Movement Through Membranes

Name _____

Date _____ Section _____

Score/Grade _____

Diffusion

1. Time in minutes for methylene blue to become evenly dispersed throughout the beakers.
Answers will be similar to those shown below.

Water Temperature	Time (min)
5°C	**60**
25°C	**15**
50°C	**2**

2. What causes the more rapid dispersion? **Molecules move faster at higher temperatures.**

3. What is the principal driving force for net diffusion? **The diffusion gradient.**

4. Solution concentration using conductivity probe **Answers will be similar to those shown below.**

Solution	Conductivity (μS/cm)
Air	**0**
0.1% NaCl	**1,732**
0.5% NaCl	**6,275**
1% NaCl	**10,336**
3% NaCl	**15,286**

5. Concentration gradients and rate of diffusion **Answers will vary.**

	1% NaCl		5% NaCl		10% NaCl	
Time	Conductivity (μS/cm)	NaCl conc.	Conductivity (μS/cm)	NaCl conc.	Conductivity (μS/cm)	NaCl conc.
1 min						
2 min						
3 min						
4 min						
5 min						

6. For which NaCl concentration do you observe the greatest change over time? Why do you think this is the case?
The 10% NaCl solution, because the concentration gradient between the dialysis bag and the water in the beaker is the greatest.

7. Between which time intervals did the greatest change occur? **Between 0 and 1 minute.**

8. Using Fick's law of diffusion as a reference, identify the specific part of the equation that brings about the change in the rate of diffusion over time.

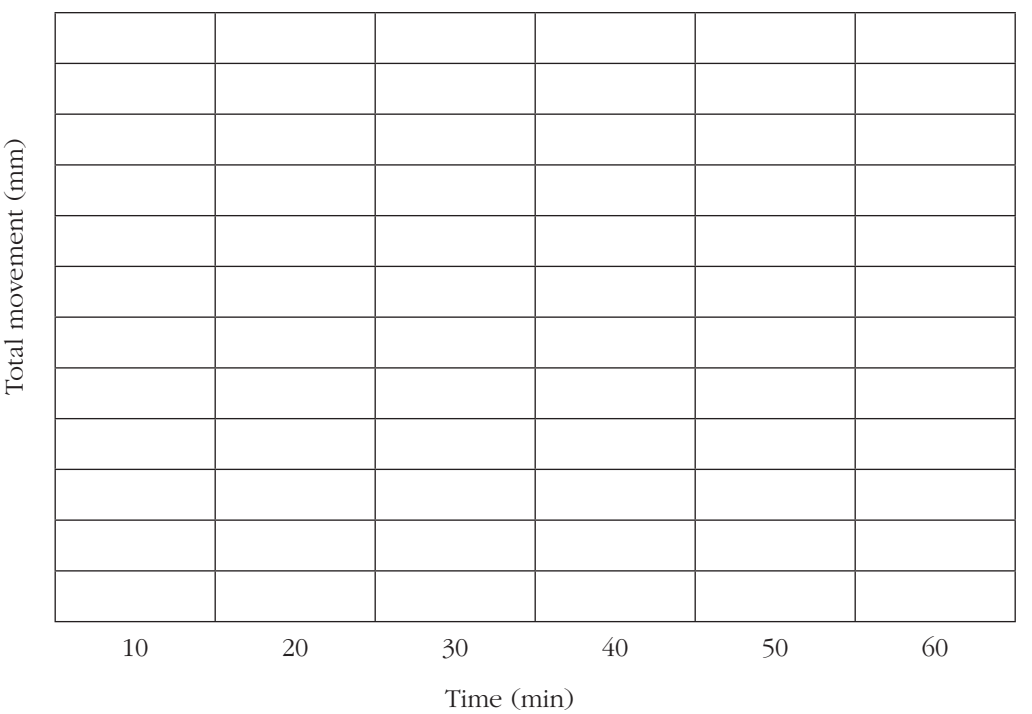
As NaCl diffuses into the beaker, the concentration gradient is reduced (therefore reducing the rate of diffusion).

Osmosis

1. Osmotic pressure **Answers will vary; example values are provided.**

		Fluid Movement (mm)					
Solution	Movement Increment	10 min	20 min	30 min	40 min	50 min	60 min
30% sucrose	Total movement	**10**	**18**	**24**	**29**	**32**	**33**
	10-min movement	**10**	**8**	**6**	**5**	**3**	**1**
60% sucrose	Total movement	**22**	**42**	**56**	**67**	**73**	**75**
	10-min movement	**22**	**20**	**14**	**11**	**6**	**2**

2. Plot osmotic pressure **Answers will vary. See Appendix C for information on plotting a graph.**



3. Osmotic pressure developed initially by each solution

30% sucrose = **21.25** atm **π = (0.082) (298) (0.87 m)**

50% sucrose = **42.75** atm **π = (0.082) (298) (1.75 m)**

4. How is diffusion related to osmosis? **Osmosis is net diffusion of water.**

5. Where in the body do we find osmosis operating? **Across capillaries and other membranes.**

6. What causes the fluid movement to decrease with time? **A decrease in the concentration gradient.**

7. Osmosis in plant cells **Answers will vary; example values are provided.**

Solution	Initial Volume (ml)	Final Volume (ml)	Percent Change in Volume
Distilled water	**1.80**	**2.26**	**+25**
0.4% NaCl	**1.48**	**1.64**	**+11**
0.9% NaCl	**1.50**	**1.50**	**0**
5% NaCl	**1.52**	**1.33**	**–12.5**
10% NaCl	**1.45**	**1.16**	**–20**

8. If the final cell size were examined, how would it compare for the potato cells in each solution? Explain.
Distilled water – greatly enlarged; 0.4% NaCl – enlarged; 0.9% NaCl – no change (isoosmotic); 5% NaCl – smaller; 10% NaCl – quite shrunken in size.

Tonicity

1. Record the lysis time. **Answers will be similar to those shown below.**

Solution	Lysis Time
Soap solution	**6**
Distilled water	**30**
0.2% NaCl	**45**
0.4% NaCl	**75**
0.6% NaCl	**Seldom lyses**
0.9% NaCl	**No lysis**
2% NaCl	**No lysis**
5% NaCl	**No lysis**

2. Explain the differences in cell size you observed under the microscope between cells in the 5% NaCl solution and cells in the distilled water.
5% NaCl – cells are crenated since water moves out of the cell.
Distilled water – cell fragments due to lysis.

3. Compare the mechanisms causing lysis of cells in these solutions:
0.2% NaCl **Osmotic movement of excess water into the cells.**
Soap solution **Detergent action disrupts cell membrane's lipid matrix.**

4. In which of the solutions would crenated cells be found? **In the 2% NaCl and the 5% NaCl.**

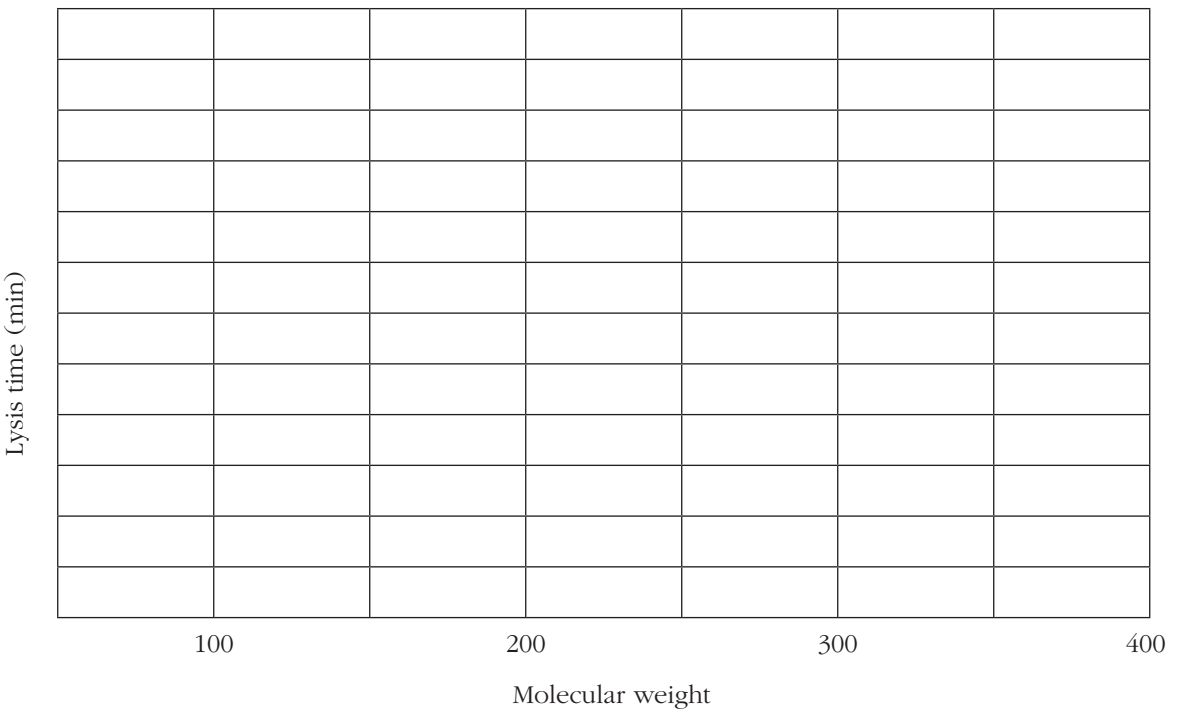
5. Which solutions would be rated as:
Hypertonic **2% and 5% NaCl.**
Hypotonic **Distilled water; 0.2% NaCl; 0.4% NaCl; 0.6% NaCl.**

6. Which solution would you rather receive via an intravenous injection? Why? **The 0.9% NaCl, since it is isotonic and the cells would remain the same size.**

Cell Permeability

1. Molecular size and cell permeability **For Urea (60 MW) and Glycerine (92 MW), answers will vary; example values are provided.**

Solution	Lysis Time (min)
Urea (60 MW)	**55**
Glycerine (92 MW)	**145**
Glucose (180 MW)	**No lysis**
Sucrose (342 MW)	**No lysis**

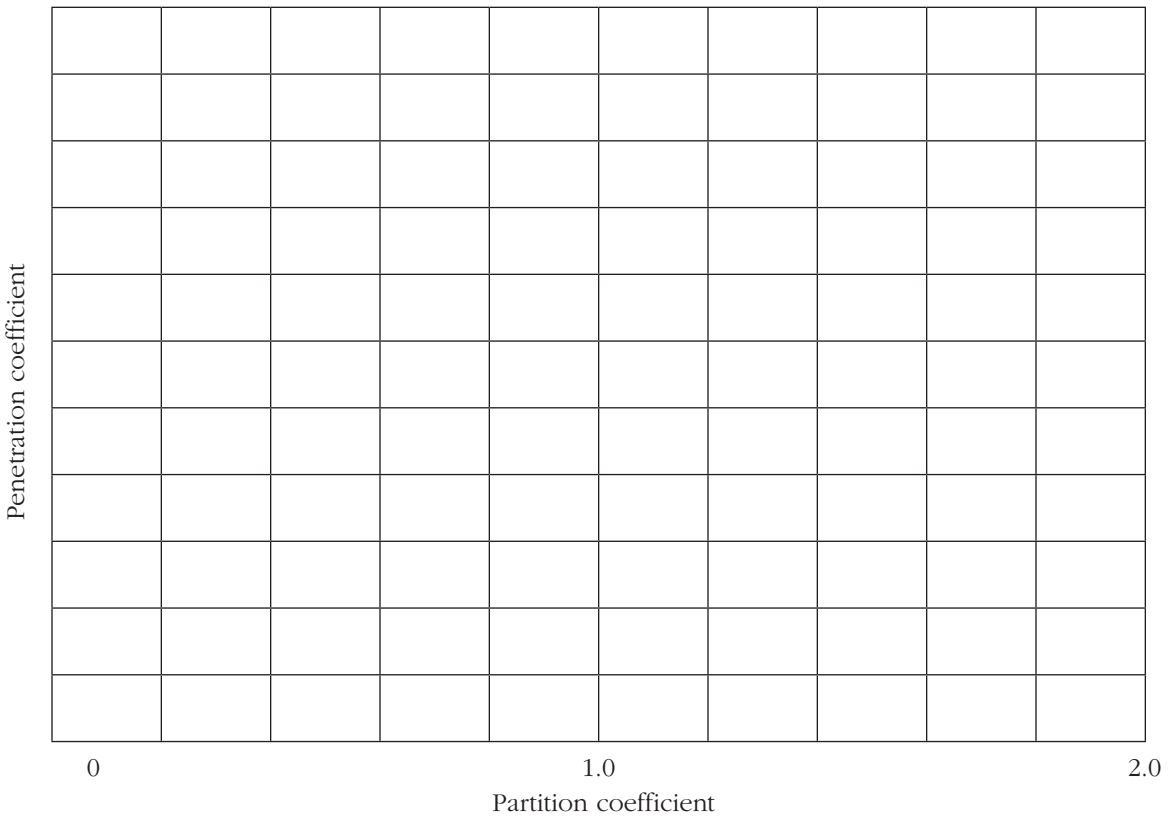


2. Why are some hypertonic solutions able to cause lysis? **Small molecules in some solutions can diffuse down the concentration gradient, water follows into the cell, and lysis occurs.**

3. Why does molecular weight affect the movement of molecules through membranes? **Membrane pore size of 7–8Å allows only smaller molecules to enter, excluding large molecules (mw > 100).**

4. Lipid solubility and cell permeability **Answers will be similar to those shown below.**

Concentration and Type of Alcohol	Partition Coefficient	Penetration Time (min)	Penetration Coefficient
22 M methyl alcohol	**0.01**	**4.25**	**0.193**
8.5 M ethyl alcohol	**0.03**	**3.75**	**0.441**
3 M propyl alcohol	**0.13**	**2.56**	**0.854**
1.1 M isobutyl alcohol	**0.18**	**1.88**	**1.710**
1.1 M n-butyl alcohol	**0.58**	**2.00**	**1.820**
0.38 M amyl (or iso-amyl) alcohol	**2.00**	**1.56**	**4.110**



5. What is the primary factor governing penetration of alcohols (and similar compounds) through biological membranes? **Their lipid solubility.**

6. Why are different concentrations of alcohols used in this experiment? **To shorten the penetration times so that the experiment can be completed during the lab period.**

7. What role does ATP play in active transport? **It provides the energy needed to activate the ion sites on the protein carrier or alter the carrier's configuration.**

8. How are active transport and facilitated diffusion similar? **Both use an integral protein carrier to move a substance through the membrane.**

How are they different? **Active transport moves a substance against a concentration gradient using ATP. Facilitated diffusion uses the concentration gradient to move a substance with its gradient.**

9. What role do lysosomes play in the bulk transport process of endocytosis in phagocytic cells? **Lysosomes fuse with an ingested vesicle so that their enzymes can perform intracellular digestion.**

APPLY WHAT YOU KNOW

1. Unless delivered intravenously, a drug must cross several semipermeable cell membranes before it reaches the systemic circulation. Identify the different mechanisms used by a molecule to cross a cell membrane.

Depending upon its properties, a molecule may move into a cell via diffusion, facilitated diffusion, active transport, or endocytosis.

2. Explain why all isosmotic solutions do not have the same effect (no change in volume) on cells that isotonic solutions have.

Since all isosmotic solutions are not isotonic, the diffusion of solutes into the cell will cause cellular volume changes that would not happen in the case of a cell immersed in an isotonic solution.