Estimation of Tissue Osmolarity Lab (IB Biology)

Purpose: In this lab, you will learn how to use experimental data to estimate the osmolarity of a fruit or vegetable tissue.

For your lab report, label each section of the lab and answer all of the questions for that section in order.

**Section 1: Calculating Molarity**

Background:

* **Molarity (M)** refers to the number of **moles** of solute per liter of solution. When we weigh one mole of a substance on a balance, this is called a "molar mass" and has the following unit: g/mol (grams per mole). The molar mass of a substance is the [molecular weight](http://www.chemteam.info/Mole/MolecWt.html) in grams.
* We express molarity as follows: If a solution has one mole of a substance per liter, we say it is a 1 molar (1M) solution. If it has 2 moles per liter it is a 2 molar (2M) solution, and so on.
* Hint: To get the correct molarity, first weigh the substance and add it to a graduated cylinder, then add water to get to the appropriate volume.

**Questions:**

1. *Sucrose has a molar mass of 342.3 grams per mole.* 
   1. *Explain how you would make 1 liter of a 1 molar (1M) solution of sucrose.*
   2. *Explain how you would make 1 liter of a 2 molar (2M) solution of sucrose.*
2. *Sucrose has a molar mass of 342.3 grams per mole. Showing your work, calculate the number of grams of sucrose needed to make 100 ml of the following:*
   1. *1.0 M sucrose solution*
   2. *0.8 M sucrose solution*
   3. *0.6 M sucrose solution*
   4. *0.4 M sucrose solution*
   5. *0.2 M sucrose solution*
   6. *0.0 M sucrose solution*

**Section 2: What is Osmolarity?**

* **Osmolarity** is the number of **osmoles** per liter of solution. An **osmole** (Osmol) is 1 mol of particles that contribute to the osmotic pressure of a solution.
* Osmolarity and molarity of a substance are often the same. For example, a sucrose solution with a molarity of 1 mol/L is the same as a sucrose solution with an osmolarity of 1 Osmol/L. This is because sucrose does not dissociate in solution.
  + Note (in case you need it for an internal): Molarity and Osmolarity are different in substances that dissociate into ions like NaCl. Since NaCl dissociates in solution to form Na+ and Cl-  ions, 1 mol of NaCl becomes 2 moles of particles in solution (1 mol of Na+ and 1 mol of Cl- ).
* The units used to express osmolarity are Osmol/L. As mentioned above, osmolarity may also be expressed as molarity (mol/L) if the substance does not dissociate.

**Questions**

1. *How are osmolarity and molarity similar? Under which circumstances will these values be different?*
2. *In our lab, we will be using sucrose as our solute. For sucrose, are osmolarity and molarity values the same or different? Explain your answer.*
3. *If we were to use sodium chloride as our solute would the osmolarity and molarity values be the same or different? Explain your answer.*

**Section 3: Designing an Experiment to Determine Osmolarity**

Your task:

1. You must first make the following 100 ml of the following sucrose solutions (note that you already calculated how to do this):
   1. 1.0 M sucrose solution
   2. 0.8 M sucrose solution
   3. 0.6 M sucrose solution
   4. 0.4 M sucrose solution
   5. 0.2 M sucrose solution
   6. 0.0 M sucrose solution
2. As you make each solution, pour it into a labeled beaker.
3. You will be assigned a tissue or sample (potato, grapes, carrots etc.)
4. You must determine the osmolarity of this tissue by allowing it to soak in the above solutions for about 24 hours.
5. Discuss as a group how this might be done. Then answer the following questions (with full sentences):

**Questions**

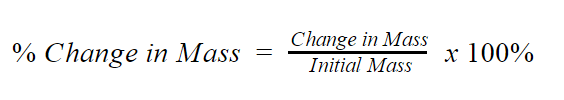
1. *What is the problem?*
2. *What is the independent variable for this experiment?*
3. *What is the dependent variable for this experiment?*
4. *What are some controlled variables for this experiment?*
5. *Devise a method to control these variables as a group. Remember, that you want to collect sufficient quantitative data to determine the osmolarity of the tissues as accurately as possible. Hint: one trial is probably not enough… Explain your method for accomplishing these tasks in detail.*

**Section 4: Data Collection and Analysis**

1. Perform the experiment that you designed.
2. Collect data using the data table you design (see question 11).

**Questions**

1. *Design a data table appropriate for the data you will be collecting. Be sure to include an appropriate title, labels, units etc. Collect your data using this data table.*
2. *Calculate the percent gain and loss of your tissue samples for each concentration. Show your work. Note: to calculate percentage gain or loss, use the following equation:*

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1. *Explain why you are calculating percent change in mass instead of just using the change in mass directly.*
2. *Plot your percent changes in mass on a graph of your design. Be sure to use an appropriate title, labels, units etc. Plot a trend line on this graph and use it to estimate the osmolarity of your tissue samples.*
3. *Clearly explain how you used the trend line to estimate the osmolarity of your tissue samples. Be sure to use the following terms: hypertonic, hypotonic and isotonic.*
4. *Explain the limitations to your experimental design and how you might address these limitations in the future.*
5. *Write out 3 further questions that you could investigate using the techniques and knowledge from this lab.*