

The Effect of Temperature on Diffusion of Dyes

March 16, 2009

Teresa Ann Lane

Pellissippi State

INTRODUCTION

Diffusion is the movement of molecules in a liquid or a gas from regions of high concentration to regions of low concentration. Diffusion occurs when you spray perfume or air freshener. The scented molecules begin to disperse so that not only those nearby, but those far away can smell the wonderful scent. Diffusion is also responsible to the distribution of sweet sugar throughout your cup of morning coffee. Molecules randomly move from high concentrations to low concentrations so that every sip is sweet. No energy is required for diffusion to occur.

Diffusion is also the mechanism by which oxygen moves into our cells. Oxygen molecules are able to easily cross the phospholipid cell membrane, and the movement of oxygen is regulated by the relative concentration. Oxygen will move from higher concentrations to lower concentrations. Carbon dioxide is also removed from cells by this same mechanism. The purpose of this experiment was to examine the effects of temperature on the rate of diffusion of dyes in an agar plate. The hypothesis being tested is that diffusion will occur more quickly at higher temperatures than at colder temperatures.

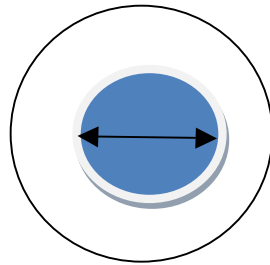
METHODS AND MATERIALS

The following materials are necessary to test the effect of temperature on the rate of diffusion of dyes: three Petri dishes with a layer of 5% gelatin poured into the bottom, a drinking straw, potassium dichromate dye (with a molecular weight of 294), a refrigerator set at 5C, an incubator set at 35C, and a ruler to measure the diffusion of the dye.

Using the drinking straw, a small round pellet of gelatin from the center of each plate is removed. This should leave a small depression or well in the gelatin plate. Into the well of each

plate should be placed a single drop of the potassium dichromate dye solution. It is important to place the same volume of dye into each well. One of the three plates should be placed in the 5C refrigerator. The second plate should be placed in the 35C incubator, and the final plate left at room temperature. The plates should be left to incubate for one hour. After the one hour incubation, the circumference ring of the diffused dye should be measured as shown in Figure 1.

Figure 1: Example showing circumference of diffused dye.



RESULTS

Table 1 below shows the distance potassium dichromate diffused in each temperature after the one hour incubation. Notice that the least diffusion occurred under refrigeration and the greatest diffusion occurred at the highest temperature. The diffusion of potassium dichromate was 2.6 times greater at the highest temperature.

Table 1: Distance Potassium dichromate diffused in three temperatures after one hour of incubation.

Temperature	Circumference of Dye
5C (refrigerator)	17mm
22C (room temperature)	31mm
35C (incubator)	45mm

DISCUSSION

In this experiment, higher temperatures resulted in a faster rate of diffusion. Diffusion is due to the random movement of molecules, and molecules move more quickly at higher temperatures. As temperatures decrease, molecular movement slows down, causing diffusion to occur more slowly. At high temperatures, liquid water becomes a gas as the molecules begin to move rapidly and spread apart from each other. As temperatures cool, water molecules slow their movement and condense together to form liquid droplets (Rayner-Canham, 1983). It is

hypothesized that all molecular movement ceases at -273.15C , otherwise known as absolute zero (Jones, 2009). Research from the University of Maine, School of Marine Sciences shows that cold temperatures do reduce the oxygen delivery to tissues of polar fishes, and their mitochondrial mechanisms to cope with reduced oxygen is being studied (Sidell, 1998). The hypothesis that diffusion will occur more quickly at higher temperatures was supported in this experiment.

REFERENCES

- Jones, Andrew Zimmerman. 2009. Absolute Zero, About.com: Physics. Retrieved March 16,2009 from <http://physics.about.com/od/glossary/g/absolutezero.htm>
- Rayner-Canham, Geoffrey, Arthur Last, Robert Perkins, Mark van Roode. 1983. *Foundations of Chemistry*. Addison-Wesley Publishing Company, Reading, Massachusetts.
- Sidell, BD. 1998. Intracellular oxygen diffusion: the roles of myoglobin and lipid at cold body temperature. *Journal of Experimental Biology*. 201(8):1119-1128.