Catalase lab report

[Science](), [Chemistry]()

An enzyme is something that helps to speed up a chemical reaction. The enzyme changes from reaction to reaction, but it always has the same impact. However, certain variables may cause the enzyme to have a more or less significant impact on the speed of each reaction. One of these variables that changes the effectiveness of an enzyme is temperature. There is an optimal functioning temperature for each enzyme in each reaction, depending on the desired change in speed. For some, this temperature is higher, and others lower. However, once this optimal temperature has been passed, the enzyme becomes less effective.

A good comparison for the impact of temperature would be running. There is an optimal temperature at which every runner runs. If it is too hot or too cold, the runner may not run as fast as they could if it were, for example, 10 °C. However, the reason temperature impacts enzymes in that matter is due to kinetic energy. As the temperature increases, the kinetic energy also increases. At the optimal temperature, the molecules are moving as fast as they can without breaking bonds. If the speed is surpassed, bonds begin to break and the enzyme becomes less effective.

The purpose of this lab is to test the effects of different variables mixed with the reaction of hydrogen peroxide and yeast, yeast being the catalase. The variables that will be changed are temperature, pH, and concentration. Our class began a lab based around enzymes and how they react when different variables are changed, such as temperature, pH, and concentration of the yeast or hydrogen peroxide. The yeast acted as the enzyme, which produces catalase needed for our desired reaction with the hydrogen peroxide. What had to be wanted to measure was how well it reacted when the variables were changed.

First off, the class needed to find a way to measure this. After you told us that the reaction would give off oxygen gas, it was realized that the oxygen being created in the reaction could displace water to measure how much oxygen gas is being given off. Next came setting up the lab. Each group received and set up with a small glass bottle (including a rubber cork with a long rubber tube), a tall graduate glass cylinder, an arm to hold said graduated cylinder, a few smaller graduated glass cylinders, a thermometer, and a rubber tub.

Before the groups were permitted to delve into the experiment, a control for the rate of the chemical reaction needed to be established. Each group then filled their rubber tub almost to the top with water which was allowed to sit until the water was about room temperature (about 22 °C). Once the water was about room temperature, everyone filled the large graduated glass cylinder completely with water and slid it upside-down into the arm to hold the lip just below the surface of the water. Sam then filled one small graduated cylinder with 5 mL of yeast and Bridgette filled the other with 5 mL of hydrogen peroxide.

The yeast was poured into the small glass bottle, and the hydrogen peroxide was added second. The cap with the rubber tube was placed on quickly, and it was placed underwater just as quickly. The rubber tube coming from the cork was then slid up into the tall graduated glass cylinder, and Bridgette began timing. Every twenty seconds across 5 minutes, Sam would write down how much oxygen gas had displaced the water (see " Control" graph and for the results). Now that a control had been established, the next step was to test the effects of different pH in the solution. Our first pH that was tested was pH 4.

Sam added 2 mL of this to the yeast, and began timing. After she finished recording the data, our group moved onto pH 8. Subsequent to pH 8 was pH 10 (see " pH" graph and for results). Another variable that was tested was the temperature of the water the reaction occurred in. The first temperature that was tested by the groups was 5 °C. The bucket was filled with the water, 5 mL of yeast and of hydrogen peroxide were poured into the small glass bottle. After 5 minutes, the water was poured out and the experiment was performed with 37 °C water. Finally, it was tried with boiling water.

The results for boiling water will not be close to the normal, however, as one group was not able to get to this point, cutting the average in half (see " Temperature" graph and for results). The third variable that was tested was the concentration. In the control, there were 5 mL of yeast and 5 mL of hydrogen peroxide used for the reaction. However, in this test, the amount of yeast was lowered from 5 mL to 4, to 3, and then to 2 (see " Concentration" graph and for results). In the control, there is only 1 line as it was the average of all groups basic reaction. it is a rough arc, as over time, the reaction began to slow down.

The reason for it being bumpy is merely that neither the groups nor the experiment is perfect. If that was the case, it would be a perfect arc. In the pH graph, the lines are more rigid than that of the control, suggesting that the amount of oxygen in the vile increased at a more steady rate than in the control. As you can see, the different levels of pH affected the strength of the reaction quite significantly, the strongest reaction being about ten mL of oxygen short of the amount of oxygen in the control, with the other two pH levels bringing down the reaction strength even further.

My hypothesis was initially the more basic, the stronger, as a pH of ten was the strongest of the reactions. However, after looking at it a second time, I realized that pH four was stronger than pH eight. My new hypothesis was that the further from neutral, the more powerful the reaction. But, upon looking a third, time, a new flaw appeared in my hypothesis. There is a difference of three between seven and four as well as ten and four. So, my third and final hypothesis was that the pH further from neutral would be more significant, as well as bases being more powerful than acids.

Unfortunately, I was unable to test this theory of mine as I didn't have any other bases or acids with a known level handy at the moment. For temperature, the lines appear to have a much smoother curve, especially 37 °C, as well as steeper. This implies that the reaction rate slowed at a much more incremental rate, instead of a steady or slower speed. Another thing this would imply is that the enzyme is more effective at the beginning, but less affective towards the end. It was obvious that boiling water was well past the optimal reaction temperature, and 5 °C quite obviously fell short as well.

37 °C was the closest to optimal, but one could infer that this was also past optimal temperature, as room temperature (about 22 °C) had a much stronger reaction. Since 5 °C is 17 °C less than 22 °C, and 37 °C is only 15 °C away, my guess would be that room temperature is also past the optimal temperature. What the optimal temperature is remains unclear to me at the

moment, but if I had to guess I would say about 16 °C would be optimal for this reaction. Again, I have insufficient supplies to test my theory, so I am not sure. Lastly is the concentration.

The curves appear to be more gradual than temperature and control, but less steady than pH. The reaction rates for concentration are also some of the closer reaction rates to that of the control. Since there is a decrease in the strength with each lower dosage of yeast, one can assume that the concentration of yeast and hydrogen peroxide should be similar, or perhaps even a higher concentration of yeast than there is hydrogen peroxide. From this graph, information is much harder to infer, but my assumption is that there should be either a 6: 5 or 7: 5 ratio of yeast and hydrogen peroxide, respectively.

But, once again, I am uncertain, as there is a lack of supplies in my home to perform science experiments. Of course, if you were to mix variables, the results from changing only one variable would be essentially useless other than the results for one to compare to, as the impact of changing two variables instead of one is similar to multiplying two numbers or three numbers. Some results may be similar, some may be drastically different. You would need to retest using each variable again as their effects on one another are unpredic (unless you study this sort of thing for a living, which i do not).