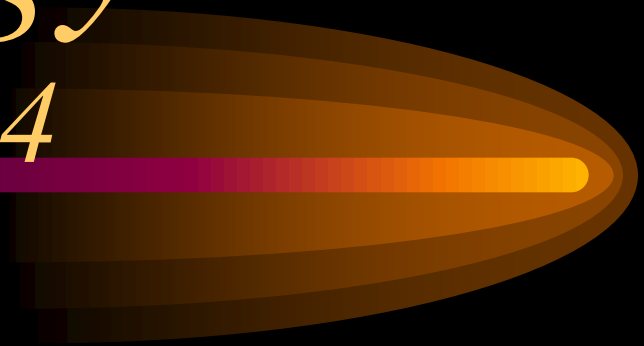



Biology

Chapter 4



- 
- The Cell Membrane & Transport
 - Membrane structure & Early discoveries

Developing the Cell theory

- Took nearly 200 years
 - Robert Hooke 1665 examined cork and oak bark and saw little cubicles he called cells
 - Matthias Schleiden 1838 discovered all plants are made of cells
 - Thodor Schwann 1839 concluded the same about animals
 - Rudolf Virchow 1858 stated that all cells come from pre-existing cells

Cell Theory

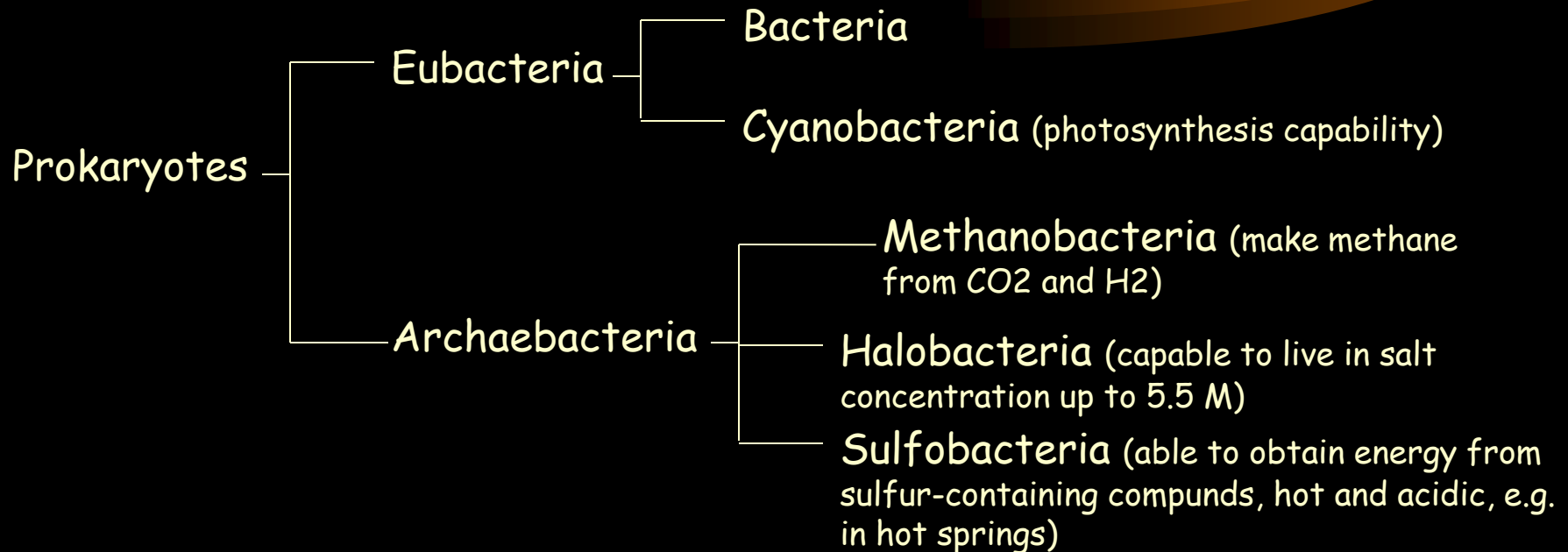
- These ideas along with the work of Louis Pasteur's work brought together to form the
- Cell Theory
 - All organisms are composed of cells
 - Cells are the basic unit of structure and function in all living things
 - All cells are produced from other cells

Properties and strategies of cells

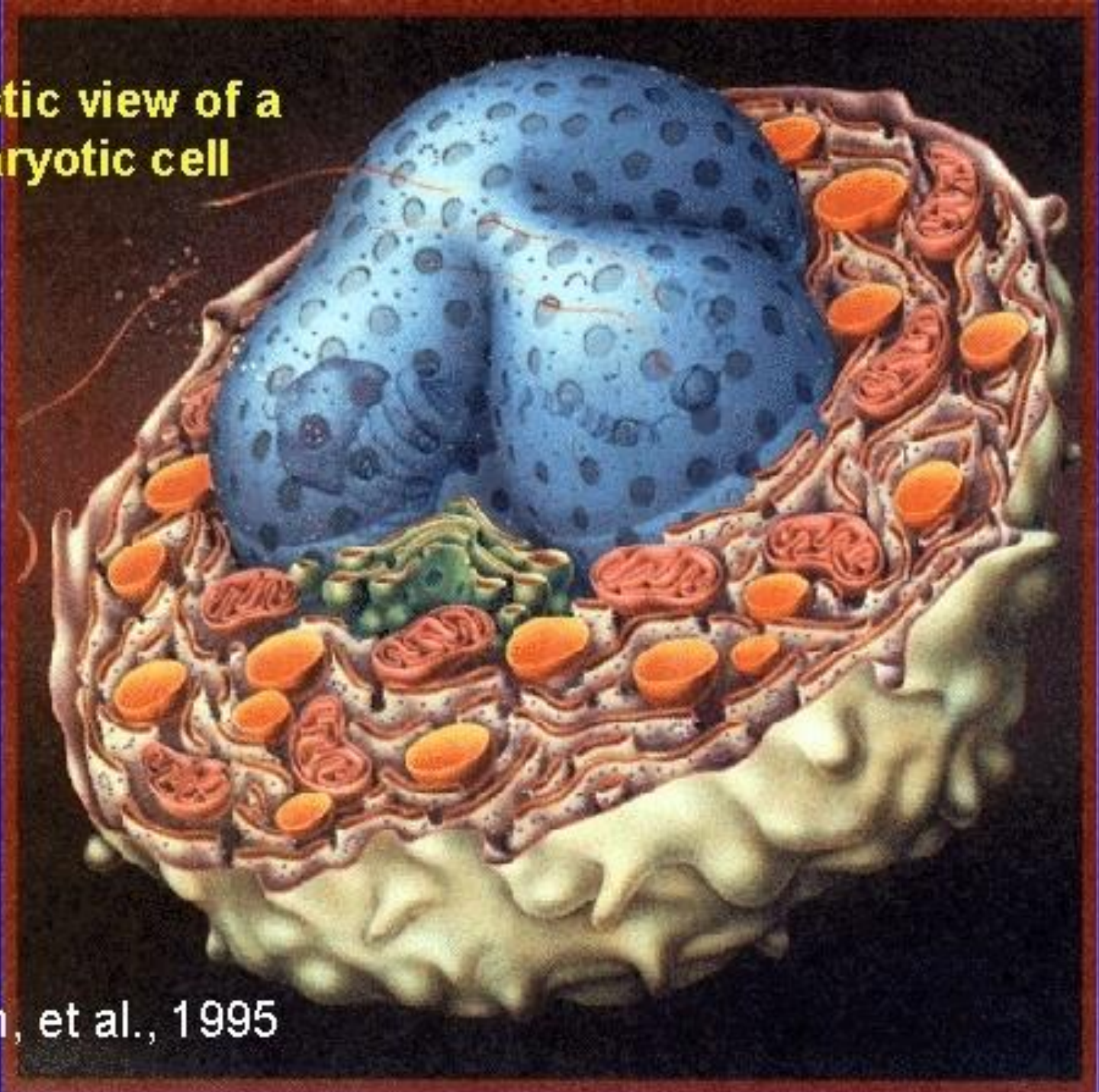
All cells are either:

prokaryotic -- bacteria

or eukaryotic -- all other forms of life having a true membrane-bounded nucleus



**Artistic view of a
eukaryotic cell**

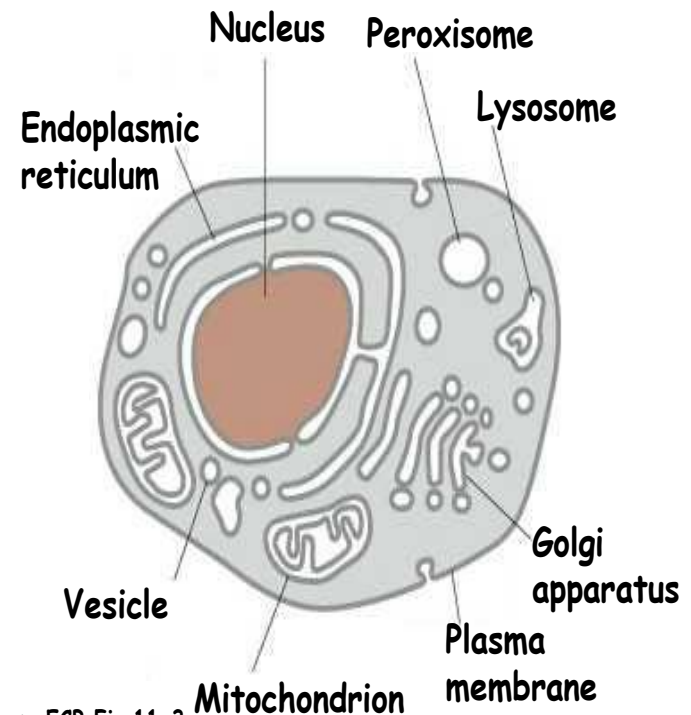


Lodish, et al., 1995

Properties of the plasma membrane

- Cells live in a fluid environment whether in land or water
- The plasma membrane is the boundary between the cell and its environment
 - It encloses the cell's contents
 - It controls what is passed between the cell and its environment.
- Plasma membrane has selective permeability
 - Only allow certain things are allowed to pass

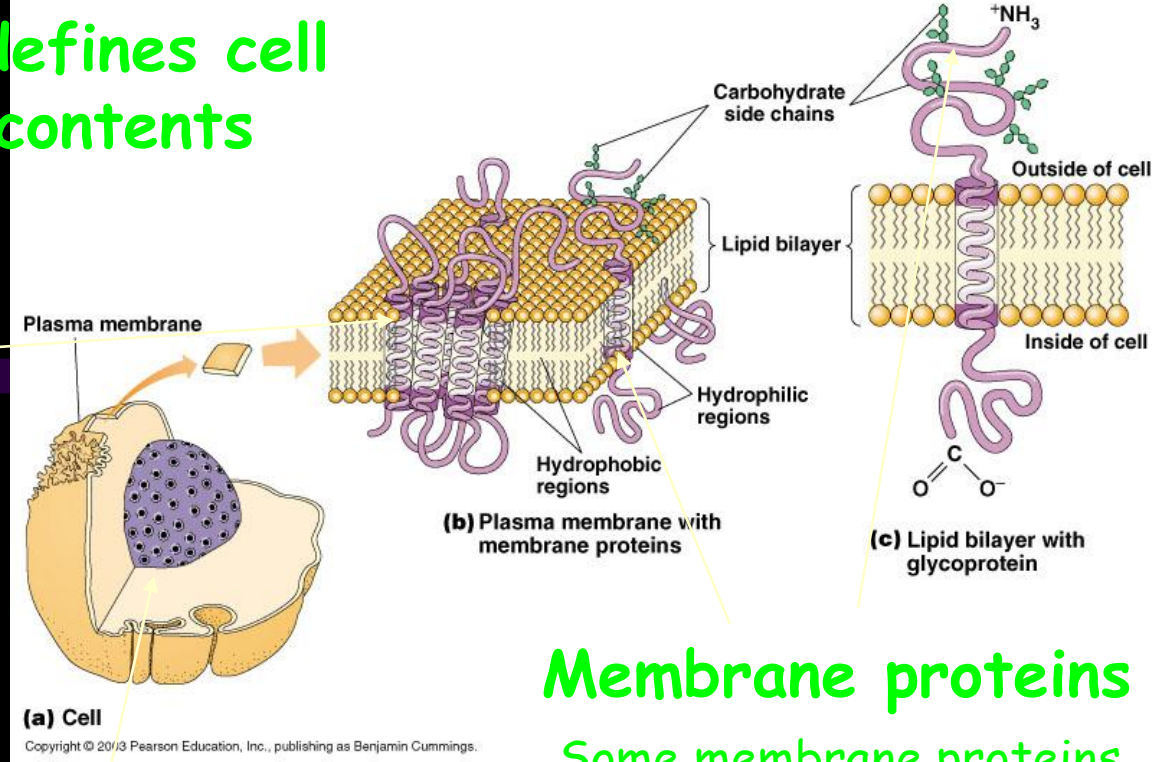
Membrane-bound compartments



Adapted from ECB Fig 11-3

The plasma membrane defines cell boundaries and retains contents

Lipid bilayer



Membrane proteins

Some membrane proteins have oligosaccharide and therefore called glycoprotein

Functions of membrane proteins:

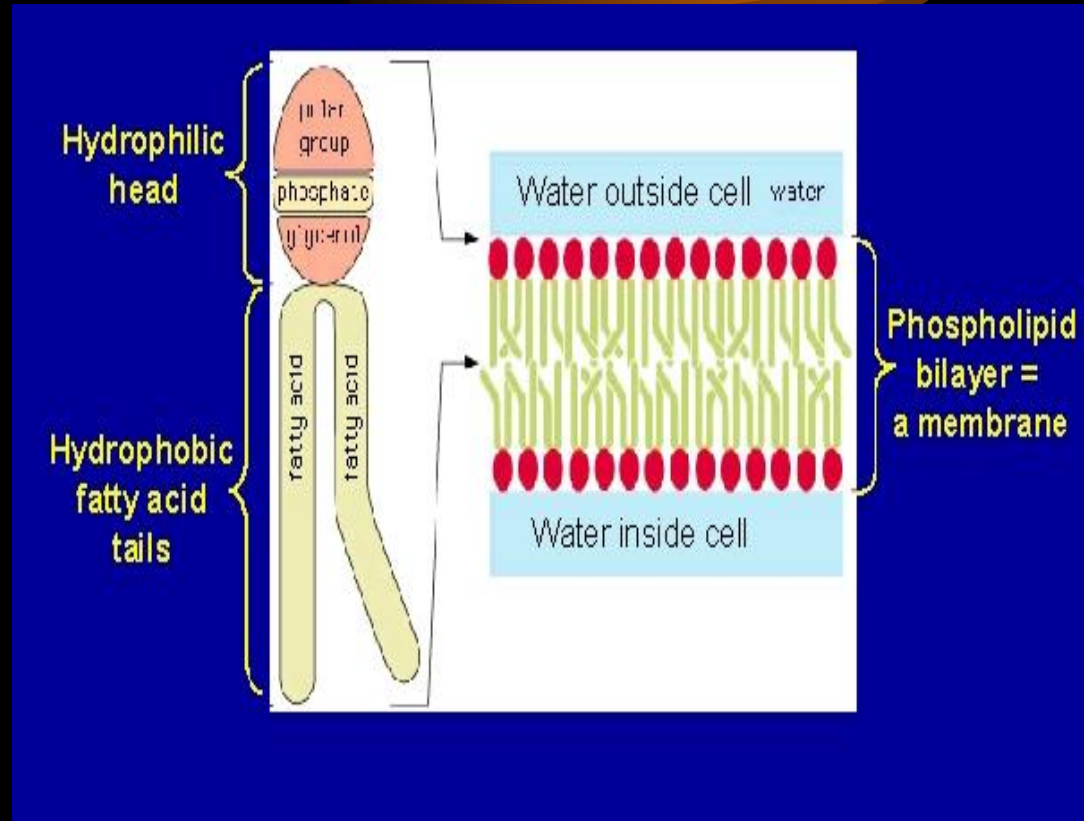
enzymes, anchors for cytoskeleton, transport proteins, receptors (for chemical signals)

The nucleus is the cell's information center

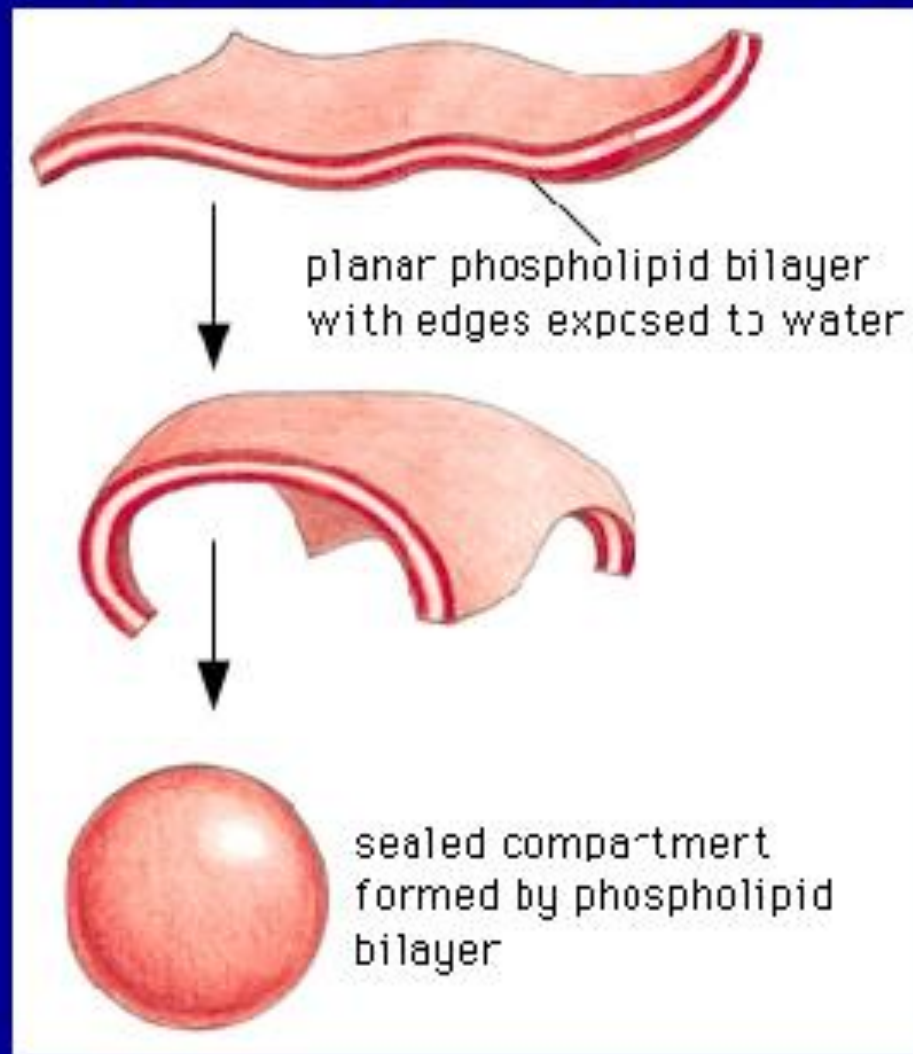
Nucleus envelope is a two-membrane structure containing pores for material exchange.

The model of the plasma membrane

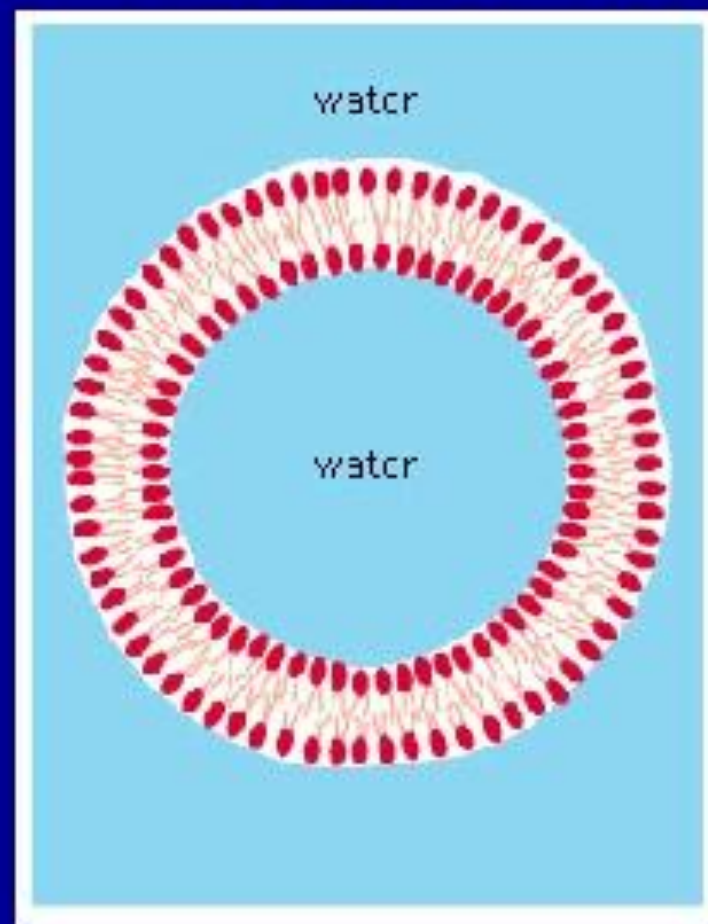
- Lipid Bilayer - two layers of lipids called phospholipid (click on picture for demonstration)
 - Phosphates, water soluble heads point toward the outside and inside of the cell
 - The lipid layer is toward the middle of the cell membrane



In a membrane, all edges are sealed so that no hydrophobic F.A. tails face water.



3-D view

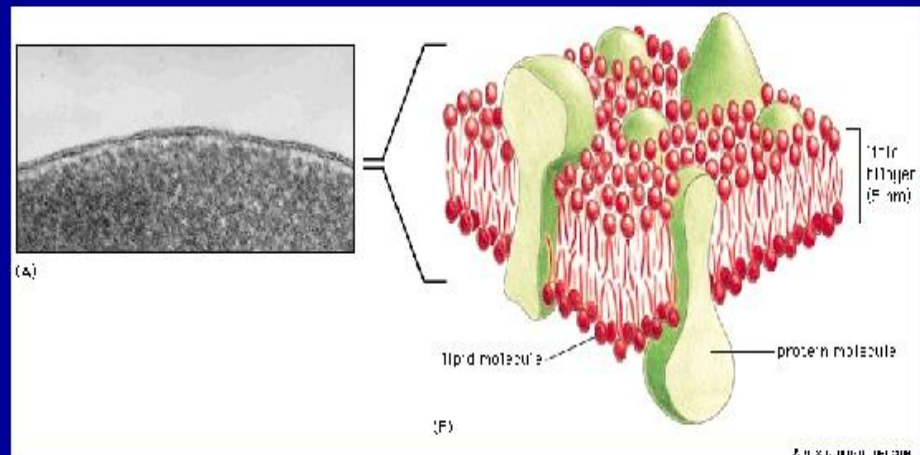


2 dimensional section through a membrane.

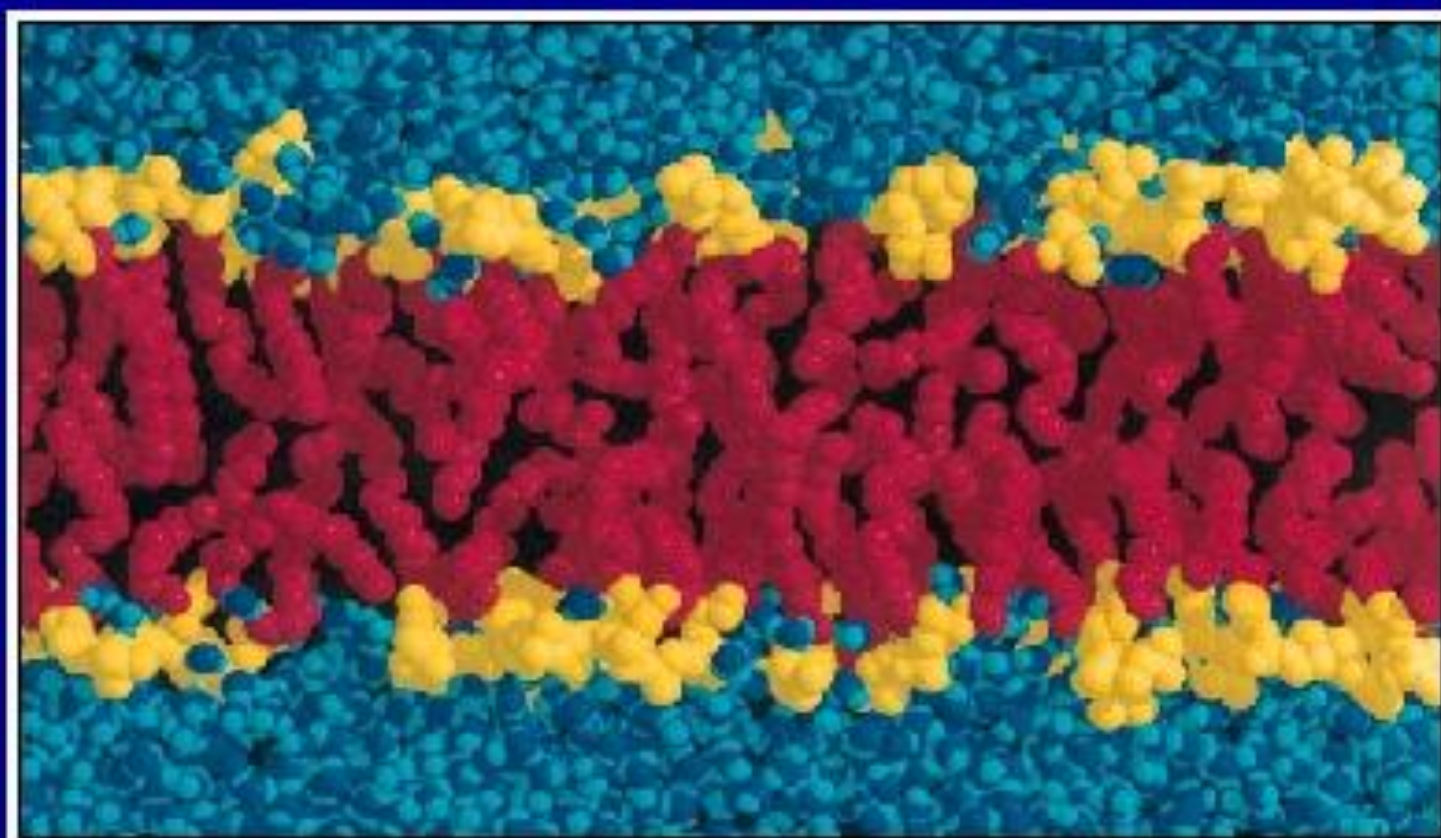
Lipid bilayer

- These properties allow the cell membrane to be maintained with the least amount of energy used
- The lipids allow the membrane to act as a thin layer of oil around the cell
- Cholesterol are embedded in the lipids to give some rigidity to the cell (overhead 4-6)

In a TEM, membranes look simple, but are highly complex at the molecular level.



What we think a phospholipid bilayer really looks like.



water

Hydrophilic h

Hydrophobic
fatty acid tail

Hydrophilic h

water

(a)

1 nm

Plasma Membrane Structural Components

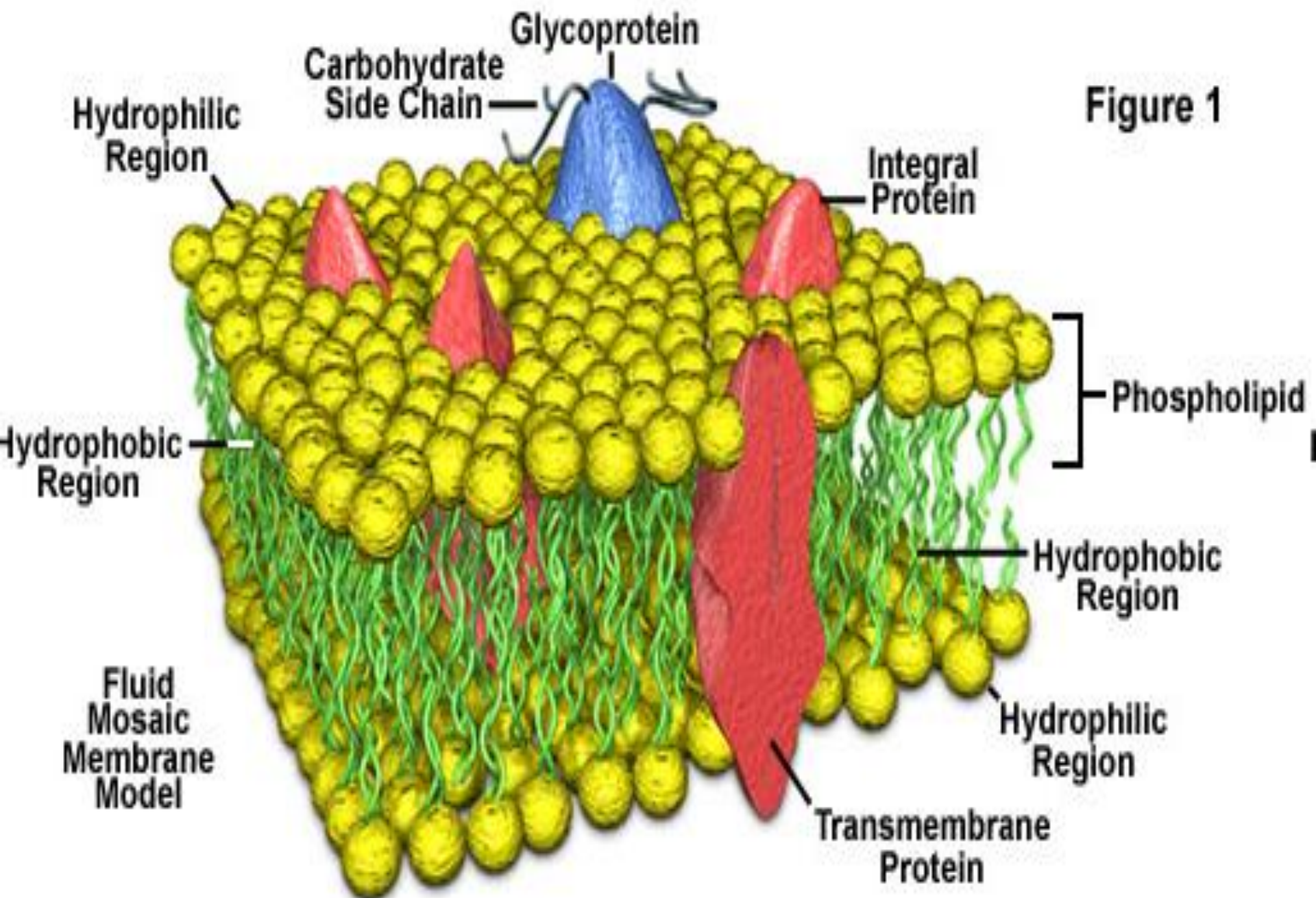
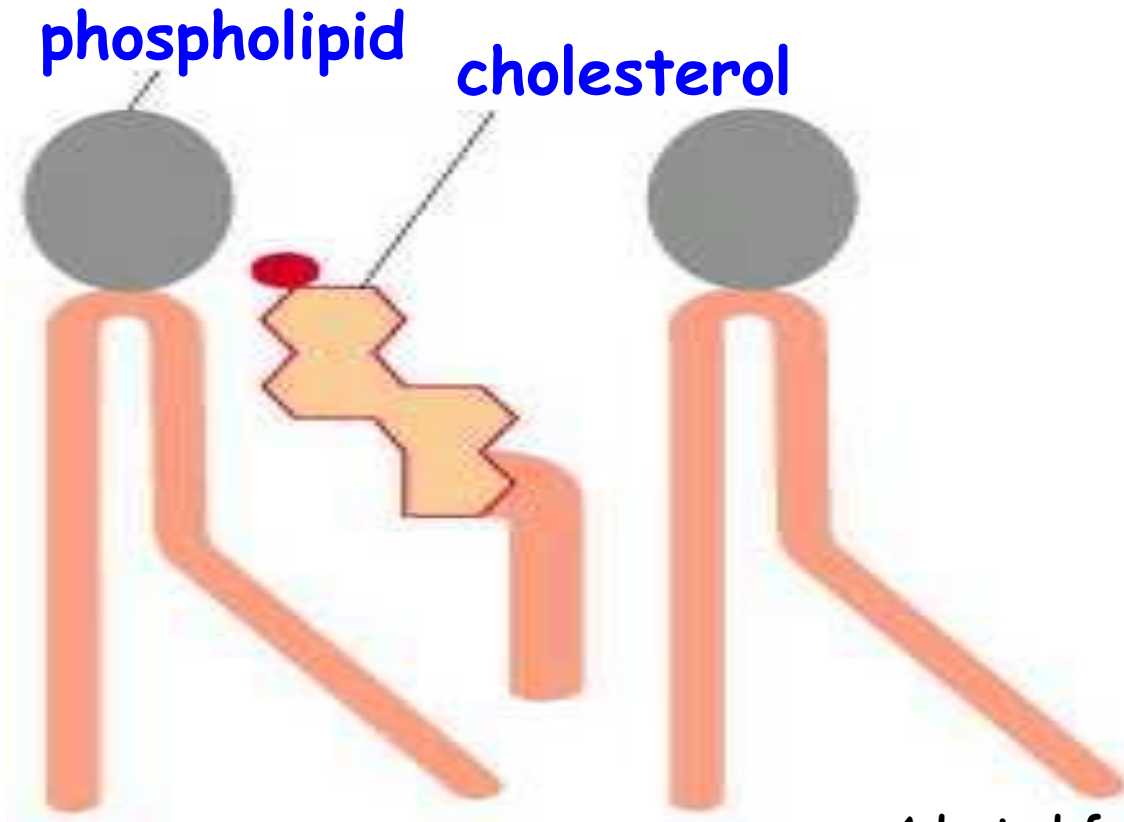


Figure 1

Membrane fluidity (cont^d)

In animal cells, cholesterol used to modulate membrane fluidity - fills gaps between kinks of unsaturated tails

Used particularly in plasma membrane \Rightarrow closer packing
 \Rightarrow less fluidity/permeability



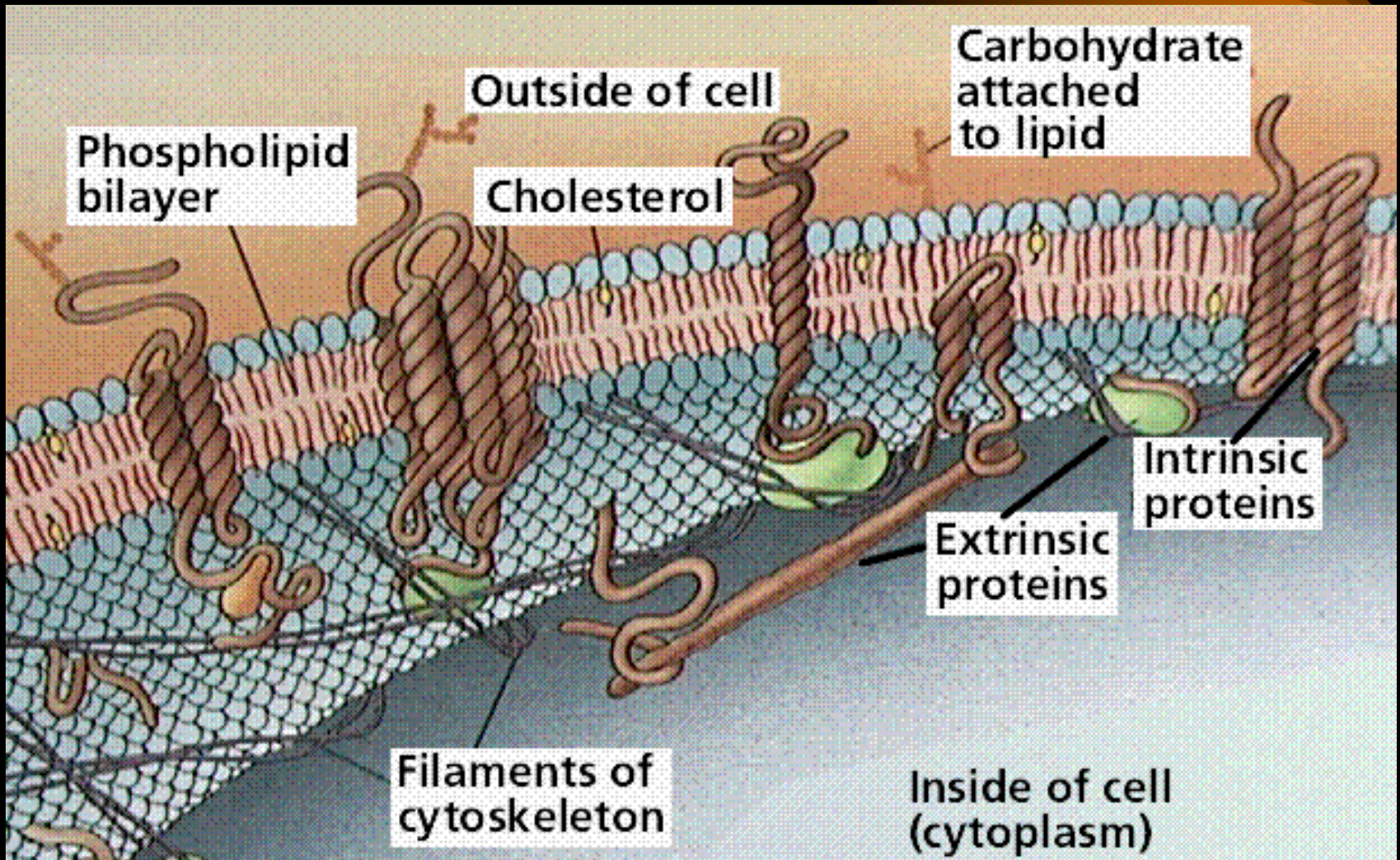
Membrane proteins -

- bumps seen with the electron microscope are proteins embedded in the plasma membrane
 - The proteins can migrate sideways within the bilayer but not as rapidly as the phospholipids
 - Because the components of the membrane are constantly moving like a fluid the current membrane model is called the “Fluid Mosaic Model” (overhead 4-8)

Roles of membrane & components

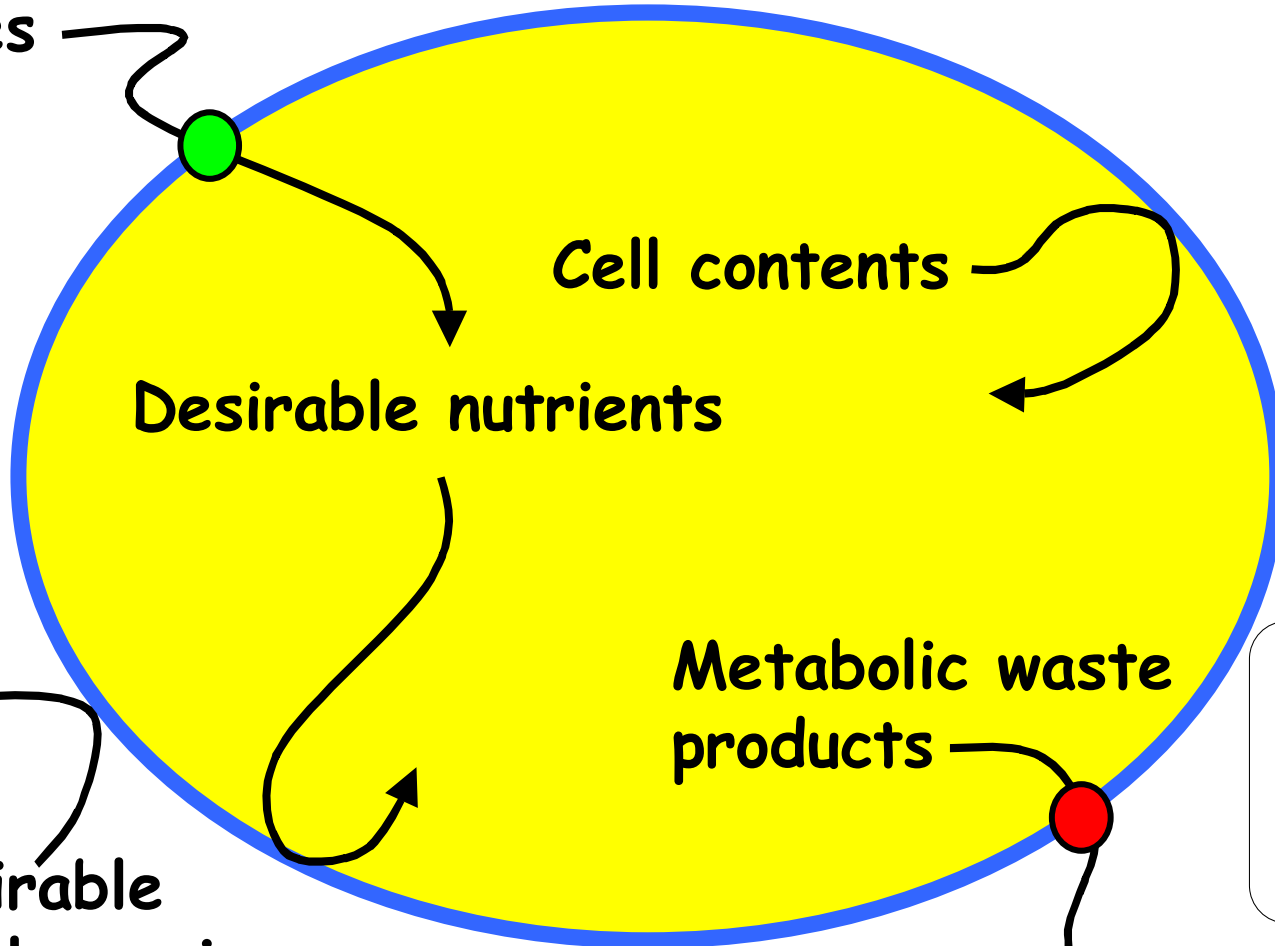
- Plasma membrane serves mainly as cell outer boundary of cells, but it also is around organelles
- The proteins play a major role in regulation, recognition and communication
 - The proteins help the cell to selectively permeable
 - Each membrane has its own distinct permeability characteristics

Cell Membrane with cholesterol and proteins



Selective barrier properties of plasma membrane

Desirable nutrient molecules



Cell contents

Desirable nutrients

Metabolic waste products

Undesirable molecules, micro-organisms etc

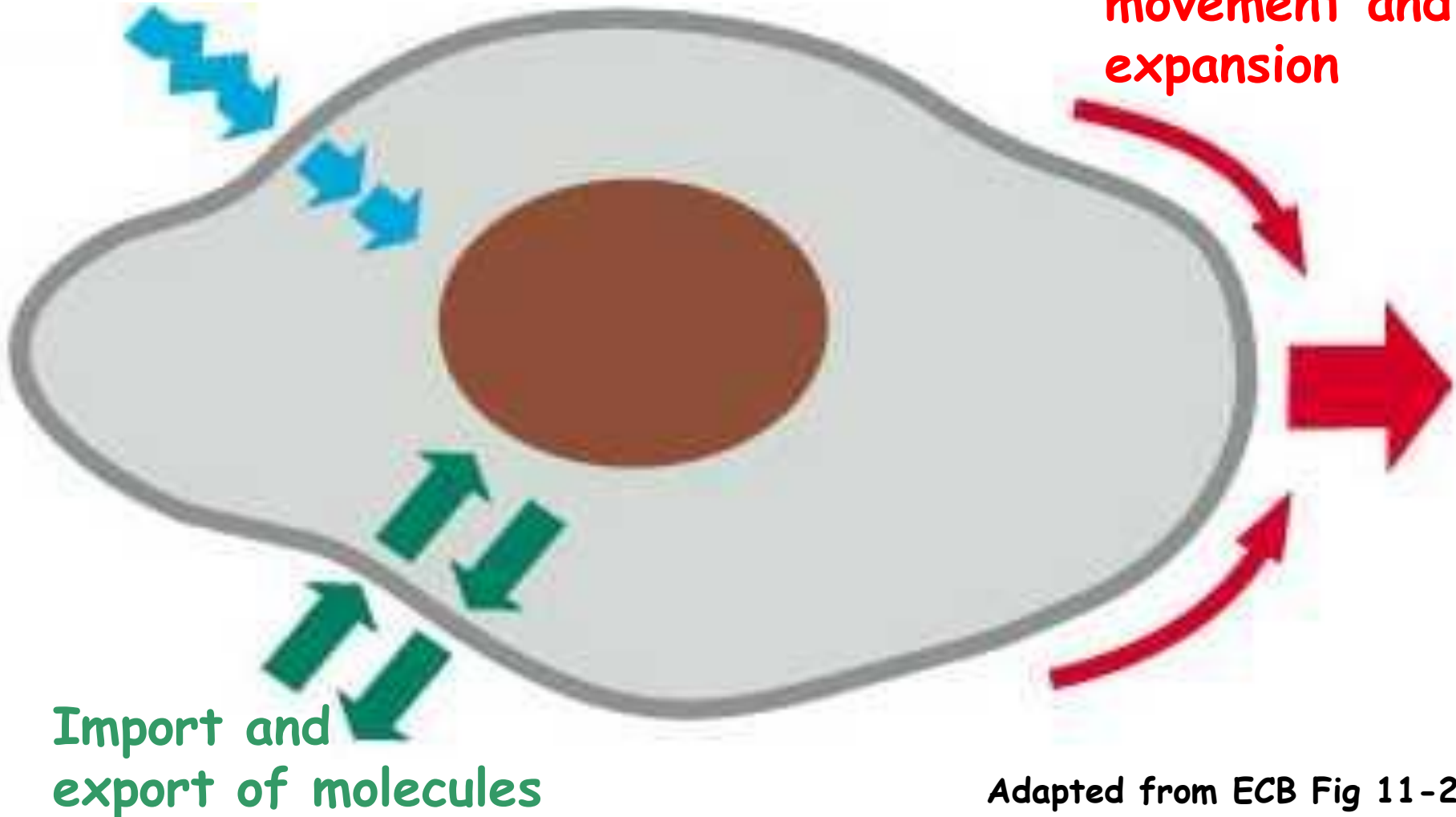
Customs



Functions of the plasma membrane

Receiving
information

Capacity for
movement and
expansion



Passive transport across the plasma membrane

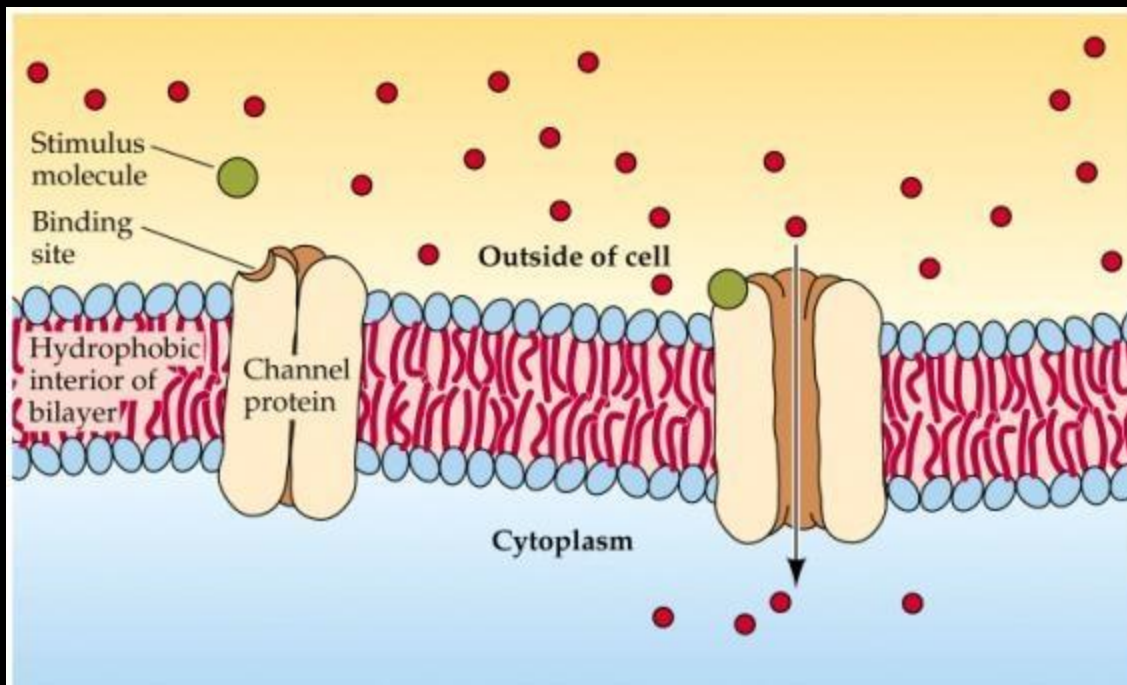
- Diffusion is the random movement of particles from areas of high concentration to areas of low concentration.
- When there is a continuous movement but no overall change this is dynamic equilibrium
 - The same concentration inside as outside or same amount leaving as coming in
 - Particles that dissolve and move quickly across the membrane are salts, liquids oxygen, carbon dioxide etc. . .
 - ..

Transport

- Osmosis is diffusion of water across a membrane
 - Osmotic balance results from the same amount of water leaving as coming in
- Diffusion and osmosis - substances are either able to dissolve in the lipid bilayer or are small enough to squeeze between phospholipids.
- Passive Transport is like osmosis and diffusion that requires no energy of the cell.

Facilitated diffusion

- is a passive transport where proteins are involved in the movement of materials that are too large to fit between phospholipids and not soluble in the lipids

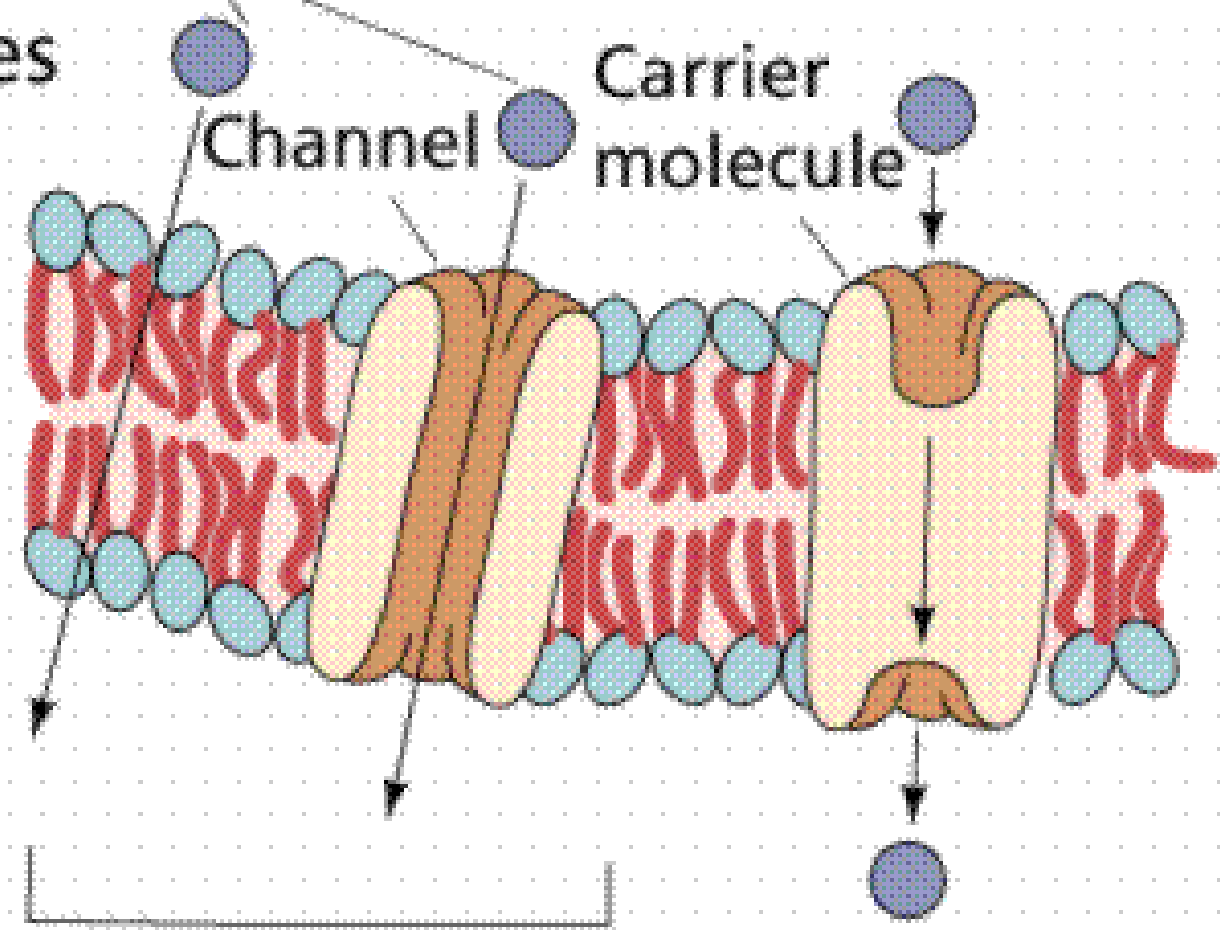


Transport Proteins and Facilitated Diffusion

- Transport proteins are the proteins embedded in the bilipid layer
 - Channel proteins are proteins with pores in them to allow certain ions to go through
 - Channel proteins many times are polar
 - Carrier proteins are proteins that change shape and move things from side of the cell membrane to the other
 - Gate proteins are proteins in the cell membrane that open and allow certain things through

Transported molecules

Uniport



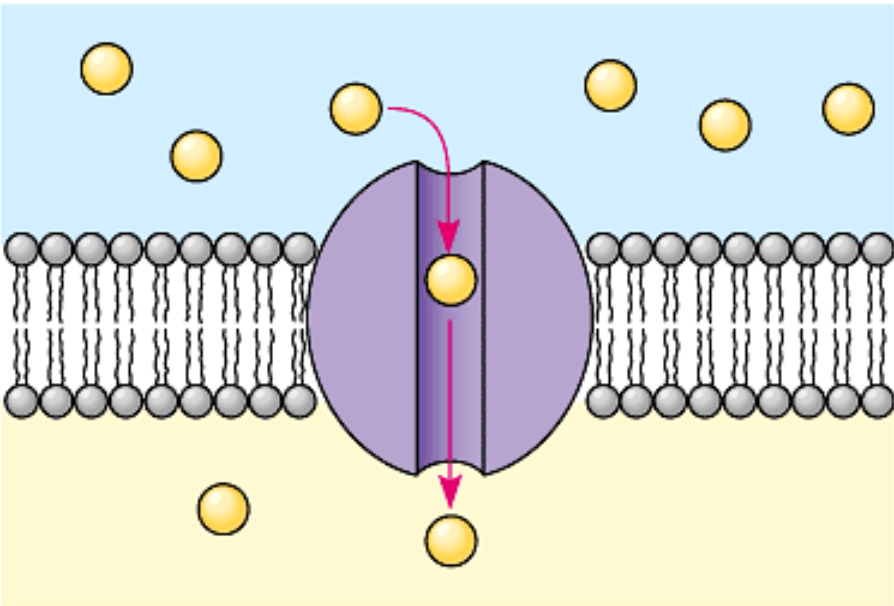
Channel

Carrier molecule

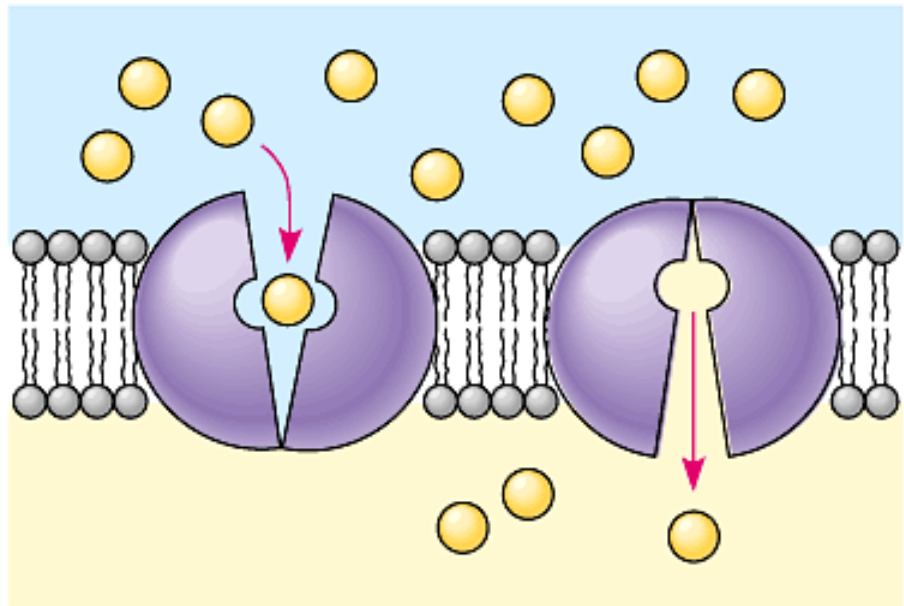
Simple diffusion

Facilitated diffusion

Passive transport

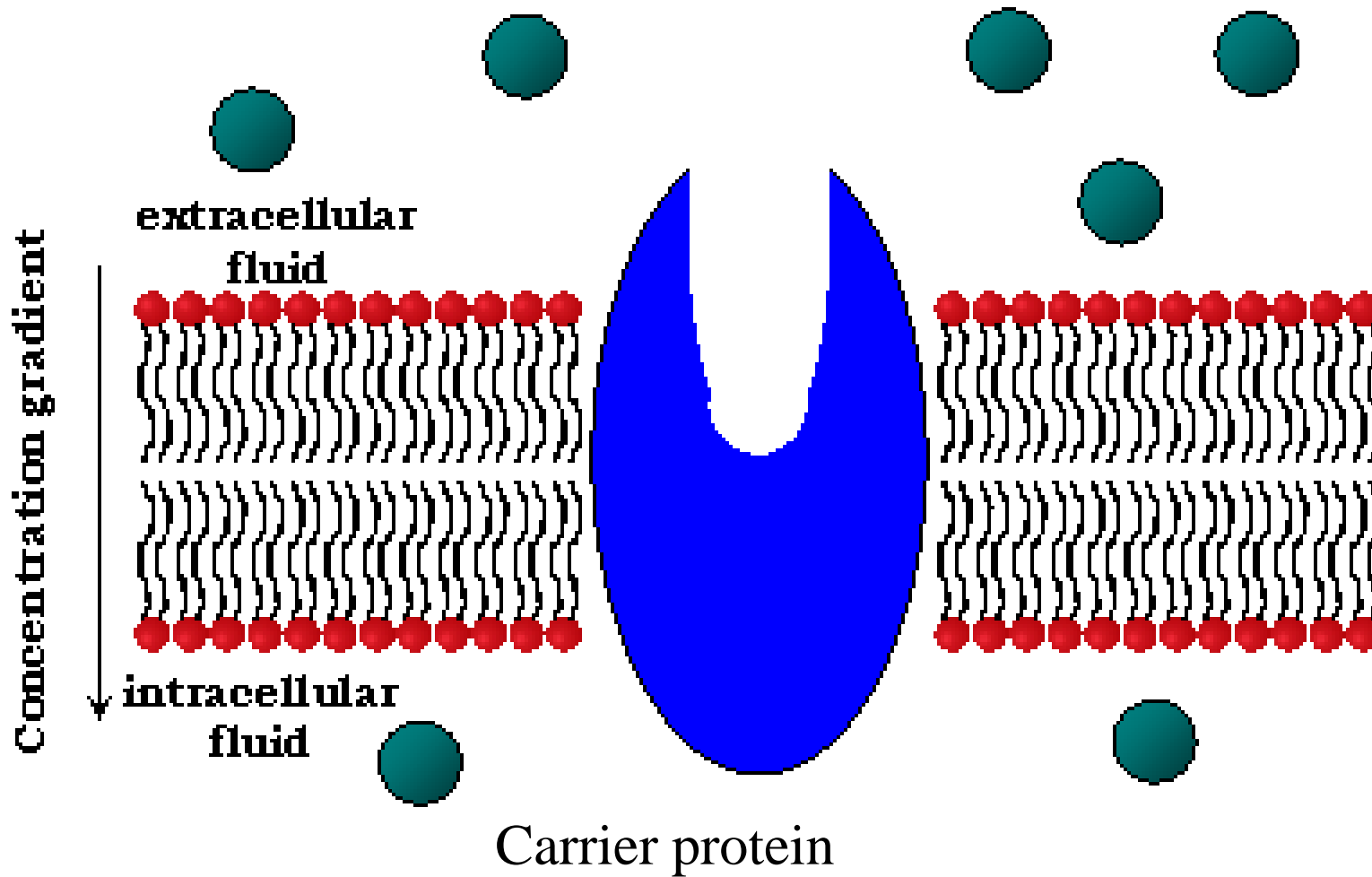


(a) Channel protein
Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.



(b) Gate protein

Facilitated Diffusion



Active transport

- requires the cell to use some of its own energy to move particles
 - Pumps - Transport proteins embedded in the plasma membrane can bind to a particle then chemical energy is used to alter the shape of pump and move particles
- Active transport may occur in either direction when moving from low to high
 - Endocytosis and Exocytosis
 - Endocytosis is the process that the plasma membrane engulfs and takes in substances from a cell's environment

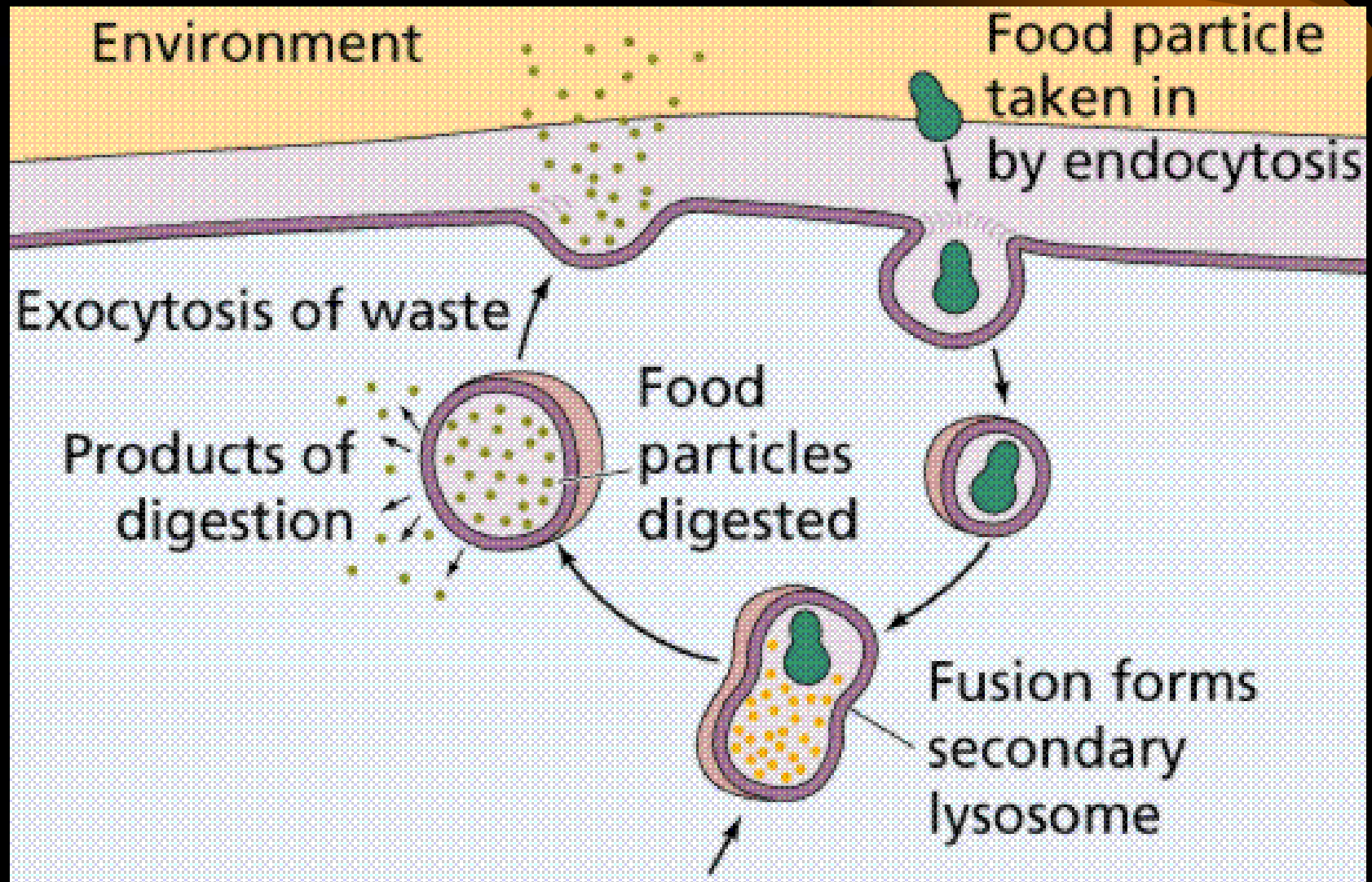
More Active transport

- Phagocytosis is when the plasma membrane surrounds large particles and forms a vesicle which then forms a vacuole inside the cell
- Pinocytosis – is the process like phagocytosis but liquids are taken in by this process
- Receptor aided endocytosis (Figure 4-8)
 - Protein in the plasma membrane recognize substance and link to form a pit then a vesicle
- Exocytosis is the reverse process of endocytosis

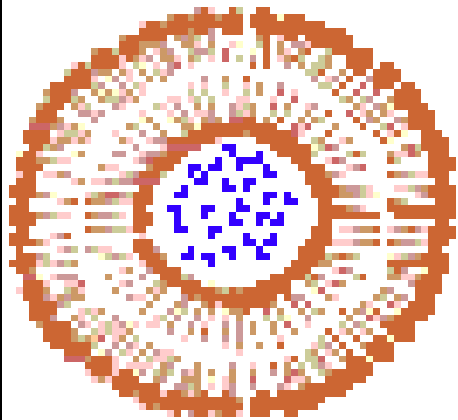
Quiz

1. What is a selectively permeable membrane?
2. How does active transport differ from passive transport?
3. What are the three types of passive transport?
4. What are the three types of plasma membrane proteins involved in facilitated diffusion?
5. What are the three parts to the Cell Theory?
6. What is the functions of cholesterol molecules embedded in the lipid bilayer?
7. Draw a small section of a lipid bilayer.

Phagocytosis & exocytosis



Exocytosis



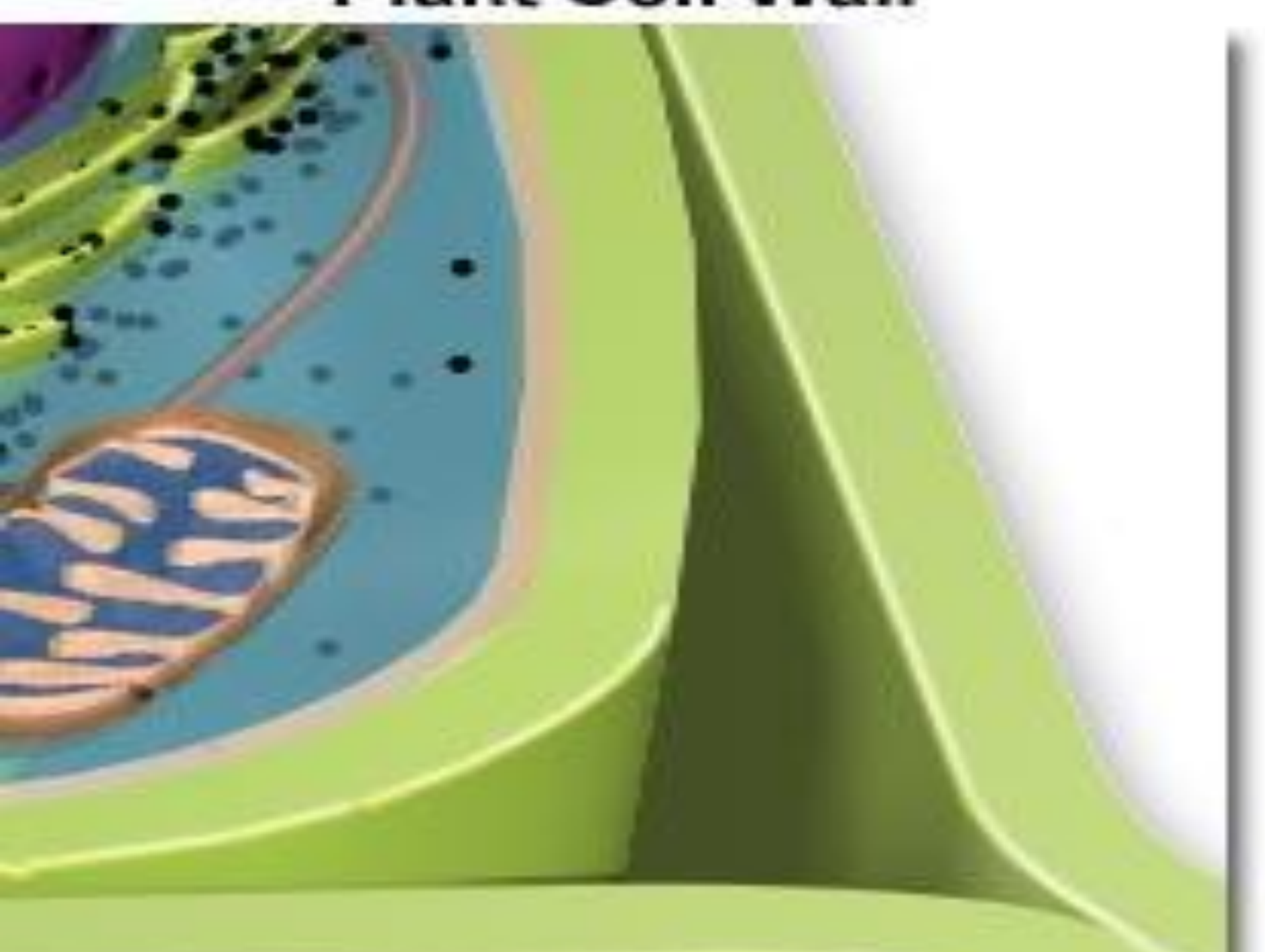
VESICLE



PLASMA
MEMBRANE

Cell walls

- lie outside of the plasma membrane in plants, fungi, algae and bacteria
- Plant cell walls are mostly composed of the polysaccharide cellulose.
 - Cellulose is arranged in rows of fiber and stacked in layers
 - Cellulose uses
 - Cotton, wood, paper, rayon
 - Middle lamella is between adjacent cell walls and pectin that binds them together
 - Read pages 111 and 112



Quiz

1. Draw and label a phospholipid.

2. Draw a series of phospholipids in a cell membrane.

3. What are the three types of proteins involved in facilitated diffusion?

4. What are the three types of passive transport?