# Lab 3: Cell transport

## **POST-LAB DATA SHEET AND WRITE-UP (15 POINTS)**

Name(s) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

### Activity 1. Selective Permeability and Osmosis

**A. Osmometer Demonstration**

1. (2 points) Given that sucrose weighs 342 g/mole (and that a 15% solution means water is added to 15 grams of solute until the solution volume is 100 ml), calculate the molarity of the two (15% and 30%) sucrose solutions used in this Lab. Calculate the osmolarity of the two sucrose solutions. Use dimensional analysis and show your work.

2. (1 point) Is either of these solutions iso-osmotic to human cells? (Human cells are 0.3 to 0.32 Osmoles/L).

3. (2 points) In the human kidney, urine is formed from blood plasma by filtration followed by reabsorption and/or secretion of various substances. One region of the kidney, known as the renal medulla, contains very high concentrations of both salts and urea in the interstitial fluid. Fluid that has been filtered from blood plasma flows through tubules that run through the renal medulla. This filtrate in the tubules is being concentrated to turn it into urine. How would the high concentrations of salts and urea in the renal medulla (the fluid OUTSIDE the tubules) allow us to generate urine that is highly concentrated (hyperosmotic) compared to blood plasma?

**B. Dialysis across a Semi-Permeable Membrane**

4. (1 points) If you would have weighed the bag containing the starch solution before and after this experiment, would you expect the weight to change? Why or why not? Remember that water can cross in or out of the bag.

**C. Red Blood Cells as Osmometers**

5. (2 points) Given that NaCl weighs 58 g/mole and that a 0.9% solution (normal saline) means that water is added to 0.9 grams of NaCl until the solution volume is 100 ml, what is the molarity of normal saline (also known as isotonic saline)? What is the osmolarity of isotonic saline? Show your work.

6. (1 points) What happened to the RBCs when you passed distilled water under the coverslip?

7. (2 points) A 1.92% urea solution has an osmolarity of 320 mOsm, which is the same osmolarity as cells have. Predict what will be seen under the microscope if a drop of red blood cells is transferred into a test tube containing 1.92% urea. Is the response the same or different than when the cells were placed into isotonic saline? Why?

### Activity 2. Effect of Molecular Weight and Lipid Solubility on Membrane Permeability

8. (2 points) How would you expect ethanol and propanol to compare to methanol and butanol in their diffusion rates based on your observations in Activity 2? How would ethanol and butanol compare to each other?

ethanol 🡪 MW = 46 g/mole; lipid solubility = 350 g/L

propanol 🡪 MW = 60 g/mole; lipid solubility = 1000 g/L

9. (2 points) The plasma membrane of human cells is selectively permeable, but it is more complex than a dialysis bag. Some small particles (like water) can slip through the phospholipid bilayer, but other, even smaller particles (like Na+ ions) cannot (without a channel or pump). This difference is due to the fact that the hydrophobic interior of the phospholipid bilayer repels the charged Na+ ion more strongly than it repels the somewhat polar water molecule. Even bigger molecules, like glucose, can also be brought across the plasma membrane, but the cell must use proteins called carriers to transport glucose. With these ideas in mind, which of these particles do you think could cross the plasma membrane without the use of a channel, pump, or carrier?

O2 (small and nonpolar)

Cl- (small, but very hydrophilic)

K+ (small, but very hydrophilic)

CO2 (small and nonpolar)

amino acids (large and often polar)