DIFFUSION DEMONSTRATION
AN INQUIRY ORIENTED PROCESS

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Probably all Biology and Chemistry instructors at both the high school and college level, discuss the concept of diffusion. Many undoubtedly have students do experiments and others do various demonstrations to help students visualize this process. The usual demonstrations involve opening some aromatic substance in a room and having students note the time that each smells the substance. The students closer to the source, smell it first and those increasingly more distant, smell it later and later.

Experiments, many times include putting a bit of potassium permanganate in test tubes of water and putting ammonia and hydrochloric acid in opposite ends of a piece of glass tubing. These experiments do away with the problem of mass movements and convection currents that plague one doing the aromatic substance in the air demonstration. In addition, the glass tube with ammonia and hydrochloric acid provide the opportunity to explore the rates of diffusion in relation to the molecular weights of the substances involved. The problem with these experiments is that they are not easily seen by large groups, thus they are good as experiments but do not make good demonstrations.

Thanks to the ideas of a former student teacher, I now begin discussion of diffusion with an inquiry oriented demonstration of that process.

It is simple to accomplish, takes little in the way of material, is visually attractive (maybe even exciting?), and it works!!

Necessary materials include: eight 1 liter beakers or similar size jars, water, food coloring, ice, a hot plate, a mehtylene blue pill (purchased from any Drug Store), and methylene blue powder. With these, one can demonstrate the process of diffusion without the convection currents and the difference in the speed of the process due to changes in temperature, concentration, and surface area.

Fill the beakers or jars with water a day or two before the demonstration so the water can come to room temperature and be completely still when the demonstration is begun. I usually put the beakers out on the lecture table the night before my demonstration but on occasion, I have had to wheel them into the classroom just ten minutes before the demonstration's onset. The site of eight beakers of liquid lined up across the lecture table, one in an ice bath and a second on a hot plate, always stirs interest and questions among my students. They can't wait to see what I am going to do with all this stuff!

A drop or two of the food color in the first beaker followed by 30 seconds to 1 minute of observation starts the class period. The question to the class is obvious: What is happening? Following an explanation and maybe a short discussion by members of the class, we look to beakers 2 and 3.

I ask "If I put one drop in beaker A and 10 drops in beaker B, in which beaker will diffusion proceed most quickly?" When the hypotheses, and sometimes explanations in support of the hypotheses, are on the board, the
experiment is carried out. Again, observations are made and now the conclusion can be drawn.

Time to move on to beakers 4, 5, and 6. #5 is in the ice bath to a depth of about 100 ml. and #6 is on the hot plate turned to a low heat. "If I put one drop of coloring in each beaker, in which will diffusion proceed most quickly?" (or slowly, if you wish to vary the student's thinking just a bit!) More hypothesizing and explanations by the students, then again the experiment is done and conclusions are drawn.

On to the final two beakers. I show the students the tiny methylene blue pill and small weighing paper containing an equal weight of powdered methylene blue. Both beakers of water are still and at room temperature! Once more the students hypothesize and usually give explanations to defend their hypotheses. The pill is always dropped in first and watched for 20 or 30 seconds before the powder is dumped into its beaker. It usually takes another 30 seconds before much is seen since the powder seems to hang on the surface tension of the water. When the powder goes, it really goes, and audible oohs and aahs can be heard from the students.

I don't lecture about diffusion anymore. These demonstrations, to as many as 180 students at a time, do the job. The students explain what is happening using the scientific process of hypothesis, observation of a simple experiment, and the drawing of their own conclusion in each case. The demonstrations are vivid, non-quantitative (thus not scary to non majors), and easy to understand and explain. The relationship between surface area and chemical reactions will not soon be forgotten and indeed, some students wish to experiment further at lab. time to test other hypotheses they have made based on these simple demonstration experiments.

Common sense things which may be overlooked when doing this demonstration include:

1. Be certain that you have a good light colored (white) background for the beakers.
2. Use a solute color which is easily seen against your background.
3. Be careful of your attire for this demonstration. Cryptic and/or protective coloration are not being demonstrated and can easily detract from and confuse the real demonstration.

I would like to demonstrate one more concept, that of pressure. I have not yet figured out how to easily do this, however, I am open to your ideas and suggestions!!