Lab 2 - Model Cell 2

(adapted with permission from R. Griffin, City College of San Francisco)

Note: You need to bring goggles to this lab

A. Objectives

Become familiar with

1. Certain properties of non-living membranes which are shared with the membranes of living organisms;
2. The actual practices of strong inference and deductive reasoning;
3. Tests for detecting ions and molecules;
4. Find out how dialysis tubing discriminates between particles. Compare this to the discrimination of living cell membranes.

B. Before coming to lab

From last laboratory's investigation, you can deduce that at least one substance passed through the membrane while at least one other could not pass through the membrane. In today's investigation, we want to

a) determine which of the substances (including the constituents of Lugol's Iodine) present can actually pass through the membrane; and
b) hypothesize which property of the substance its (dis)ability to pass through the membrane is based.

To prepare for this lab,

1. Read this exercise. Pay special attention to the materials available and the safety notes that accompany them.
2. Construct in your notebook a table similar to the one for the color change investigation, this time with **at least 5** hypotheses about the permeability of the dialysis membrane to the substances present in the first investigation. Write the experiment(s) you plan to perform to test each hypothesis. Since you have at least 5 hypotheses to test, think about how you can save time and materials.
3. Don't forget to bring the page assessing your experimental design and the title for a hypothetical report on the last lab.

C. Procedures during lab

1. Carry out the experiments to test each hypothesis and fill in the table.
2. **Clean-up and waste disposal**. Dispose of all solutions containing iodine, cobaltinitrite, Benedicts, or silver nitrate in the containers provided. Starch, glucose, sodium, potassium, and chloride ions can be flushed down the sink. For glassware clean-up see above.

D. Materials available

Materials	Notes
All materials from Lab 1	
Benedict's (B.'s)reagent (a solution of cupric sulfate, sodium carbonate and sodium or potassium citrate)	A test for reducing sugars, such as glucose. Place 1 or 2 mL of the solution to be tested in a test tube with an approximately equal volume of B.'s and place the test tube in a water bath*****. After 3-5 minutes, B.'s will react with any reducing sugar present to form a yellowish/orange precipitate of cuprous oxide. If very little sugar is present, the precipitate will not be visible as a solid precipitate, but the tiny particles will be numerous enough to absorb and scatter light to cause the solution to change from blue to green.
*****Tripods, bunsen burners, igniters, boiling chips, wire gauze	Benedict's test has to be performed in a boiling water bath. Leave the boiling chips in the beaker -- they protect the glassware from breaking (and you from burns). When lighting the bunsen burner, remember to close the air intake first. The igniters work only if you make the spark about two inches above the mouth of the bunsen burner
Silver nitrate ($AgNO_3$)	A test for monoiodide ion (I^{-1}). If I^{-1} is present in a solution, adding a few drops of silver nitrate solution will produce a white precipitate of silver iodide. We do not have a test for I_3^{-1} alone. Tri-iodide ions form only in the presence of an excess of monoiodide. Think about how you can reach conclusions about I_3^{-1}.
Sodium Cobaltinitrite ***Contains glacial acetic acid. Highly corrosive - wear goggles*****	A test for potassium ion. Place 2 mL of the solution to be tested in a test tube and add 15 drops of sodium cobaltinitrite test solution. If potassium ions are present, a yellow precipitate of potassium cobaltinitrite will form in 3 to 5 minutes. Warming the test tube in your hand will speed up the reaction a little bit.

A Note on Safety . . .

*** If you get anything in your eyes in spite of the safety goggles*

1. *Immediately tell your classmates around you and get them to guide you to the nearest faucet or the eyewash spray.*
2. *Hold your eyelids open while someone else runs water into your eyes.*
3. *Rinse your eyes continuously for several minutes after your feel relief.*
4. *Clean up all spills immediately. Do not put acid-contaminated towels in the wastebasket. Neutralize them first.*

E. After lab

Write a laboratory report on Model Cell 2, using the instructions that follow.
Here are some hints for writing the report on model cell 2 (for general instructions on writing laboratory reports refer to the Appendix C).
Your report should include the following, clearly marked sections:

1. A descriptive title in which you communicate the **question** being answered in this investigation.
2. An introduction, in which you explain what the investigation is all about. Again, think of the **question** you've been trying to answer. State hypotheses and educated expectations.
3. A results section in which you report what you observed (note: you do not need to explain the procedures). You might want to report your results in the form of a table.
4. A discussion, in which you analyze and interpret your results. Please also compare your results with the work of your classmates. Point out factors that might have impacted your results and what you would do differently if you were to do this experiment again. If your investigation has led to new questions, state those as a basis for future investigations. Can you answer your questions with certainty?
5. A conclusion, in which you summarize your major findings (answers to your questions) in a concise statement.

F. Lab review

1. What caused the color change? Justify your answer.

2. Where are starch, glucose, tri-iodide -, monoiodide- and potassium ions located after diffusion has been allowed to proceed for 20 minutes?

3. State the evidence on which your inferences are based.

4. What further inferences can you make about the artificial membrane? Why do you think some molecules or ions can pass through the membrane while others cannot?

5. What are the principal ingredients of Lugol's iodine?

6. Explain what is meant when the concentration of a solution is expressed as a certain percent (w:v) (see Appendix D).

7. Which positive and which negative controls (if any) did you use in your tests?

8. Which further tests do you suggest to increase confidence in your results?

9. Identify independent, dependent and control variables for your experiments.

10. Last semester, only two out of 12 teams had positive results when testing the permeability of the artificial membrane for potassium ions. Suggest explanations assuming a) that K^+ cannot, and b) that K^+ can permeate the membrane.