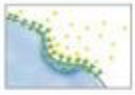
SBI4U Biochemistry Unit Review

SAMPLE ANSWERS

Review Questions:

1. What is the difference between prokaryotes and eukaryotes?
   Prokaryotes do not have a true nucleus (no nuclear membrane) or any membrane bound organelles
   Eukaryotes have a true nucleus & membrane bound organelles
2. What are the structure and function of organelles in plant and animal cells?

SUMMARY TABLE 7.2 **Eukaryotic Cell Components**

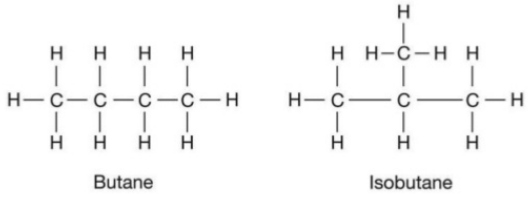
Icons not to scale		Structure: Membrane	Structure: Components	Function
	**Nucleus**	Double ("envelope"); openings called nuclear pores	Chromosomes Nucleolus Nuclear lamina	Genetic information Assembly of ribosome subunits Structural support
	**Ribosomes**	None	Complex of RNA and proteins	Protein synthesis
	**Endomembrane system** ***Rough ER***	Single; contains receptors for entry of selected proteins	Network of branching sacs Ribosomes associated	Protein synthesis and processing
	***Golgi apparatus***	Single; contains receptors for products of rough ER	Stack of flattened cisternae	Protein processing (e.g., glycosylation)
	***Smooth ER***	Single; contains enzymes for synthesizing phospholipids	Network of branching sacs Enzymes for synthesizing lipids	Lipid synthesis
	***Lysosomes***	Single; contains proton pumps	Acid hydrolases (catalyze hydrolysis reactions)	Digestion and recycling
	**Peroxisomes**	Single; contains transporters for selected macromolecules	Enzymes that catalyze oxidation reactions Catalase (processes peroxide)	Oxidation of fatty acids, ethanol, or other compounds
	**Vacuoles**	Single; contains transporters for selected molecules	Varies—pigments, oils, carbohydrates, water, or toxins	Varies—coloration, storage of oils, carbohydrates, water, or toxins
	**Mitochondria**	Double; inner contains enzymes for ATP production	Enzymes that catalyze oxidation-reduction reactions, ATP synthesis	ATP production
	**Chloroplasts**	Double; plus membrane-bound sacs in interior	Pigments Enzymes that catalyze oxidation-reduction reactions	Production of ATP and sugars via photosynthesis
	**Cytoskeleton**	None	Actin filaments Intermediate filaments Microtubules	Structural support; movement of materials; in some species, movement of whole cell
	**Plasma membrane**	Single; contains transport and receptor proteins	Phospholipid bilayer with transport and receptor proteins	Selective permeability—maintains intracellular environment
	**Cell wall**	None	Carbohydrate fibers running through carbohydrate or protein matrix	Protection, structural support

3. What are the unique properties of water and the chemical bases for these properties?

TABLE 3.2	THE PROPERTIES OF WATER
Property	**Explanation**
Heat storage	Hydrogen bonds require considerable heat before they break, minimizing temperature changes.
Ice formation	Water molecules in an ice crystal are spaced relatively far apart because of hydrogen bonding.
High heat of vaporization	Many hydrogen bonds must be broken for water to evaporate.
Cohesion	Hydrogen bonds hold molecules of water together.
High polarity	Water molecules are attracted to ions and polar compounds.

4. What is an isomer? Do they have the same properties as the initial molecule? (Thalidomide causing birth defects is an optical isomer created upon ingestion.)

A structural isomer is any of two or more chemical compounds having the same molecular formula but different structural formulas

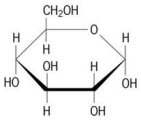


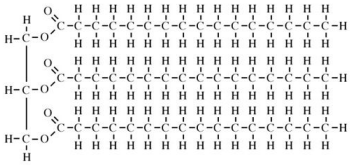
Butane Isobutane

5. Draw the 4 major classes of macromolecules (carbohydrate, fat, protein, nucleic acid).

MACROMOLECULES

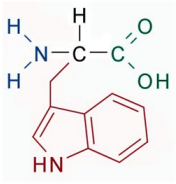
Carbohydrate

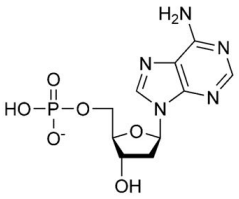




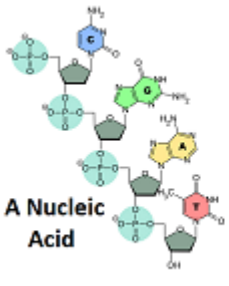
Lipid

Amino acid

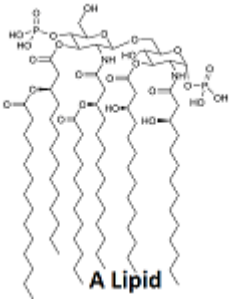




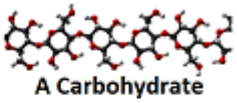
Nucleotide



A Nucleic Acid



A Lipid

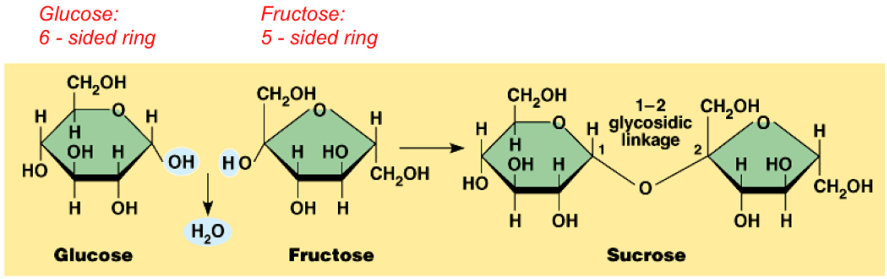


A Carbohydrate

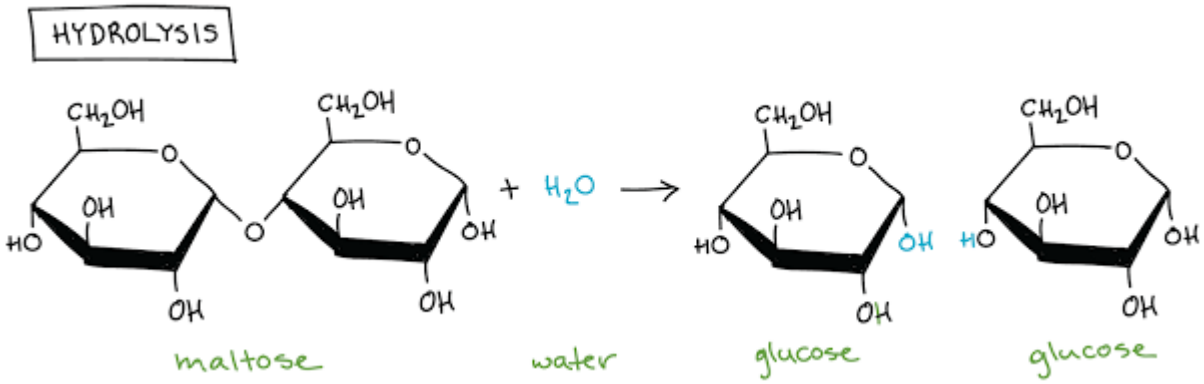
A Protein

6. Draw dehydration and hydration synthesis reactions for all macromolecules.

   Carbohydrate example



(b) Dehydration synthesis of sucrose



7. What is the difference between anabolic and catabolic reactions?

   Anabolic – building a large molecule from smaller pieces

   Catabolic – breaking a molecule into smaller pieces

8. Describe the formation of polymers for macromolecules.

   monosacchrides → polysaccharide

   amino acids → polypeptide → protein

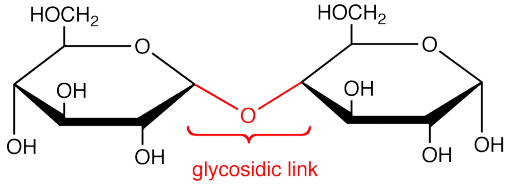
   glycerol & fatty acids → triglyceride

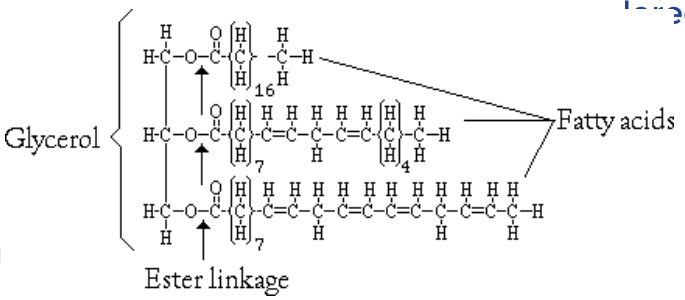
   glycerol & fatty acids & phosphate → phospholipid

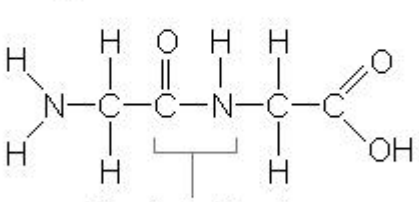
   nucleotides → nucleic acid

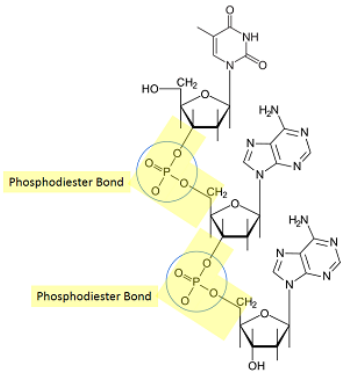
The Four Classes of Macromolecules Found in Living Cells				
Macromolecule	Elements	Monomer	Polymer	Example
Carbohydrates	C, H, O	Simple sugar	Polysaccharide	Starch, cellulose
Lipids	C, H. O	Fatty acids, glycerol	Lipid	Fats, oils, waxes
Proteins	C, H, O, N, S	Amino acids	Polypeptide	Insulin
Nucleic acids	C, H, O, N, P	Nucleotides	Nucleic acid	DNA

9. Label the unique bond/linkages within macromolecules.









10. Explain the main functions for each macromolecule.

Macromolecules

Macromolecule	Description	Examples	Major role in living things
Nucleic Acid	Macromolecules made up of long chains of **nucleotides**.	DNA or RNA	-Contain genetic information that is passed from parent to offspring.
Protein	Macromolecules made up of long chains of **amino acids.**	amylase, keratin	-help cells communicate -transport substances -break down nutrients -provide structural support
Lipid	A large macromolecule that does not dissolve in water.	cholesterol, phospholipids, vitamin A	-help form protective barriers -major part of cell membrane -energy storage -help cells communicate
Carbohydrate	A macromolecule made up of one simple sugar, or a long chain of sugars molecules	sugar (fruit) and starches (bread)	-structural support -energy storage -help cells communicate

11. Describe unique properties of macromolecules.

See chart in question 8 – be able to identify the functional groups in each

12. Describe how enzymes work.

Decrease activation energy by MODS to speed up naturally occurring reactions. Substrate(s) bind to active site to that…

- creating an ideal microenvironment for a reaction

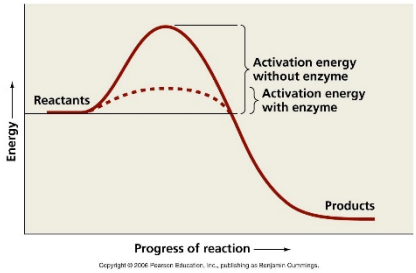
- putting reactants in the correct oreientation

- Directly participating in a reaction

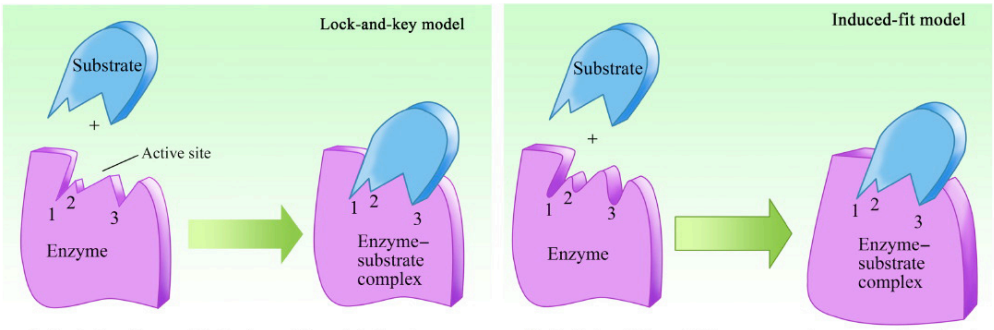
- straining bonds in reactants

can produce product(s)

13. Draw an activation energy graph for a catalyzed reaction comparing it to the non-catalyzed reaction.



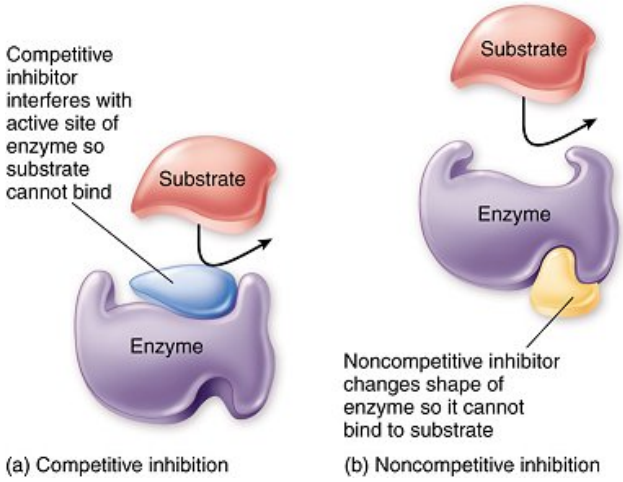
14. Describe the induced fit model and the lock and key model.



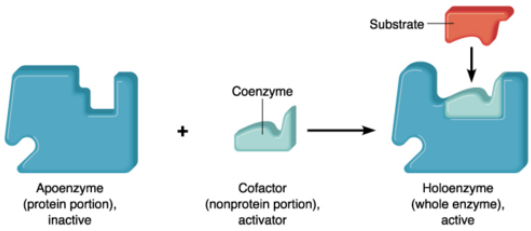
In the lock-and key model, the shape of the substrate and the confirmation of the active site are complementary to one another.

In the linduced-fit model, the enzyme undergoes a confirmational change upon binding to substrate. The shape of the active site becomes complementary to the shape of the substrate only after the substrate binds to the enzyme.

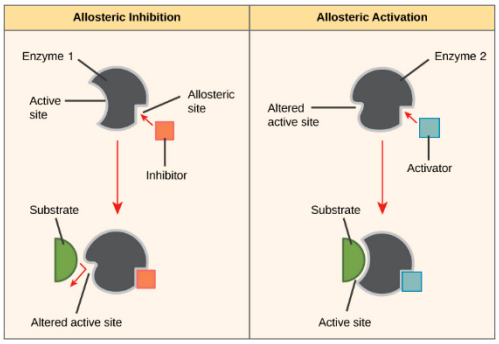
15. What is the difference between competitive and non-competitive inhibitors?



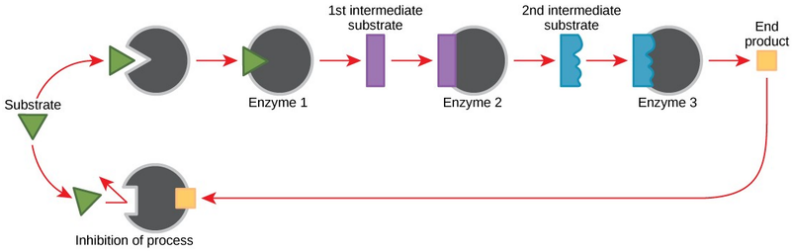
16. Describe how cofactors work.



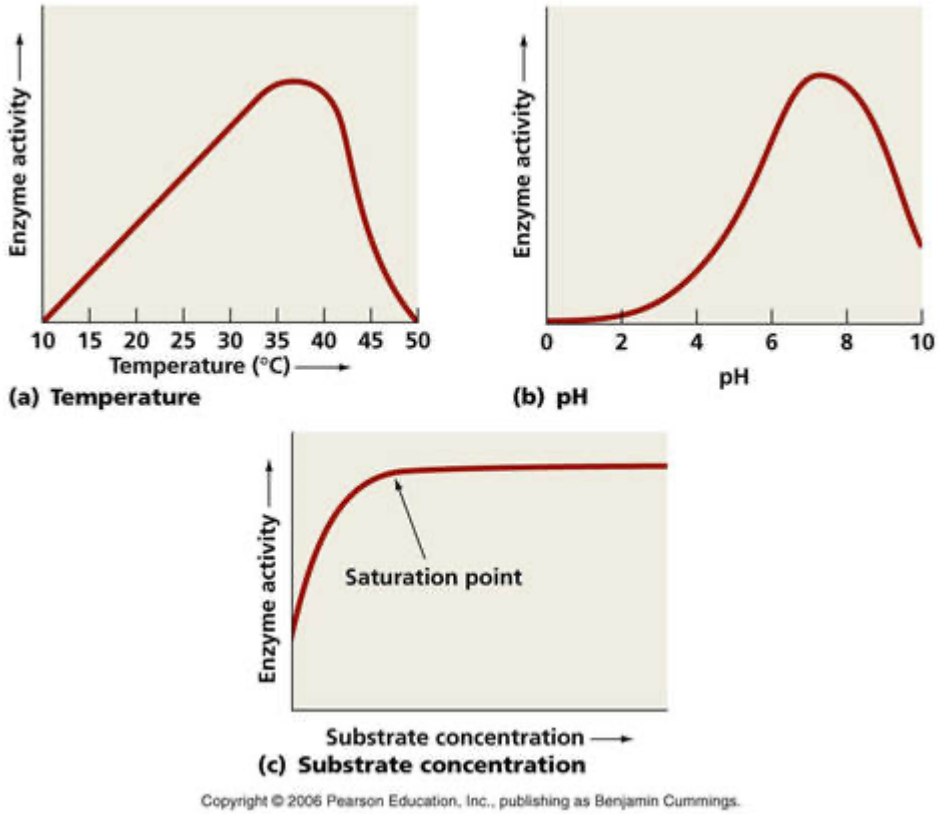
17. Describe allosteric regulation.



18. Describe how feedback inhibition works.



19. Explain how pH, temperature, substrate concentration, and enzyme concentration affect enzymes and their rate of reaction.



Changing pH & temperature can change the tertiary structure of an enzyme, changing the shape of the active site so it cannot bind to the substrate. Too much of a change can cause protein to denature and not function.

Adding more enzymes will increase reaction because there will be more active sites for substrate to bind to. This will happen until substrates run out.

Adding more substrates will increase reaction until all active sites are full.

20. How are enzymes used in the pharmaceutical industry, food industry, for digestive disorders, and in forensics?

    They are used to speed up reactions

    - making break, beer, cheese, milk products

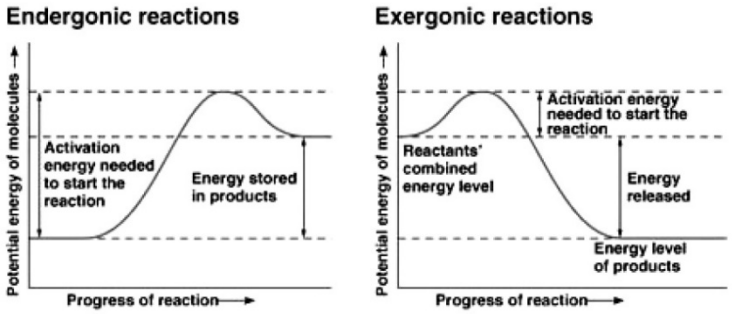
    - laundry detergent that can break down stains

    - break down foods in body when enzymes missing or not working

    - break apart DNA molecules to identify suspects (ie who's your daddy??)

~~21. What is the first law of thermodynamics?~~

22. Draw & describe the energy profile (graph) for anabolic & catabolic reactions. Explain using bond energies.



23. Why are catabolic reactions spontaneous?

    There is a net release of energy – does not need a source of energy to allow reaction to continue

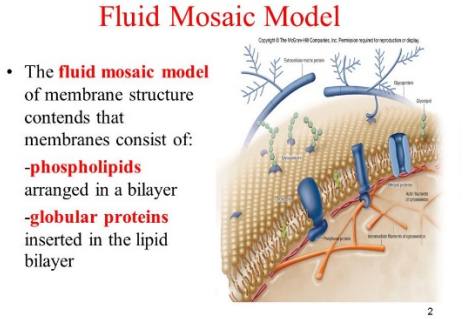
~~24. How do redox reaction work?~~

~~25. What does LEO the lion says GER mean?~~

~~26. How does an oxidizing agent work? Reducing agent?~~

~~27. How do buffers work?~~

28. Explain the fluid mosaic model of a phospholipid bilayer.



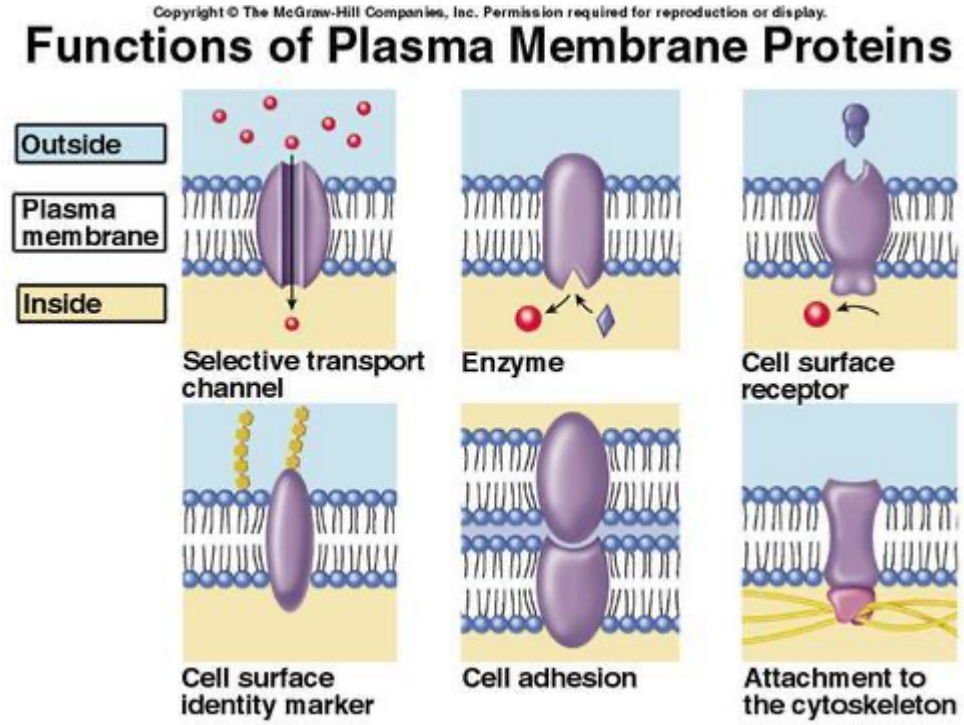
29. What is the function of the phospholipid bilayer?

    Protect cell, allow some things into/out of cell and prevent others from entering or leaving

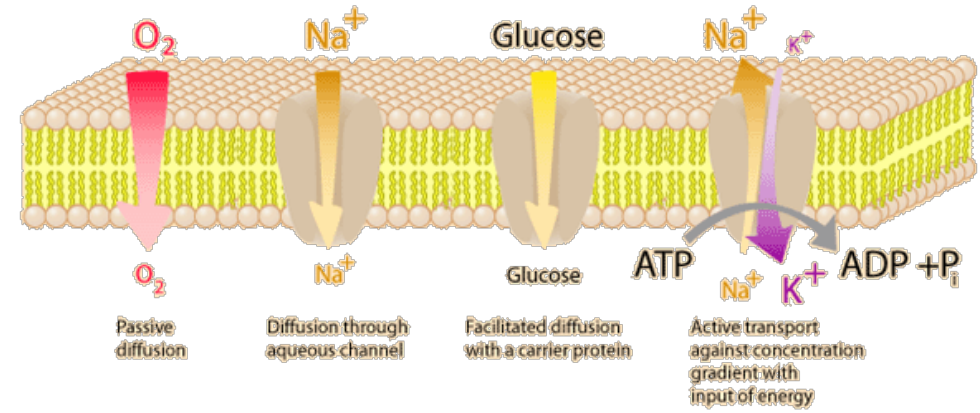
30. What are the roles of the components are in a phospholipid bilayer? (phospholipid, cholesterol, membrane proteins, glycoproteins, glycolipids)

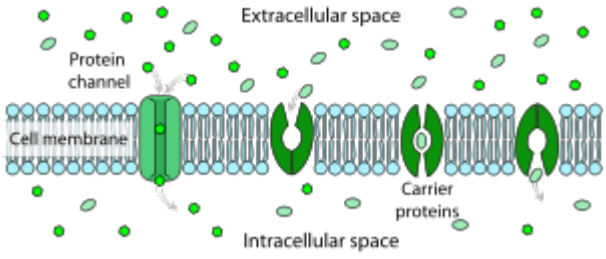
The Components and Functions of the Plasma Membrane	
Component	**Location**
Phospholipid	Main fabric of the membrane
Cholesterol	Attached between phospholipids and between the two phospholipid layers
Integral proteins (for example, integrins)	Embedded within the phospholipid layer(s). May or may not penetrate through both layers
Peripheral proteins	On the inner or outer surface of the phospholipid bilayer; not embedded within the phospholipids
Carbohydrates (components of glycoproteins and glycolipids)	Generally attached to proteins on the outside membrane layer

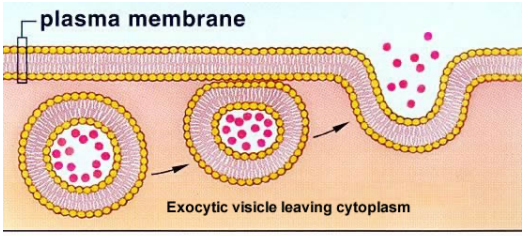
31. Describe the 6 major ways of membrane proteins function?

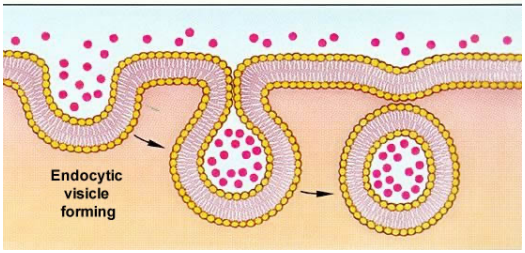


32. Describe the methods of transport across membranes (passive, active, osmosis, diffusion – simple & facilitated, endocytosis, exocytosis)

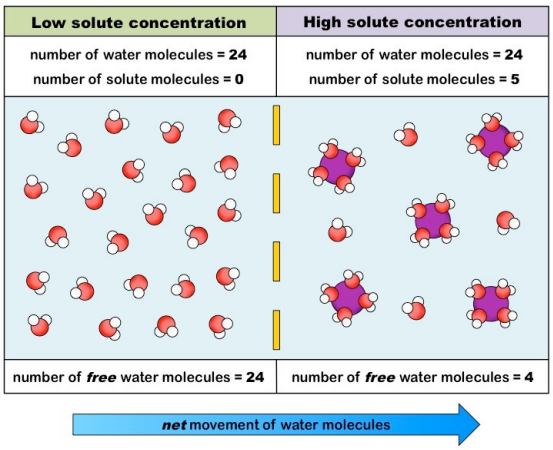





plasma membrane
Exocytic visicle leaving cytoplasm


Endocytic visicle forming

Osmosis


Low solute concentration
High solute concentration
number of water molecules = 24
number of solute molecules = 0
number of water molecules = 24
number of solute molecules = 5
number of free water molecules = 24
number of free water molecules = 4
net movement of water molecules