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Thursday Lab

11/2/2023

Lab #2 Molecular Activity and Membrane Transport

Purpose: Investigate the basic properties of passive transport including diffusion, osmosis, and differential permeability. The concept of filtration and the effects of tonicity on cells will also be explored.

Procedures:

2 – B: Measurement of diffusion through a liquid

1. Working in groups, fill three Petri dishes with 40 ml. of 25°C water.
2. Drop one crystal of potassium permanganate into each dish. Be sure to use the same amount of potassium permanganate for each dish. Record the time.
3. Measure, in millimeters, and record the largest diameter of the colored spot after 5minutes.
4. Repeat steps 1-3 for water at 5°C and at 45°C.
5. Construct a graph of ranges and means for each temperature.
6. Based on your knowledge of diffusion, what is an explanation for these results?

2 – C: Measurement of diffusion through agar

1. Petri dishes have been filled with agar. Two holes have been made in the agar. Into one hole, place two drops of methylene blue. Into the other hole, place two drops of potassium permanganate. Record the time and immediate diameter of each spot. This will be your time zero measurement.
2. Measure the diameter of each spot in millimeters once every minute for fifteen minutes. Calculate the averages from the data collected by all groups doing this exercise. Summarize this data.
3. Construct a graph of average diffusion diameter versus time for both chemicals.
4. Determine the diffusion rate of each chemical. Which has the fastest diffusion rate, methylene blue or potassium permanganate? Record these results.
5. Look up the molecular formula and structure of methylene blue and potassium permanganate in a Merck Index. Make note of this information.
6. Interpret your result with respect to the information obtained from the Merck Index

2 – F: Measurement of osmosis

1. Attach dialysis bags filled as much as possible with sucrose solutions securely to the bottom of two open, thin glass tubes. One bag should be filled with a25% sucrose solution and the other should be filled with a 50% sucrose solution. Make sure the ends of the tubes are immersed in the solutions. NOTE: reliable results depend on your ability to tightly seal the dialysis bags.

2. Insert both bags into separate beakers of distilled water making sure the dialysis bags are fully submersed but not touching the bottom of the beakers and suspend each by gently applying a ring stand clamp to the glass tubes. Check for solution leaking out of the bags.
3. Allow five minutes for the systems to equilibrate. Then, mark the fluid levels of each glass tube with a felt pen. Record the time.
4. Record the fluid level of the glass tubes in millimeters every 10 minutes for 50 minutes.
5. If the fluid level rises to the top of the glass tube sooner than 50 minutes, record the time it took to get there, measure the length in millimeters from the equilibration line to the top of glass tube. Divide that length by the number of minutes to get your rate in mm/min.
6. Determine the rate of osmosis for each system. Which system had the fastest osmotic rate, the 25% or 50% sucrose solution? Explain these results.

2 – G: Measurement of differential permeability of sugar and starch

1. Fill a dialysis bag with a 1% starch–10% glucose solution. Reliable results depend on your ability to tightly seal the dialysis bag.
2. Tie the bag to a glass rod and suspend it in a beaker of distilled water. NOTE: Test the water from the bottom of the beaker to ensure that it is free of starch and/or sugar.
3. After 15 minutes have passed check the water again for starch and sugar in the following way:

    Test for starch:

    a. Add 10 drops of Lugol's solution to 5 ml of water obtained from the beaker.

    Reddish color = No starch

    Navy blue color = Starch present

    Test for sugar:

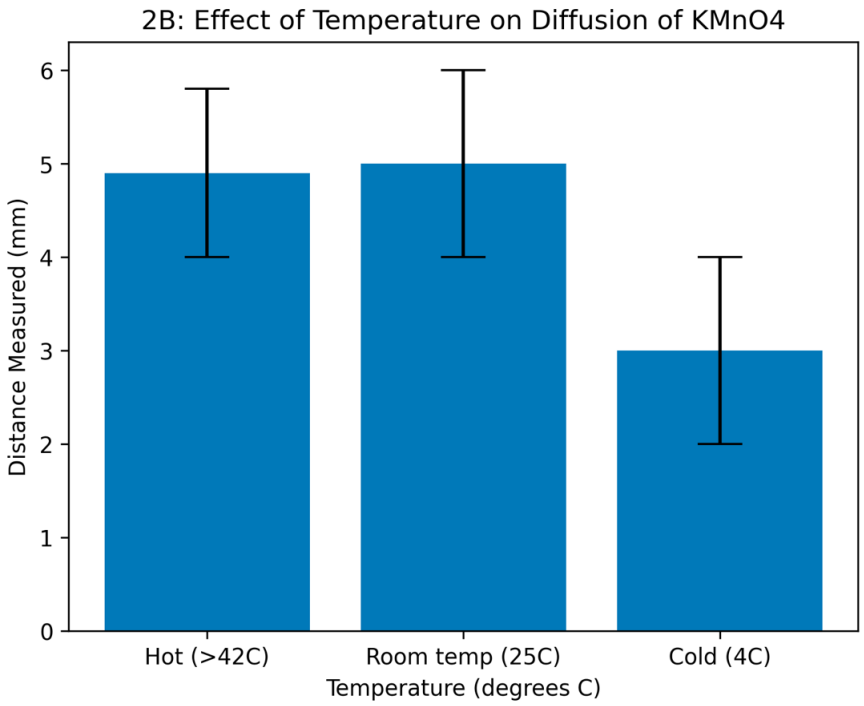
    a. Add 3 ml of Benedict's solution to 5 ml of water obtained from the beaker. Simmer the solution at a low boil for 5 minutes.

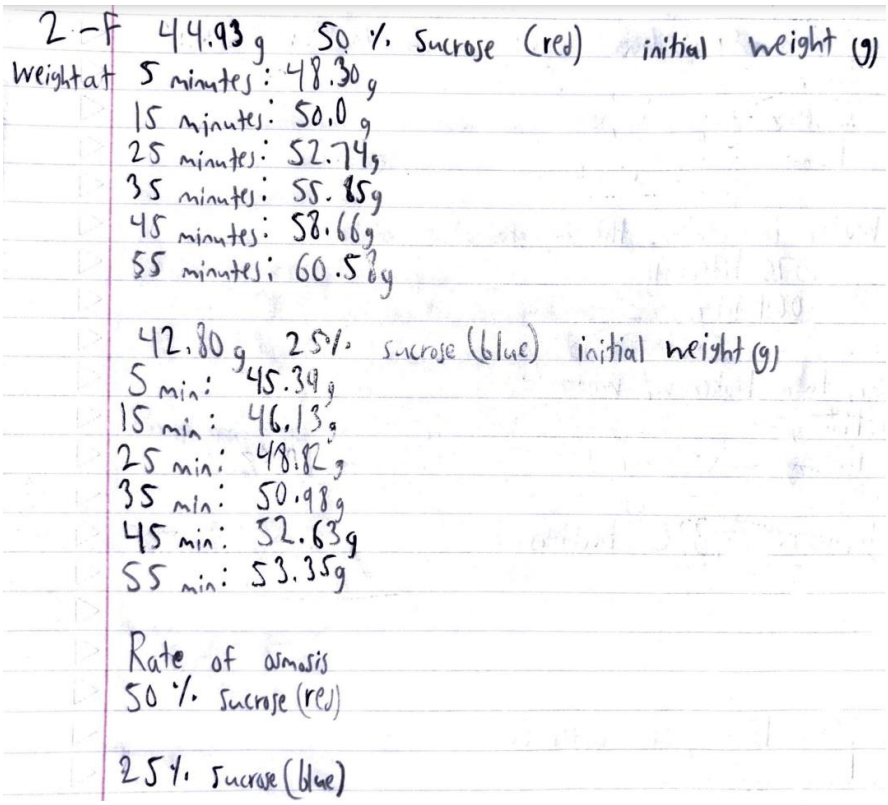
    Blue color = No sugar

    Color change = Sugar present (green = little sugar; yellow =moderate sugar; orange = more sugar; red = lots of sugar)

4. Test the water in the beaker again at 30, 45 and 60 minutes.
5. Record these results. Explain the significance of these findings in relation to the permeability of the dialysis bag.

Results:


2B: Effect of Temperature on Diffusion of KMnO4
Distance Measured (mm)
0
1
2
3
4
5
6
Hot (>42C)
Room temp (25C)
Cold (4C)
Temperature (degrees C)



Discussion: Materials are moved in and out of cells by mechanisms of passive and active transport. Passive transport results from the constant movement of molecules. Diffusion, the movement of particles from higher to lower concentration, and osmosis, the movement of water through a semi-permeable membrane from higher to lower water concentration, are both types of passive transport. Passive transport implies the movement of material, along a concentration gradient, without the expenditure of adenosine triphosphate (ATP) by any living system. Active transport implies the movement of materials against a concentration gradient by expanding ATP.

Conclusion: In conclusion, we were able to identify that cell membranes act as selectively permeable structures, allowing certain materials to pass through while restricting others. We noticed that during the measurement of diffusion through a liquid, the size of diameter of each colored spot fluctuated when in different temperatures. At room temperature the colored spot was 25 ml, at boiling hot the colored spot was 28 ml, and at freezing point the colored spot was 30 ml (the largest diameter of all three). Our group was successful in discovering the basic properties of passive transport including diffusion, osmosis, and differential permeability.