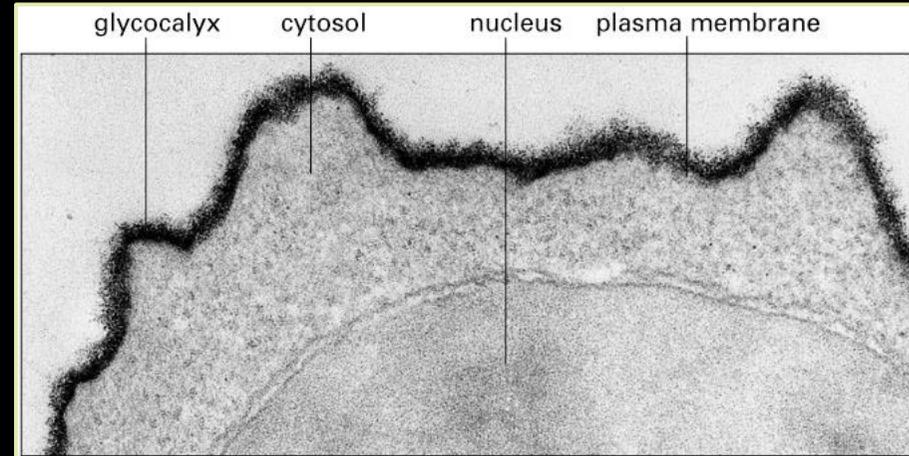
Components

Glycocalyx

Glycolipid

Glycoproteins

Proteoglycans

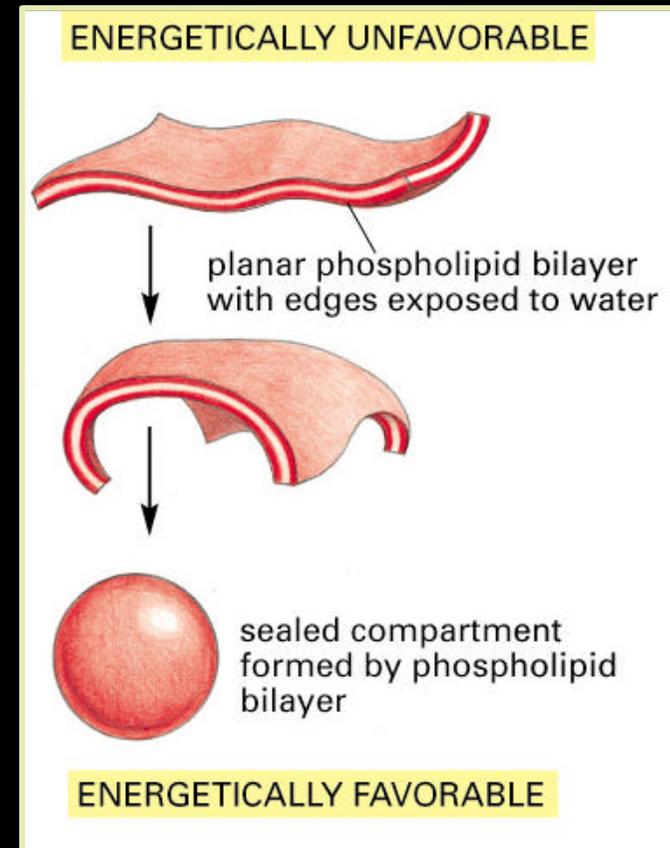
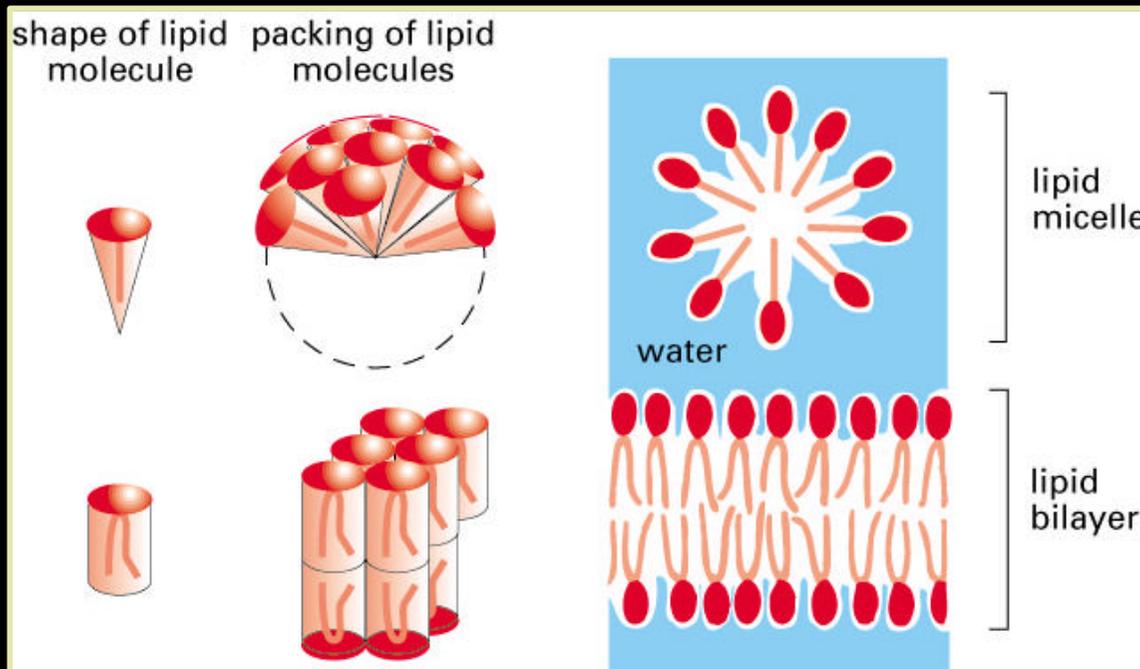


Interacts with environment

Structure

Lipid bilayer

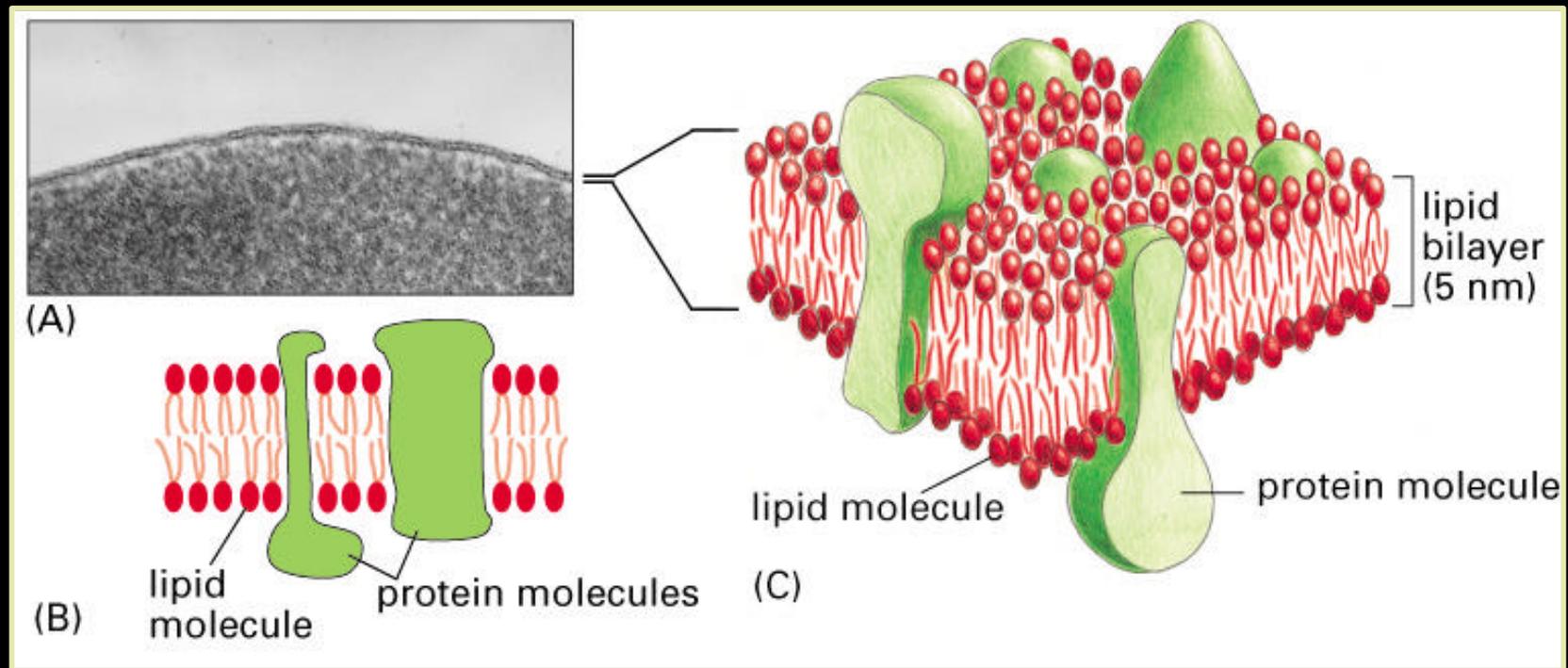
Spontaneous association of phospholipids



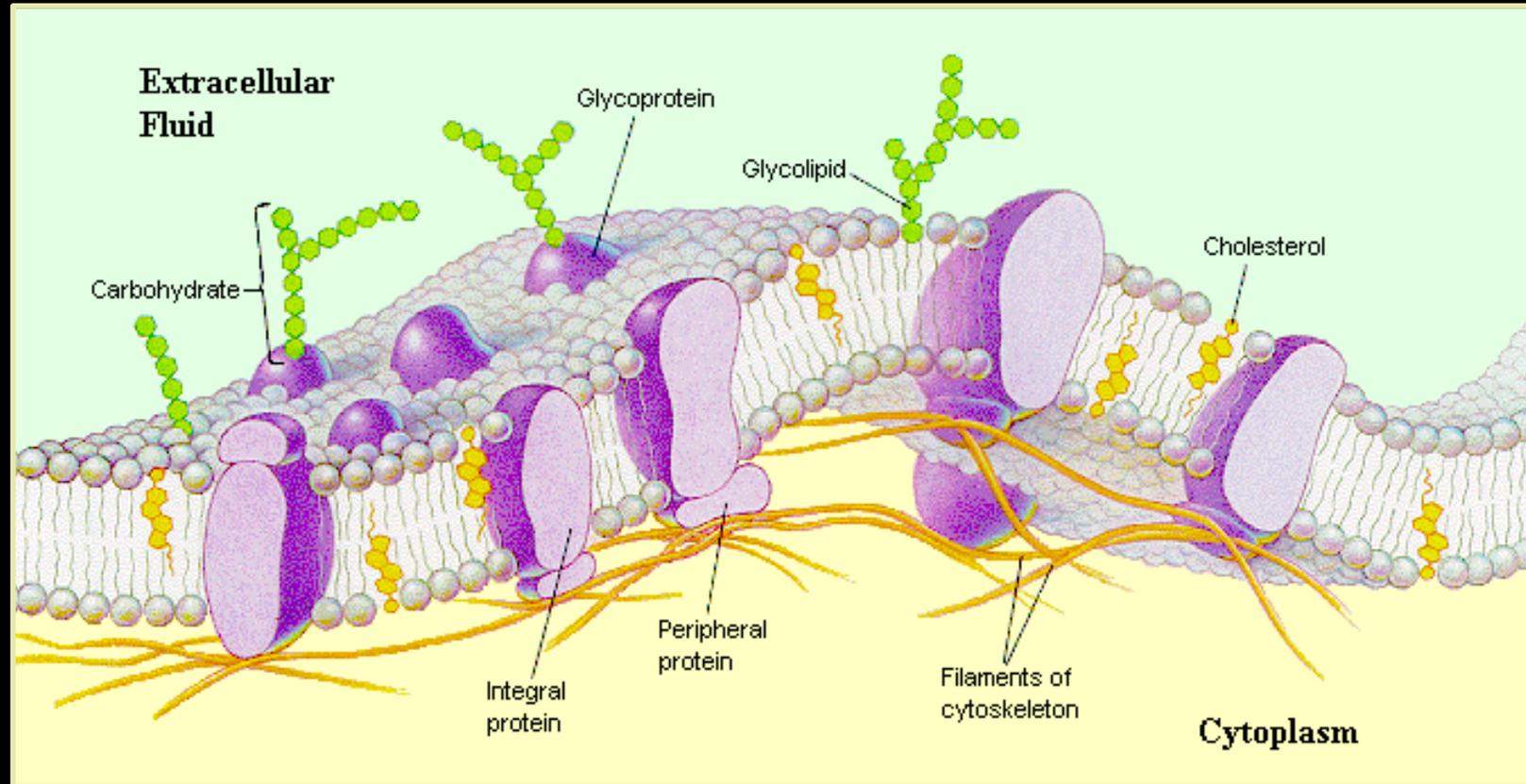
Liposome

Structure

More than phospholipids...



Structure



Much more!

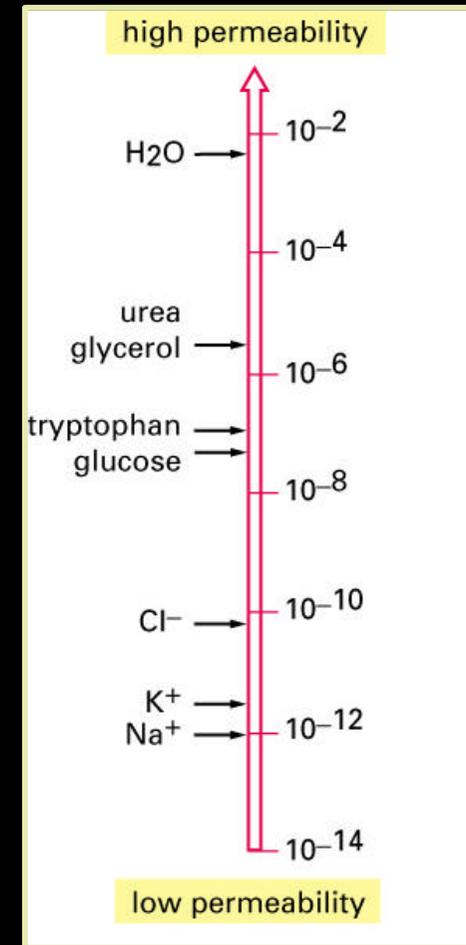
Properties

Highly Selective filters

Permeability

Size

Electrochemical charge



Properties

Control entrance of nutrients and exit of residual products

Endocytosis

Pinocytosis

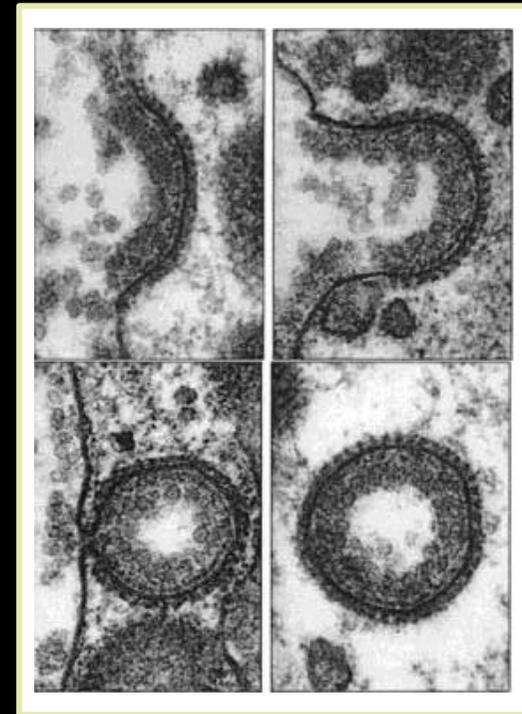
small vesicles
dissolved materials

Fagocytosis, bigger vesicles

microorganisms
big particles

Exocytosis

Excretion
Secretion



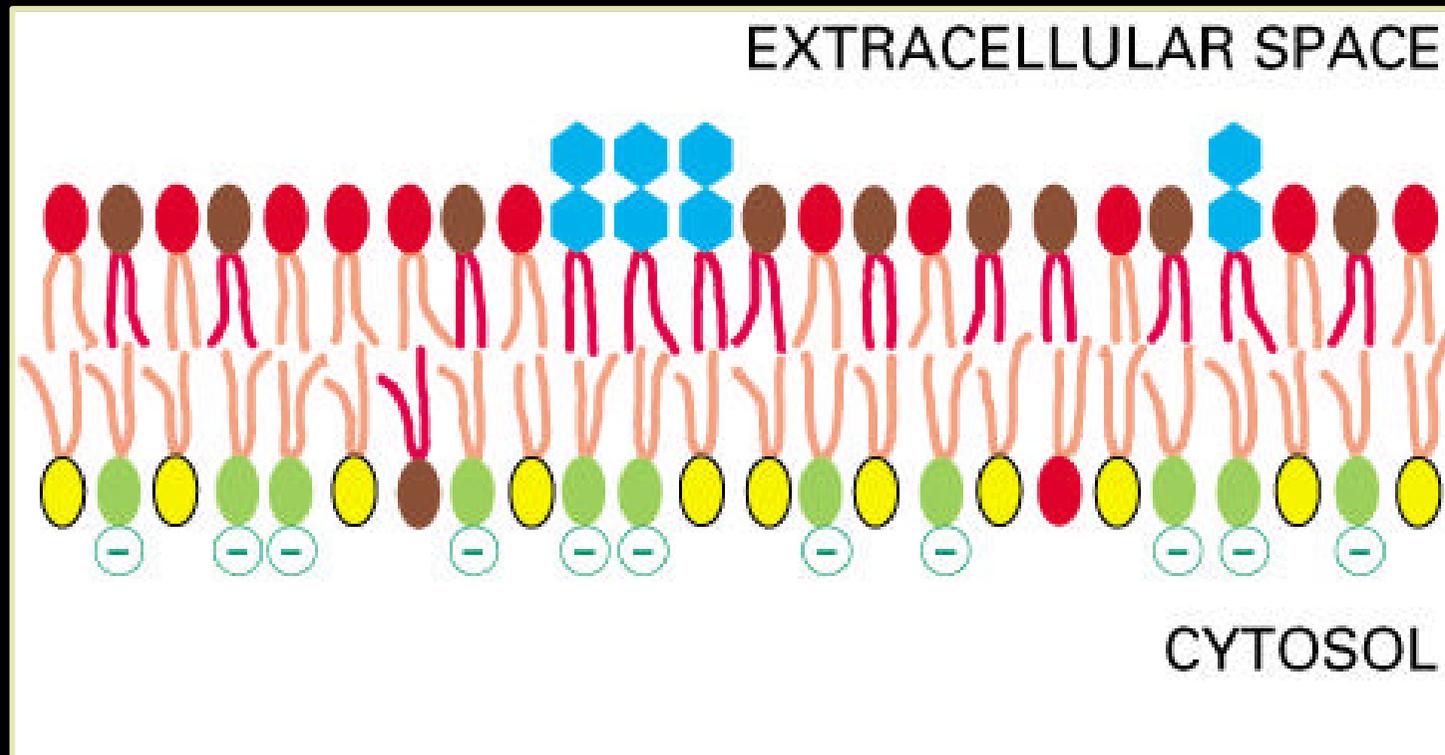
Properties

Generate differences between contents and environment

Mammalian cell	Intracellular mM	Extracellular mM
Na	5/15	145
K	140	5
Mg	0.5	1/2
Ca	0.0001	1/2
Cl	5/15	110

Properties

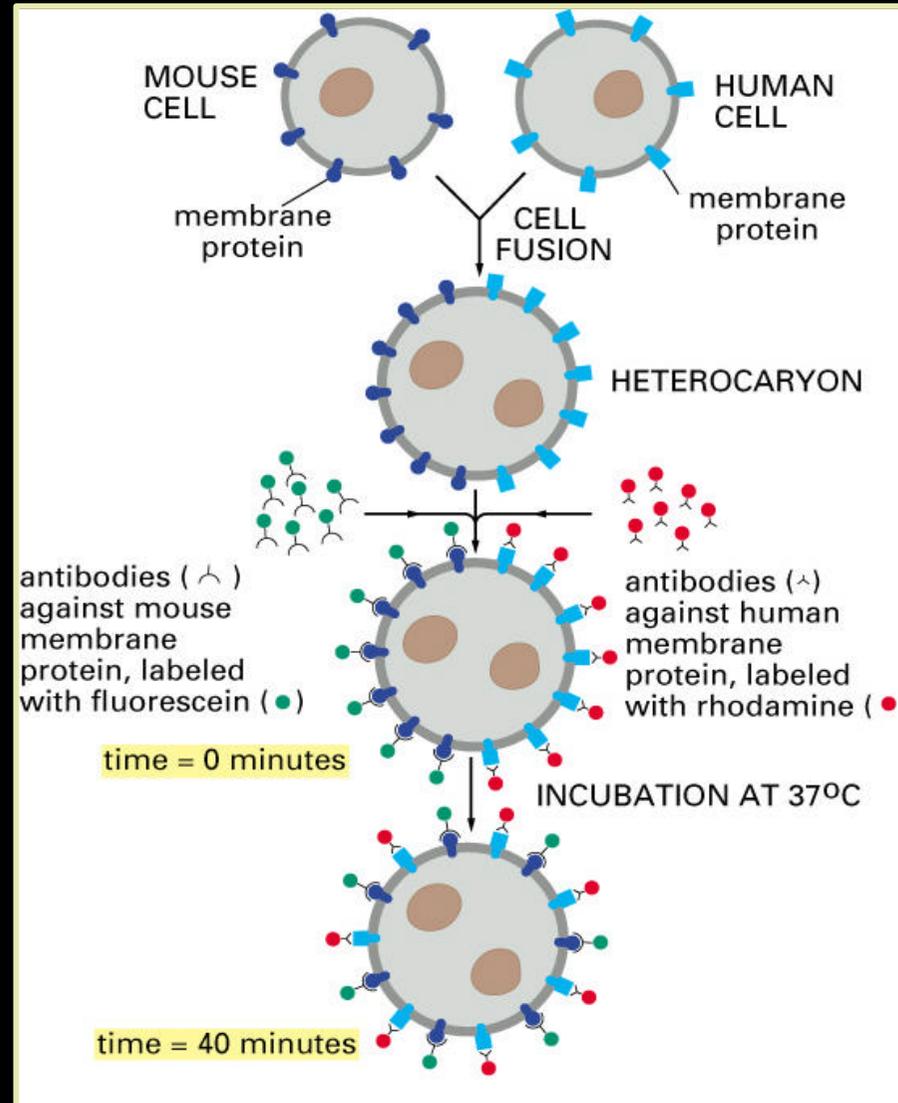
Asymmetry



Properties

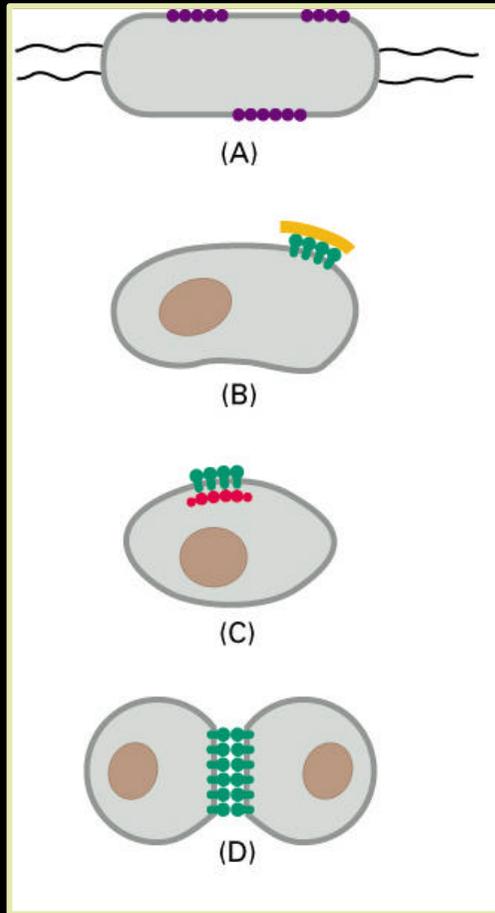
Fluidity

Lateral diffusion

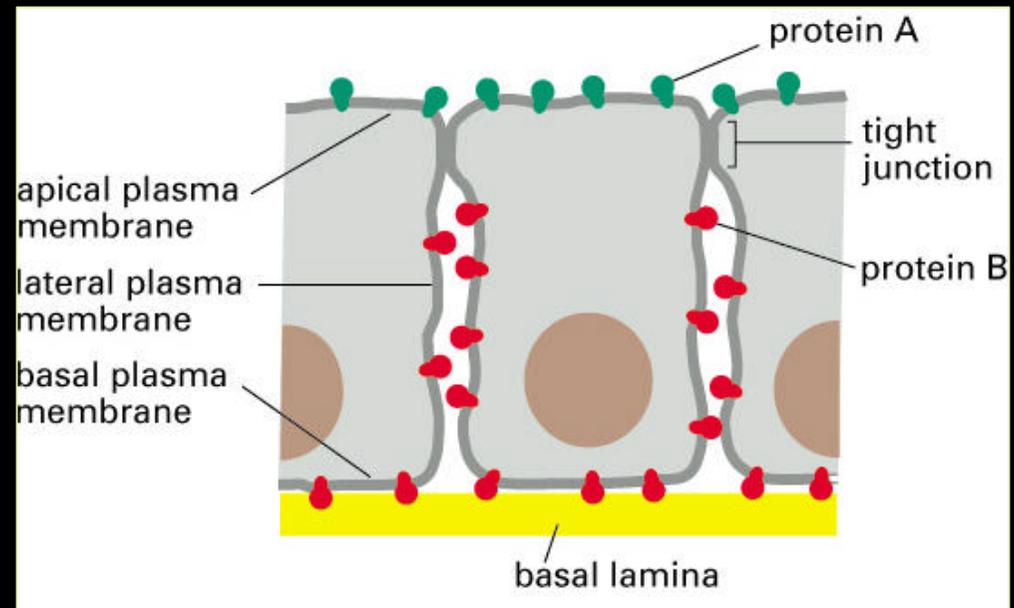


Properties

Fluidity



Restricted lateral mobility



Cytoskeleton

Compartmentation

Outline

- Compartmentation

1. Extracellular space

2. Cytosol

3. Endoplasmatic reticulum

4. Organelles

Compartmentation

Extracellular space

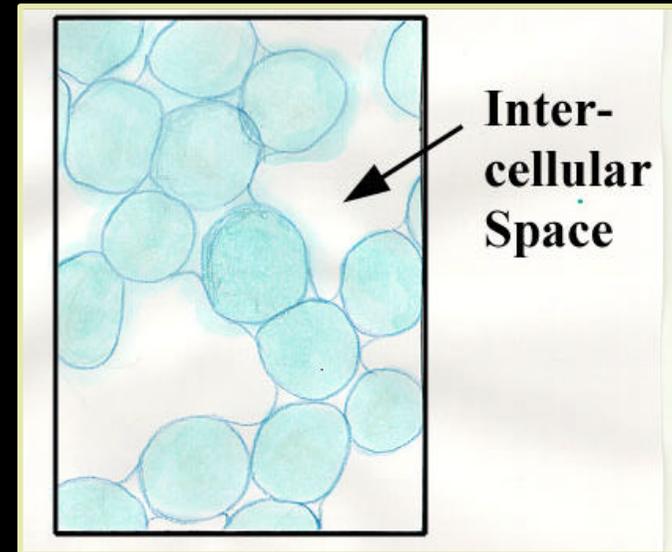
Aqueous

Depends of tissue

Cell external stimulus

Interstitial space between cells

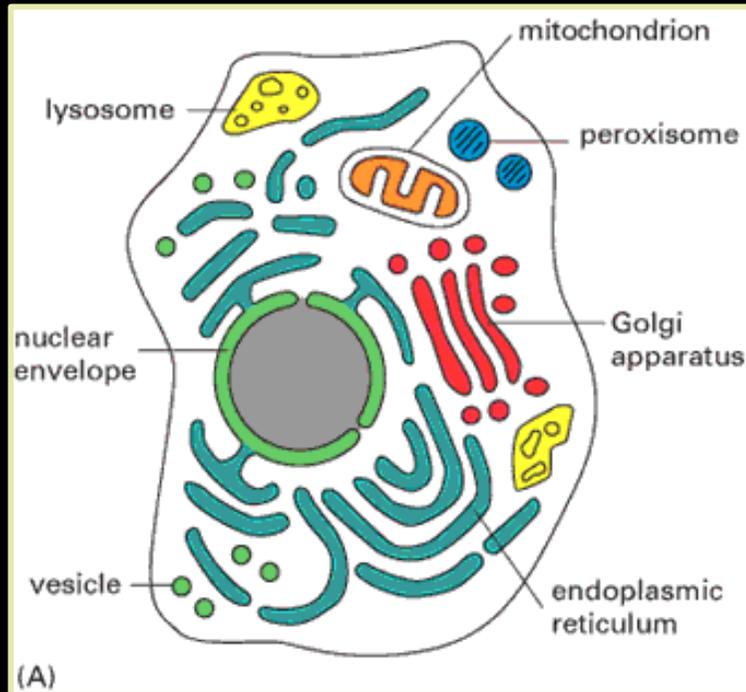
Environment



Compartmentation

Cytosol

Organized by proteic filaments



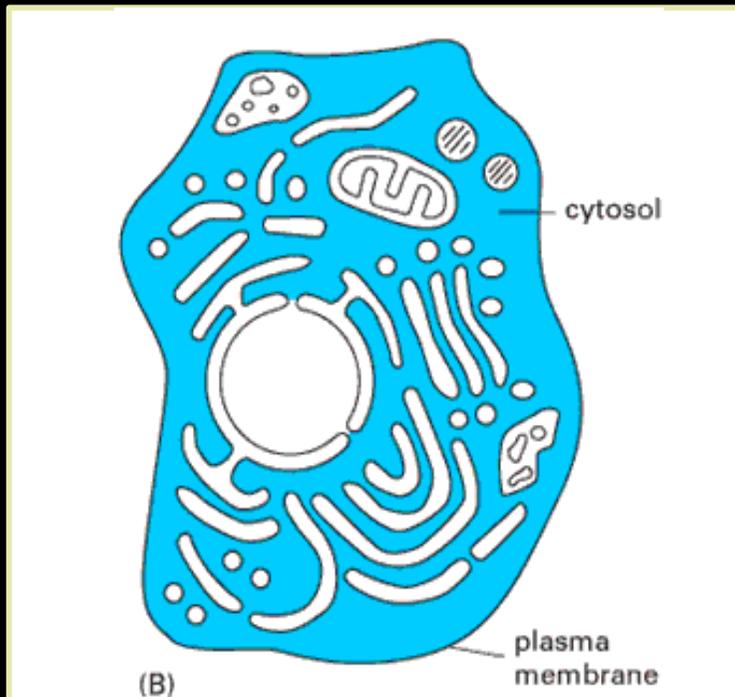
Cytoskeleton

cytoplasmic movements
shape of cell
organization of enzymatic reactions

Compartmentation

Cytosol

Organized by proteic filaments



Cytoskeleton

cytoplasmic movements
shape of cell
organization of enzymatic reactions

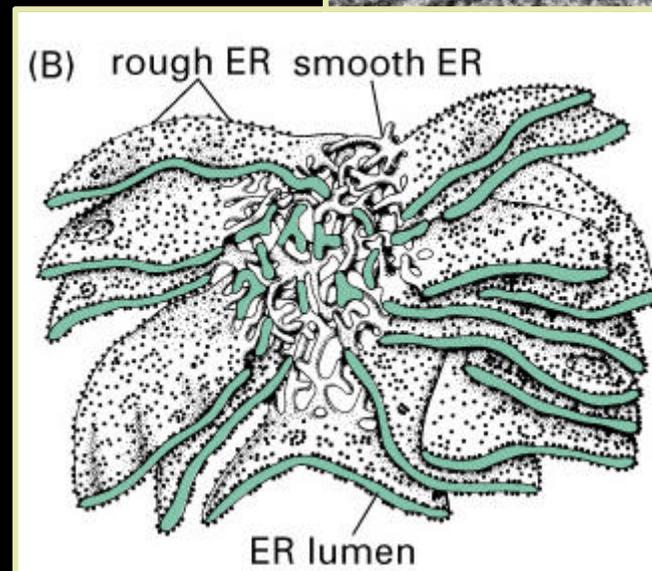
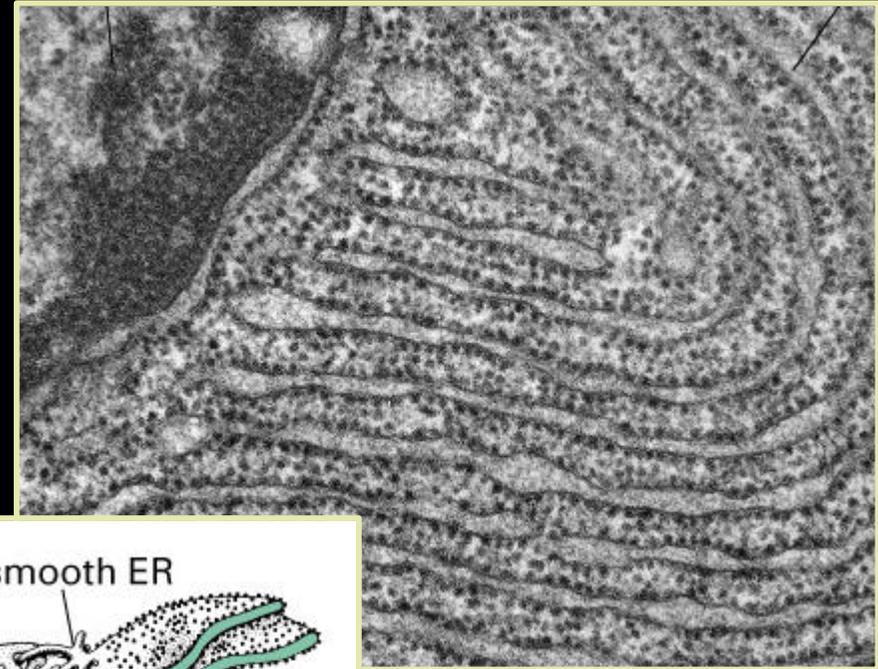
Compartmentation

Endoplasmatic reticulum

Membrane syntesis

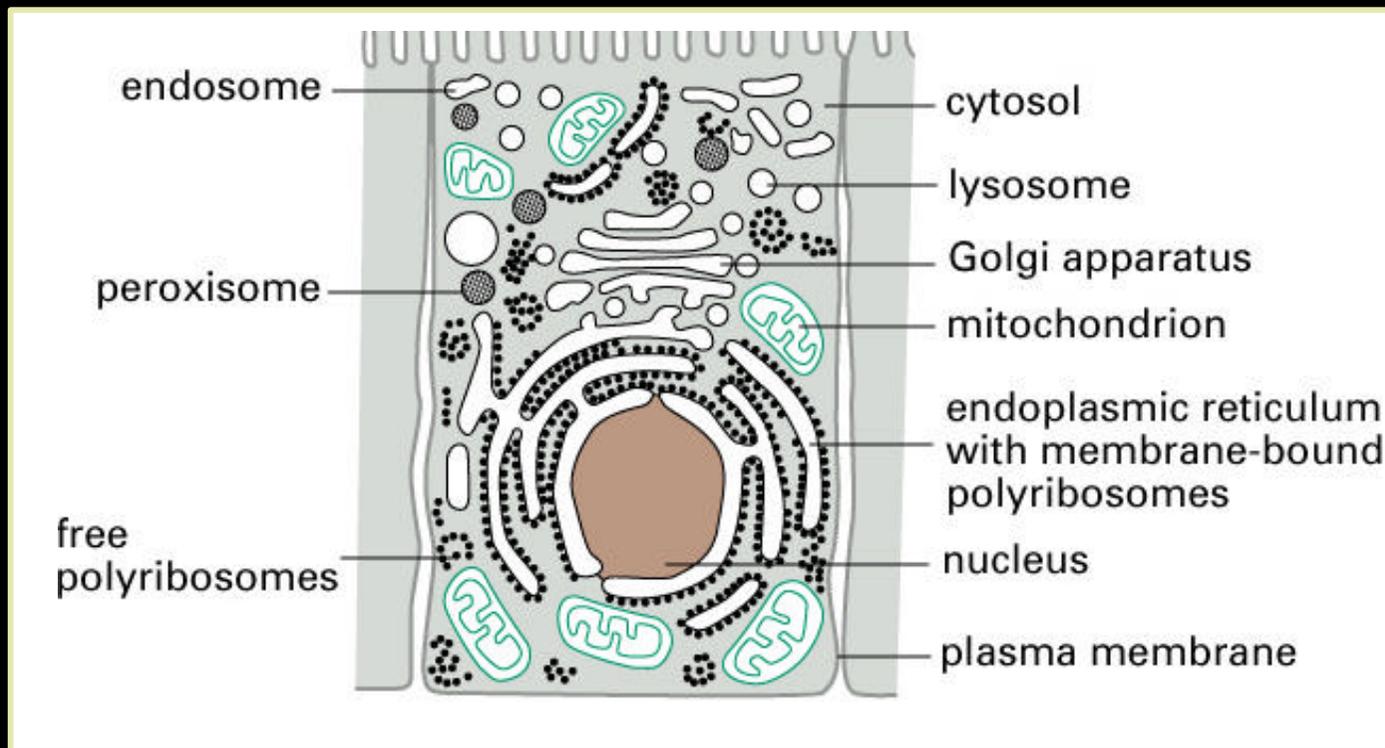
10% cell volume

50% cell membrane



Compartmentation

Organelles



Compartmentation

Hepatocyte	% V	N	%Memb
Cytosol/Plasma membrane	54	1	2
Mitochondria	22	1700	39
Endoplasmatic reticulum	10	1	51
Nucleus	6	1	0.2
Peroxisomes	1	400	0.4
Lysosomes	1	300	0.4
Endosomes	1	200	0.4
Other	5	-	6.6

Transport

Outline

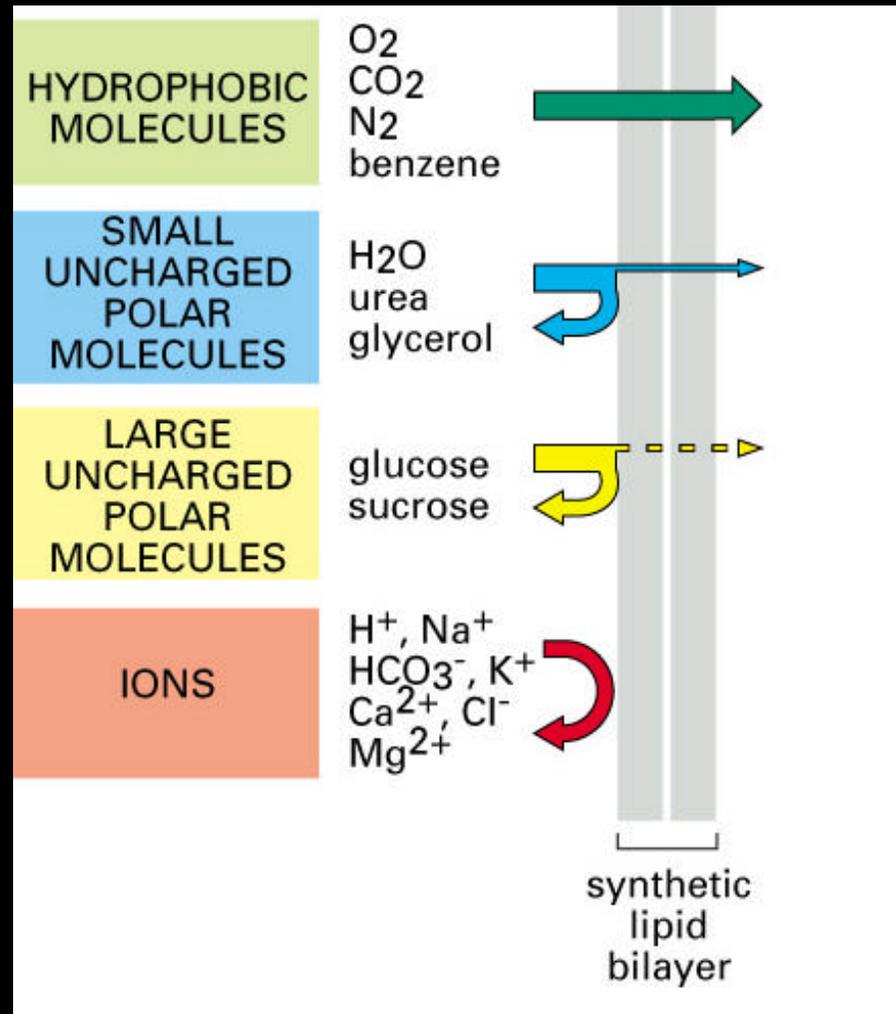
- Transport
 1. Difussion
 2. Passive
 3. Active

Difussion

Polarity

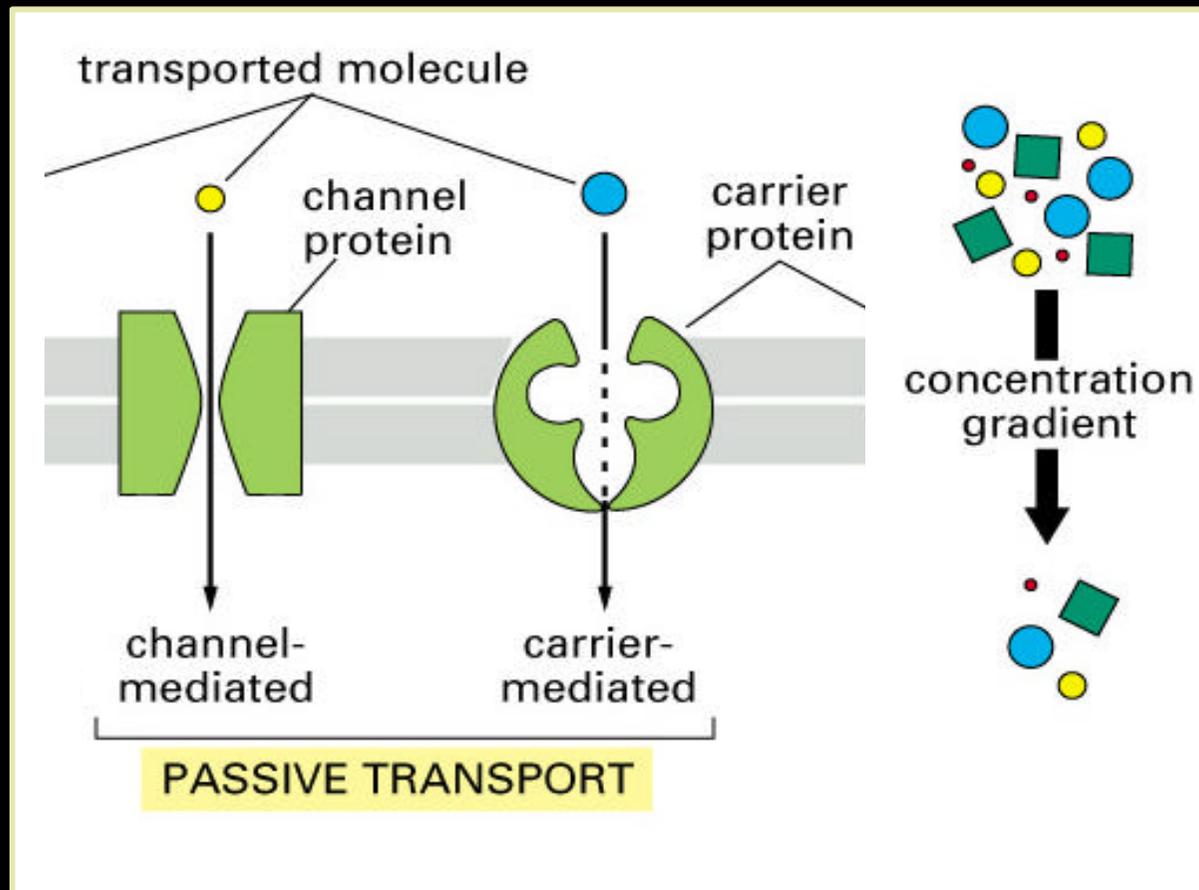
Size

Gradient



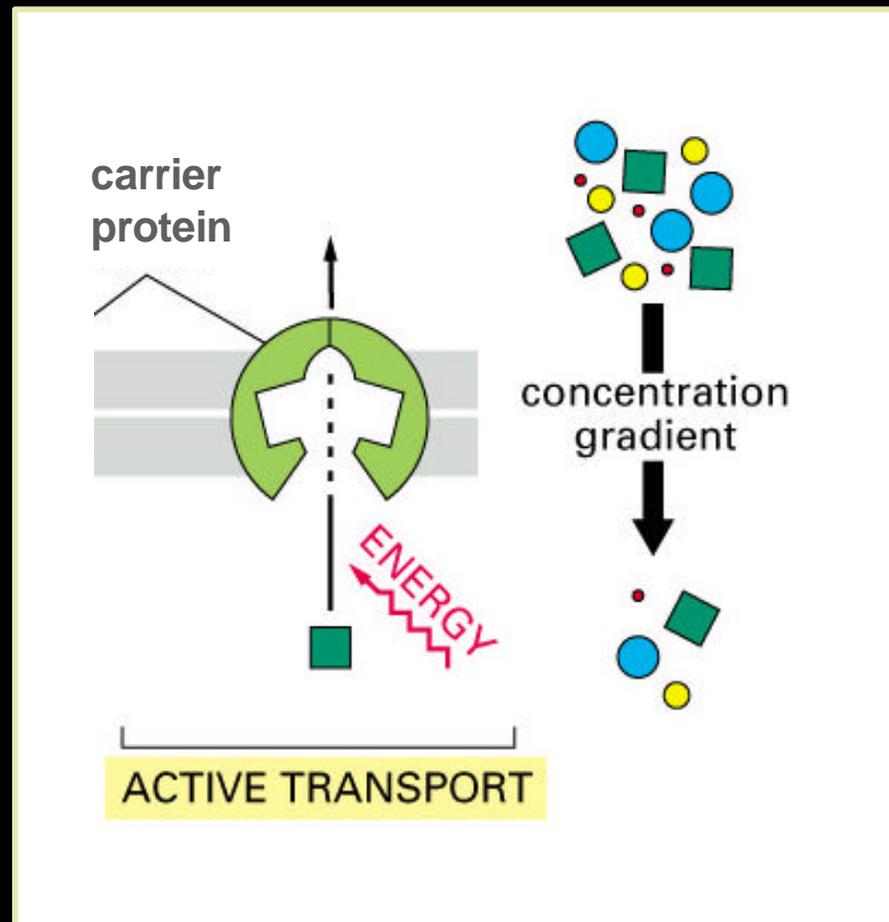
Passive transport

Down chemical concentration gradient



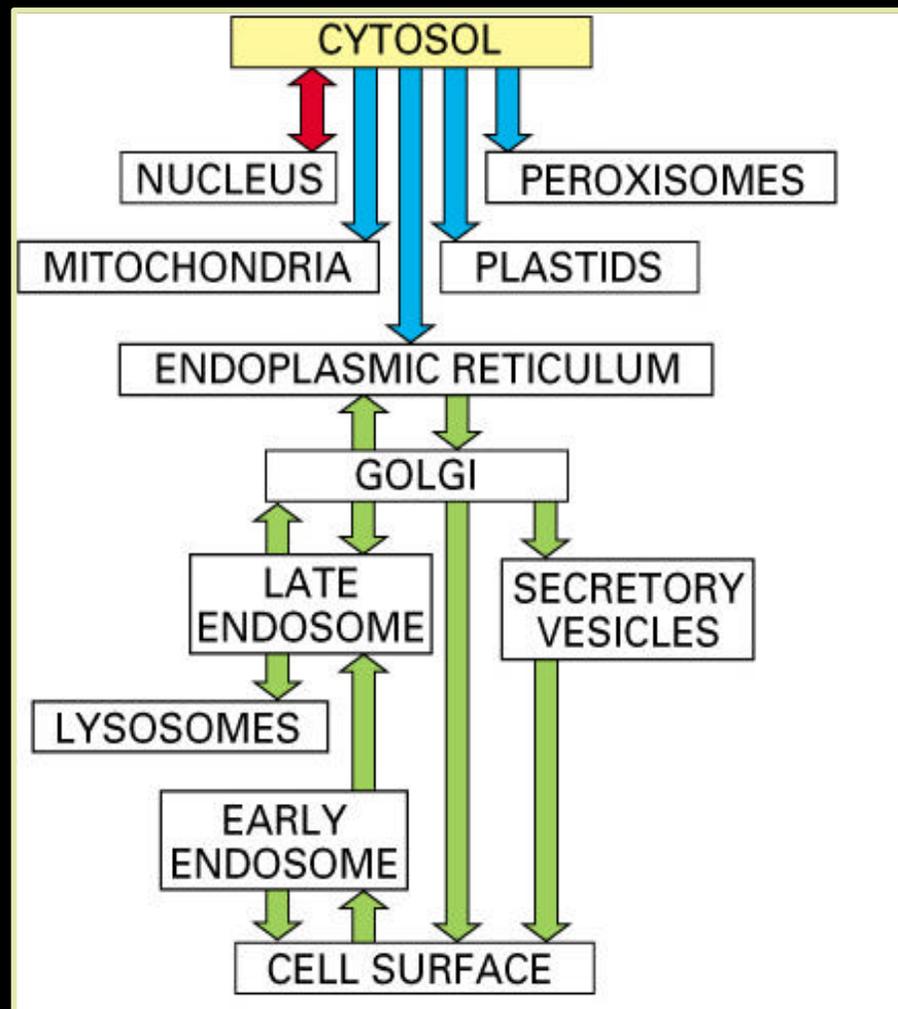
Active transport

Against chemical concentration gradient



Energy use!

Transport between compartments



 Gated transport

 Transmembrane transport

 Vesicular transport

Outline

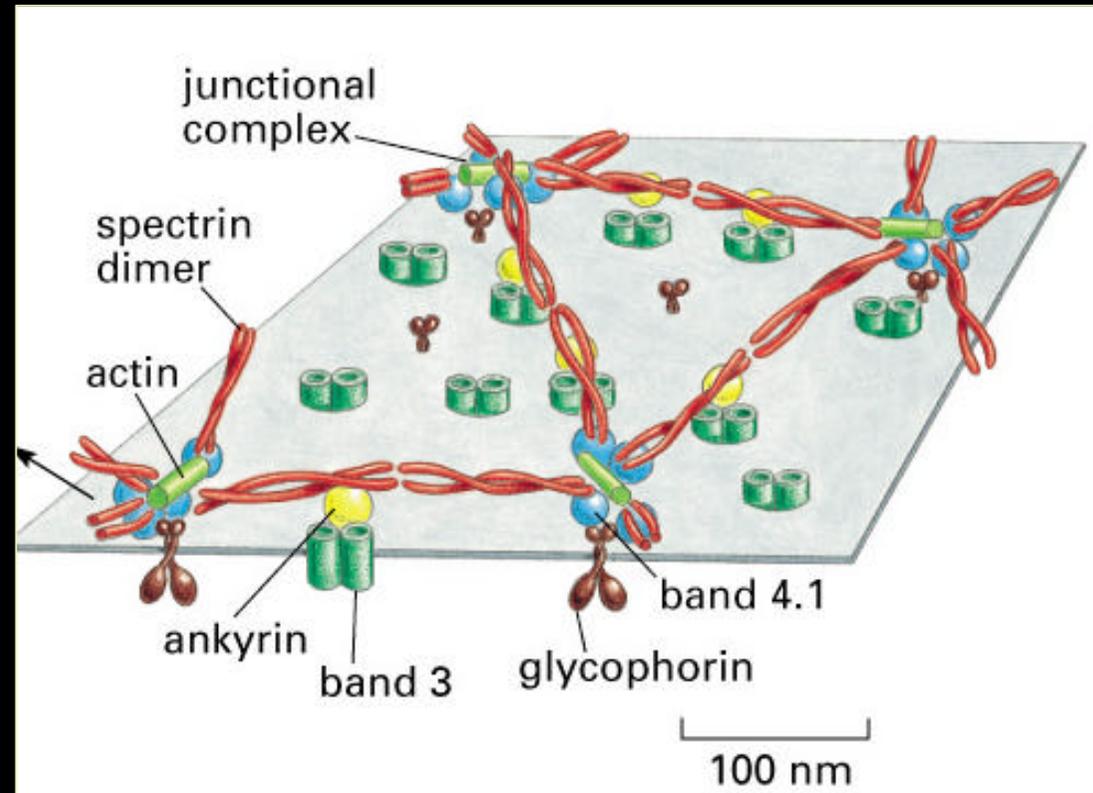
- Imprecisions
 1. Complexity and randomness
 2. Sources of imprecision
 3. Modelling: Na/K Pump

Complexity and randomness

↑ Complexity

↑ Order and regulation

↓ Randomness



Sources of imprecision

Transported molecules

Membrane properties

Physicochemical conditions

Transport systems

Sources of imprecision

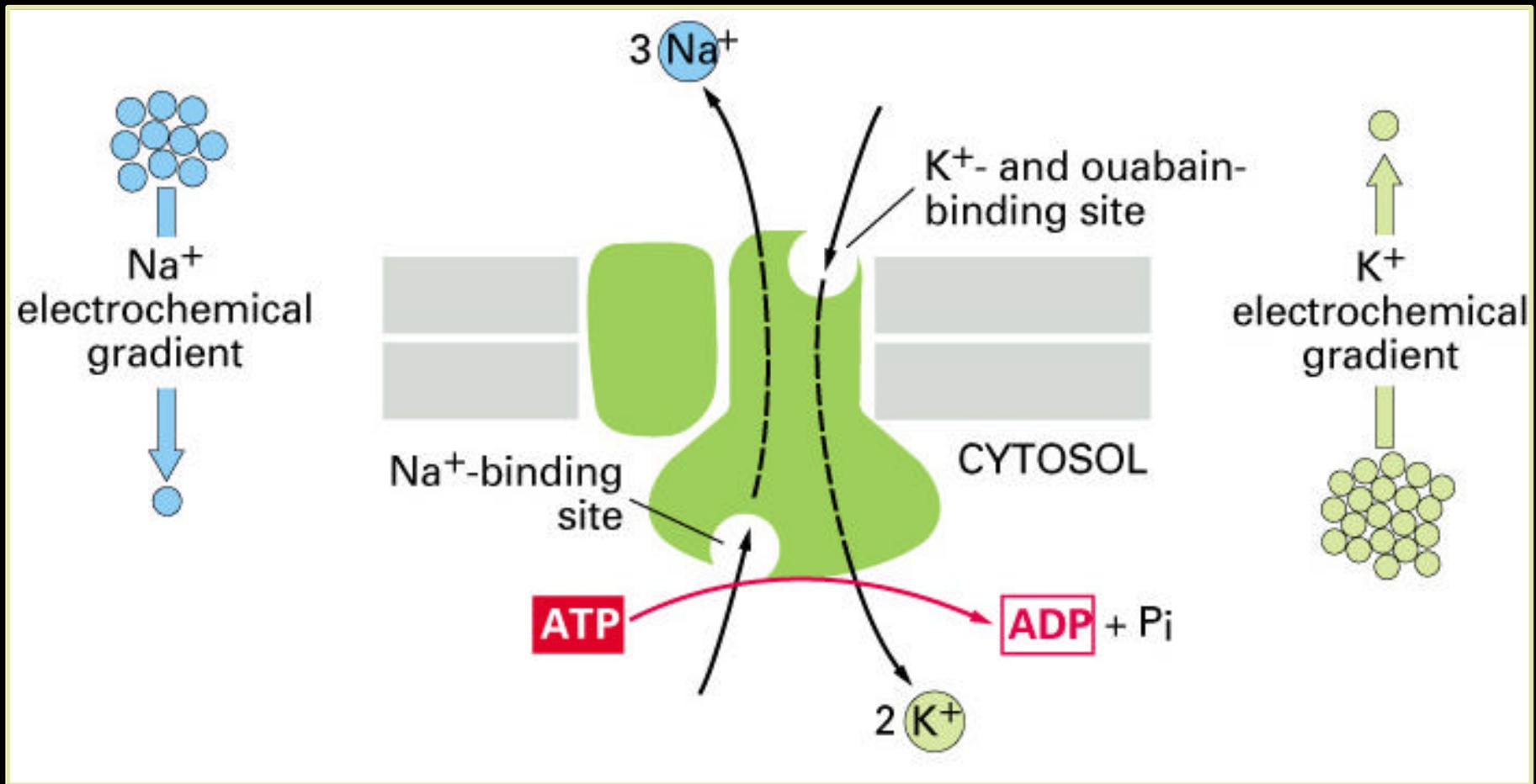
Transport systems

Transported molecules

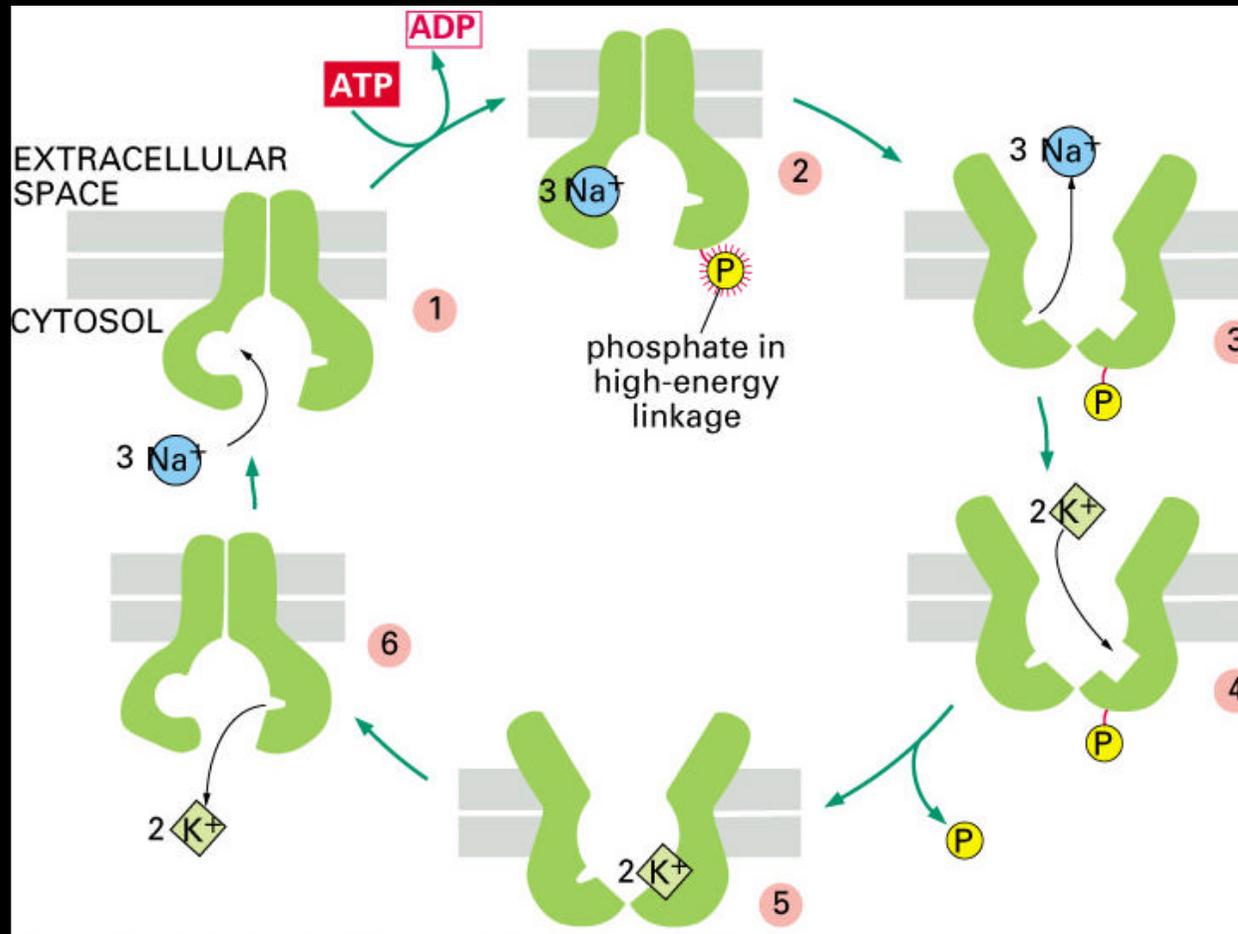
Membrane properties

Physicochemical conditions

Modelling Na/K pump



Modelling Na/K pump



Molecular chaos

Boltzmann



Microscopic level

Brownian movement

Unpredictable

Macroscopic level

General currents

Predictable