Describe the fluid-mosaic model of a plasma membrane. Discuss the role of the membrane in the movement of materials through by each of the following processes.

a. Active Transport
b. Passive Transport

STANDARDS:

FLUID-MOSAIC MODEL: Max. = 9 points

__ Singer/Nicholson or "differs from" Davson/Danielli
__ Dynamic
__ Phospholipid Bilayer
__ Hydrophilic heads/hydrophobic tails and explanation
__ Polar/Nonpolar
__ Proteins - intrinsic/extrinsic
__ Permeases (active + passive)
__ Pores or apertures
__ Functional "R" Groups
__ Glycoproteins or carbohydrates (recognition)
__ Diagrams appropriately used with explanation
__ Selectivity

TRANSPORT Max = 9 points

PASSIVE TRANSPORT:

__ Definition of Diffusion
__ Osmosis
__ Size of molecule / polarity
__ Facilitated Diffusion
__ Function of pores

ACTIVE TRANSPORT:

__ Definition
__ ATP
__ ATPase
__ Na^+/K^+ Pump
__ Substances diffuse in-need transport out
__ Carrier molecules and specificity

A laboratory assistant prepared solutions of 0.8 M, 0.6 M, 0.4 M, and 0.2 M sucrose, but forgot to label them. After realizing the error, the assistant randomly labeled the flasks containing these four unknown solutions as flask A, flask B, flask C, and flask D.

Design an experiment, based on the principles of diffusion and osmosis, that the assistant could use to determine which of the flasks contains each of the four unknown solutions.
Include in your answer
(a) a description of how you would set up and perform the experiment;
(b) the results you would expect from your experiment;
and
(c) an explanation of those results based on the principles involved.

(Be sure to clearly state the principles addressed in your discussion.)

STANDARDS:

A. EXPERIMENTAL SET-UP (1 point each)

___ 1. Experiment based on concentration gradient

___ 2. Experiment based on semipermeable membrane
(dialysis tubing, thistle tubes, plant or animal cells)

___ *3. Experimental set-up (design) adequate to produce measurable results

___ *4. (2 max) Experimental variables are eliminated
(mass, volume, time, temperature, tissue type, etc.)

___ *5. Experimental set-up is exemplary
(must include semipermeable membrane)

B. RESULTS (1 point each)

___ *1. Describes a measurable change

___ *2. Correctly correlates the observed changes with molarities of unknowns

C. APPLICATION OF PRINCIPLES TO RESULTS (1 point each)

___ *1. Correctly applies principles of diffusion and osmosis in the interpretation of results
(a correct analysis)

___ 2. Demonstrates an understanding of the concept of water potential
(hydrostatic/turgor pressure) in analysis of results

D. PRINCIPLES (1 point each)

___ 1. Demonstrates an understanding, or gives a correct definition of diffusion

___ 2. Demonstrates an understanding, or gives a correct definition of osmosis
** (must include both water and semipermeable membrane)

___ 3. Demonstrates an understanding, or gives a correct definition of selective permeability

___ 4. Describes how solute size and/or molar concentration (hypertonic/hypotonic) affect the process of diffusion through a membrane

_____
Max possible = 14

* No points if the lab will not work.

**Osmosis: the diffusion of water through a selectively (semi)permeable membrane in the following directions:

- from higher water potential toward lower water potential
- from hypotonic (hypoosmotic) solution toward hypertonic (hyperosmotic) solution
- from higher water concentration toward lower water concentration
- from lower solute concentration toward higher solute concentration
- from region of lower osmotic pressure toward regions of higher osmotic pressure
- from region of higher osmotic potential toward region of lower osmotic potential

Membranes are important structural features of cells.
(a) Describe how membrane structure is related to the transport of materials across a membrane.
(b) Describe the role of membranes in the synthesis of ATP in <u>either</u> respiration <u>or</u> photosynthesis.

Membranes serve diverse functions in eukaryotic and prokaryotic cells. One important role is to regulate the movement of materials into and out of cells. The phospholipid bilayer structure (fluid mosaic model) with specific membrane proteins accounts for the selective permeability of the membrane and passive and active transport mechanisms. In addition, membranes in prokaryotes and in the mitochondria and chloroplasts of eukaryotes facilitate the synthesis of ATP through chemiosmosis.

PART A. (6 Maximum)
Membrane Structure (3 Internal Maximum)
__ Phospholipid structure - hydrophilic, hydrophobic, amphipathic
__ Phospholipid bilayer / fluid mosaic description
__ Proteins embedded in the membrane
__ Sterols embedded in the membrane
__ Well-labeled diagram may replace one of the above

Membrane Transport (3 Internal Maximum)
__ Use of the term "selectively permeable" or a good definition of selective permeability or an explanation of the role of phospholipids or proteins including nuclear pore proteins in determining selective

permeability
__ Description of the effect of size, charge, polarity, lipid solubility on membrane permeability

Mechanisms + description related to structure:
__ Passive transport: diffusion / osmosis + reference to membrane gradient
__ Ion channel: transport as a mechanism for a change in permeability
__ Facilitated diffusion: description (symport, antiport, uniport)
__ Active transport: description
__ Exocytosis, endocytosis, phagocytosis, pinocytosis: description

(1 pt additional) A good example of one of the above mechanisms

PART B. Role of the Membrane in the Production of ATP in Photosynthesis <u>or</u> Respiration (6 Maximum)

Chemiosmosis:
__ Involved molecules are embedded in the membrane
__ Electron carriers are sequentially organized
__ The energy comes from the flow of electrons
__ H^+ / Proton / pH gradient established
__ Movement through the membrane generates ATP
__ A specific protein makes ATP

RESPIRATION	**or**	**PHOTOSYNTHESIS**
__ Site is the mitochondrion		__ Site is the chloroplast
__ Inner mitochondrial membrane (cristae) are involved in eukaryotes		__ Thylakoid / grana membranes are involved in eukaryotes
__ Folded membrane present		__ Folded membrane present
__ Cell membrane is involved in prokaryotes		__ Thylakoid / grana membranes involved in prokaryotes
__ Correct direction of H^+ flow		__ Correct direction of H^+ flow