**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_**

Web Lab on Enzymes

Directions: 1) Go to: <http://bioweb.wku.edu/courses/Biol114/enzyme/enzyme1.asp>

2) Answer the questions below by typing directly into this document.

3) Once done, go to “File”🡪”Save as”🡪 type in, “YourLastName\_FirstInitial\_EnzymeLab” and save the file to the desktop

 For example, I would name mine *Campbell\_E\_EnzymeLab*

4) Log-in to your email, and email me the document at ellen.campbell@asu.edu. In the subject line of the email, write “Enzyme Lab”

**Part I - Measuring the Rate of Reaction**

**Introduction:**

1. Write the **word** equation for the reaction that the enzyme catalase carries out.
2. Why does raising the temperature increase the rate of the reaction?
3. What can be used to STOP the reaction of catalase? Why does this work?

**Click on the "more" button.**

1. What is the active site?
2. If we start with 3 ml of H2O2 from your bathroom cabinet and add catalase. After 3 minutes we measure the amount of H202 remaining and find 1 ml remains.
How much H202 was consumed in the reaction? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. If we repeated the experiment above but found 2 ml of H202 remaining, would this indicate a ***lowe****r* or ***higher*** rate of reaction? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

You slowly add KMnO4, which is purple, to the flask. The peroxide in the flask causes the KMnO4 to lose color when the solution is mixed thoroughly. When all the peroxide has reacted with KMnO4, any additional KMnO4 will remain light brown or pinkish even after you swirl the mixture. This is the endpoint. **Record** the amount of KMnO4 you have used.  **The more KMnO4 you use, the more peroxide is left in the flask.**

**Click on the "more" button.**

1. The Experimental Procedure - fill in the blanks:
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ tubes containing catalase and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at different temperatures and examine the rate of enzyme activity by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ any remaining (unreacted) substrate. This will give us an indirect measure of the substrate converted to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and therefore the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of reaction.
2. When you added H2O2 to the test tubes, did you add substrate or enzyme? \_\_\_\_\_\_\_\_\_\_\_\_\_
3. The four tubes are placed in what temperatures? Fill out the table below
4. After you added catalase, wait 3 minutes and then add what? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Why is this step important?
5. What reaction occurred in the test tubes? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Titrate using potassium permanganate each of the four tubes and fill out the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | Tube 1 | Tube 2 | Tube 3 | Tube 4 |
| Temperature (°C) |  |  |  |  |
| Amount of Potassium Permanganate needed (mL) |   |   |   |   |

1. (Click on "back to the lab") Which tube had the highest rate of reaction? How do you know? Remember to answer questions here and do NOT hit submit on the website.
2. What variable(s) would have caused the differences in reaction rates for each tube?

**Part II - Extension Questions (not on site):**

1. Amylase is an enzyme in saliva that helps to break starches into sugars. An experiment with amylase and starch was set up similar to the one you did above and the following results were obtained. Instead of measuring the amount of starch remaining in the tube, scientists measured the amount of glucose produced. Assume that the temperature was never raised high enough to denature the enzyme.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Tube 1 | Tube 2 | Tube 3 | Tube 4 |
| Amount of glucose in each tube after 3 minutes(Each tube started with 13 ml of glucose) | 2 ml | 6ml | 4ml | 12ml |

1. Which of the tubes in the above experiment was the coldest? \_\_\_\_\_\_\_\_\_\_ The warmest? \_\_\_\_\_\_\_\_\_\_
Explain how you know this.
2. Indicators such as potassium permanganate and iodine can be used to measure the amount of substance left in a test tube or beaker. For each of the indicators, list whether they serve to indicate **substrate left**, or **product created.**

Iodine measures the amount of starch broken down to glucose \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Potassium permanganate measures the amount of peroxide in a beaker \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_