Purpose

The purpose of this lab was to determine the effect that temperature has on the rate of diffusion of food coloring in water.

Problem

What effect does temperature have on the rate of diffusion of food coloring in water?

Hypothesis

If the water is heated to a warm temperature, and food coloring is then added to the water, the rate of diffusion of the food coloring in the water will be much faster. If the water is at a colder temperature, and food coloring is then added to the water, the rate of diffusion of the food coloring into the water will be at a much less rapid rate.

Materials

The materials used were:

- 200ml beaker
- food coloring
- water
- ice
- bunsen burner
- thermometer
- stopwatch
- beaker tongs

Variables

The quantity of water and the quantity of food coloring used during this experiment are both controlled variables. They are controlled by measuring out the amounts of each until they reach a set quantity. Therefore there is not too much or too little of the water or food coloring, which could cause an irregularity in the results.

The water temperature is another controlled variable. The temperature of the water could vary, and has an effect on the rate of diffusion, which would therefore create uncertainty in the results, but it can be regulated by using a thermometer so that this does not happen.

Procedure

1. Put 200ml of water in a beaker.
2. Heat the water until it reaches a temperature of 50C.
3. When this temperature changed is attained, remove from the Bunsen burner and add two drops of food coloring.
4. Time how long it takes for the food coloring to hit the bottom of the beaker, and then how long it takes for the food coloring to completely diffuse within the beaker.
5. Start with a new beaker and 200mL of water.
6. Chill the water with ice cubes until it reaches a temperature change of 7C.
7. Add two drops of food coloring.
8. Repeat Step 4.

Data

200mL water at 50C	200 mL of water at 7C
1. 2 drops of food coloring were added to the water. 2. The food coloring hit the bottom of the beaker after 19 seconds. 3. The rate of diffusion was slow. 4. The food coloring took 3 minutes and 20 seconds to diffuse completely within the beaker. 5. The food coloring was more concentrated at the surface than at the bottom of the beaker, resulting in a darker color nearer to the top.	

Results

The data demonstrates to us the rates of diffusion in water which is at both cold temperatures and warm temperatures. In our hypothesis, it was said that if the water was at a warm temperature, the rate of diffusion would be very quick, and if the water was at a colder temperature, the rate of diffusion was very slow. In actuality, when the water was at a colder temperature (7C) the food coloring reached the bottom of the beaker at a very rapid rate, surpassing the speed of the food coloring in the warm water. But the actual rate of diffusion, or the time it took for the food coloring to diffuse completely within the beaker, was slightly slower than that of the food coloring in the beaker containing warm water. It is in this aspect that the hypothesis regarding diffusion in cold water was correct.

When the water was heated to a warm temperature, in this case 50C, the time that it took for the food coloring to diffuse completely within the beaker was quicker, as it had been predicted in the hypothesis. But the food coloring took longer than had been anticipated to reach the bottom of the beaker, because its rate of diffusion in this case was slower than that of the food coloring in the beaker containing cold water. It was in this aspect that the hypothesis was incorrect.

The reason for this taking place is because the overall level of kinetic energy within the water was high, and therefore the molecules moved about the substance haphazardly and at a very rapid rate. It is for this reason that in the beaker containing the warm water, at 50C, that the rate of diffusion of the food coloring within the beaker was quicker, even if it took longer for it to sink to the bottom. The reason for this is due to the fact that molecular bonding was facilitated and therefore diffusion of the food coloring in the water was also easier.

When the water was at a cold temperature because of the ice, at 7C, the level of kinetic energy within the beaker was much lower. Therefore the rate of diffusion of the food coloring in the water was much slower. The reason for the food coloring having reached the bottom of the beaker at a faster rate than that of the food coloring in the beaker containing warm water was due to the fact that the molecules were not closely bonded. This created a space in between through which it could pass.