**Subject area/course**: Science/Biology

**Grade level/band**: 11-12

**Task source**: Educational Policy Improvement Center (EPIC)

**Water Works: Cells & Osmosis**

**STUDENT INSTRUCTIONS**

1. **Task context**:

Have you or anyone you know undergone surgery? Or do you watch medical shows on TV? If so, you’ve probably seen an intravenous drip (or IV). IV therapy is when a liquid solution is delivered directly to a vein. IVs are used in a variety of medical treatments, including restoration of electrolyte balance in patients suffering from dehydration and the delivery of chemotherapy drugs for cancer patients. The commonness of this type of therapy may lead you to believe this is a simple process. In fact, a lot of knowledge of both chemistry and cellular biology is involved in making such IV drips work. If the solute concentration in the drip is not correct, there can be serious consequences for the patient.

In this exercise you will explore the possible issues that must be taken into consideration when making an IV. You will place cells in solutions that differ in their solute concentration. Some will be *hypertonic* (greater solute concentration when compared to the cell), some will be *isotonic* (same solute concentration as the cell) and some will be *hypotonic* (less solute concentration when compared to the cell). Based on your knowledge of diffusion and osmosis,

* What is your hypothesis about what will happen to cells placed in these three solutions? Why?
* What are the consequences for a patient’s cells if the solute concentration in an IV drip is too high or too low?
* What factors may determine how quickly solutes move from the IV drip into cells?

1. **Final product**:

After researching diffusion and osmosis using your textbook and online resources, test your understanding by doing experiments exploring how solute concentration affects diffusion and how cells react when placed in different kinds of solutions. You should develop hypotheses based on your understanding of diffusion and osmosis.

Write a 4-page lab report, including an introduction, methods, results (including a graph), and discussion section. In the introduction, be sure to include an explicit hypothesis, then present your data, and then state clearly in the conclusion whether that hypothesis was supported or not. Support your conclusion with specific data/observations from your experimental data.

Your paper should:

* + Use discipline-specific vocabulary.
  + Cite your sources correctly in the text of your paper and create a Works Cited page using MLA format or another style that your teacher selects.

**Additional Information**

1. **Knowledge and skills you will need to demonstrate on the task:**

* Why and how substances move through membranes
* Why some substances move faster than others through membranes
* Why concentrations of substance cause differences in movement through membranes
* Comparing how hypertonic, hypotonic, and isotonic solutions react with each other
* Setting up experiments to test hypotheses
* Creating data tables for comparison of data
* Using data to come to a conclusion about cellular processes

1. **Materials needed:**

* Agar plates (in petri dishes with lids)
* 2 concentrations of Methylene blue
* Cork borer
* Wax pencil or sharpie
* Ruler
* Dialysis tubing representing animal cells
* Distilled water
* Salt water
* Extracellular fluid
* Scale

1. **Time requirements:**

This task will take approximately 1 week. Your teacher may choose to make changes to the task or adjustments to the timeline.

|  |  |
| --- | --- |
| Prior to experiment (at home or in class) | Research diffusion and osmosis |
| Day 1 | Design experiment with group and make hypothesis |
| Day 2 | Do Methylene Blue experiment, create data tables, finish designing osmosis experiment |
| Day 3 | Do Dialysis tube experiment, create data tables, share data |
| Day 4 | Share data, collaborate and make conclusions |
| Day 5 | Share data, collaborate and make conclusions |

1. **Scoring:**

Your work will be scored using the SCALE Scientific Practices Rubric (Grades 9-12) and/or the CCR Task Bank Rubric. You should make sure you are familiar with the language that describes the expectations for proficient performance.

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**Student Experiment Guidelines**

**Diffusion experiment:**

* 1. Decide on 2 percents of methylene blue that might be used to show different diffusion rates, decide on how often the data will be collected over a 40-minute period, decide how the data will be recorded and presented.
  2. Write down hypothesis about how the solute concentration may affect diffusion rate.
  3. Gather 2 petri dishes with agar in each petri dish
  4. Use the cork borer, cut a hole in the middle of the agar.
  5. Place the lid on the petri dish and mark the middle of the hole with a wax pencil or Sharpie.
  6. Fill each of the two holes with a different methylene blue solution
  7. Place the lid back on, mark the edge of diffusion, and measure the distance the methylene blue moved at the predetermined intervals. When finished, make an appropriate display of the data (e.g. table, graph, etc.).
  8. Between measurement intervals, determine how to graph diffusion data and finish designing the osmosis/dialysis tubing experiment

**Osmosis experiment**

* 1. Gather three 9-inch dialysis tubes
  2. Decide on the solutions that will go inside the dialysis tubing and the solutions that the dialysis tubing will soak in for 20 minutes to determine direction and rate of molecular movement and results of the movement. Decide on how the data will be recorded and presented.
  3. Write down hypothesis about what should happen to the dialysis tube when placed in each of the following solutions: hypotonic, hypertonic, and isotonic
  4. Place a determined amount of substance into dialysis tubing
  5. Weigh bags and record.
  6. Place the dialysis tubing into a predetermined solution for 20-30 minutes depending on length of class time
  7. Weigh bags
  8. Mathematically determine the percent difference between start mass and final mass
  9. Draw results of osmosis experiment and determine which substances are hypertonic, hypotonic, isotonic, what happened in each case and why.