

Factors Affecting Diffusion

In this activity you will investigate the effects of concentration, molecular size, and temperature on the rate of diffusion. To investigate the effect of molecular size, you will study the movement of three different molecules, (methylene blue, congo red and potassium permanganate) through an agar gel. For the effect of temperature you will measure the rate of diffusion of potassium permanganate in water of different temperatures. Finally, for the effect of concentration you will measure the rate of diffusion of potassium permanganate solutions of different concentrations through agar.

Q 1. Write hypotheses predicting the effects of concentration, molecular size, and temperature on the rate of diffusion.

Procedure

A. Diffusion and Molecular Weight

1. Obtain a Petri dish containing agar. Carefully punch three holes in the agar using a cork borer. Use forceps to remove the three plugs.
2. Fill each hole with a small amount of one of the following solutions: 1% congo red, 1% methylene blue solution and 1% potassium permanganate solution. Be careful to not overfill the wells.
3. After one hour, examine the Petri dish and measure the distance in millimeters that each substance has diffused into the agar. (the dishes can be left overnight if that is more convenient)

B. Diffusion and Temperature

4. Place 250 mL of water in a 500 mL beaker and bring it to about 50°C using a hotplate.
5. Place 250 mL of 0°C in a second 500 mL beaker
6. Make a final recording of the temperature of the water in each beaker.
7. Place both beakers on a spot on the bench where they will not be disturbed. Carefully add one crystal of potassium permanganate to the center of each beaker.
8. Over the next 30 minutes, record the changes in the distribution of potassium permanganate in each beaker.

C. Diffusion and concentration

9. Design a protocol to investigate which of three solutions, 1%, 5% and 10% potassium permanganate, diffuses fastest.

Questions

2. Why do you think agar was used in this experiment?
3. From the results in Part A, what can you say about the effect of molecular size on the rate of diffusion?
4. From the results in Part B, what can you say about the effect of temperature on the rate of diffusion?
5. In Part B why was it important to not disturb the two beakers during the experiment?
6. From the results in Part C, what can you say about the effect of concentration on the rate of diffusion?
7. In three separate graphs, show the relationship between each of the three factors and the rate of diffusion.
8. For each factor, did the results support or reject your hypothesis?
9. Give an explanation for the effect of each of these three factors on the rate of diffusion.
10. Parts of this experiment had to be left for a long time.
 - a) Considering the length of time involved, what limitation does diffusion pose to organisms?
 - b) Describe an adaptation you have that mitigates the limitation.