Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Unit 2 Topic 4

Period: \_\_\_\_\_\_ Page: \_\_\_\_\_\_

**U2T4 Enzymes Lab**

**Student Handout**

**Introduction:**

As we’ve discussed in class, enzymes are a special type of protein that act as biological catalysts. This means that enzymes work to speed up chemical reactions in living things. Without these enzymes, chemical reactions would proceed too slowly to be useful, meaning that organisms would fail to carry out many of their metabolic reactions. Enzymes are able to speed up these reactions by lowering the amount of energy required to start the reaction. An example of a specific enzyme found within plants and animals, including us, is catalase. Catalase breaks down hydrogen peroxide (H2O2). In cells, hydrogen peroxide is formed as a product in chemical reactions such as cellular respiration. If left in the cells, this toxin would kill the cells. Therefore, cells need to immediately break down hydrogen peroxide into water (H2O) and oxygen (O2).

**Purpose:** to determine how temperature affects enzyme activity

**Materials:**

|  |  |  |
| --- | --- | --- |
| Hydrogen Peroxide (H2O2) | Beakers | Forceps |
| Fresh liver (chicken or beef) | Frozen liver (chicken or beef) | Cooked liver (chicken or beef) |
| Fresh potato  | Frozen potato | Cooked potato |
| Water | Magnifying lens | Stirring rod |

**Safety:** As we will be working with both chemicals and glassware in this lab, goggles are required (start through cleanup)

**Data Collected:**

|  |  |  |
| --- | --- | --- |
| **Liquid** | **Treatment** | **Result** |
| H2O | **Animal tissue - cooked** |  |
| **H2O2** | **Animal tissue - cooked** |  |
| H2O | **Animal tissue - frozen** |  |
| **H2O2** | **Animal tissue - frozen** |  |
| H2O | **Animal tissue - fresh** |  |
| **H2O2** | **Animal tissue – fresh** |  |
| H2O | **Plant tissue- cooked** |  |
| **H2O2** | **Plant tissue- cooked** |  |
| H2O | **Plant tissue- frozen** |  |
| **H2O2** | **Plant tissue- frozen** |  |
| H2O | **Plant tissue- fresh** |  |
| **H2O2** | **Plant tissue- fresh** |  |

**Questions:**

1. Write an equation for the breakdown of hydrogen peroxide. What is the name of the gas that is given off?
2. Hydrogen peroxide is formed in cells at the end of the cytochrome system (electron transport chain) during respiration. Why is it necessary that the hydrogen peroxide be removed immediately? (use the intro to the lab if you need help)
3. What does catalase do inside of cells?
4. What does heat do to the enzyme catalase?
5. Which experimental setup gave the greatest results? Why do you think this is?

**Your task:**

1. Complete an **introduction**. The introduction will include the following vocabulary terms:

|  |  |  |  |
| --- | --- | --- | --- |
| Enzyme | Catalyst | Catalase | Substrate |
| Active site | Activation energy | Enzyme-substrate complex | Temperature |
| pH | Optimum | Product(s) | Denature  |

An \_\_\_\_\_\_\_\_\_\_\_\_\_ is a protein that acts as a biological catalyst, meaning it speeds up chemical reactions in living things. A \_\_\_\_\_\_\_\_\_\_\_ is something used to speed up a chemical reaction, without being destroyed in the process. Therefore, an \_\_\_\_\_\_\_\_\_\_\_\_\_ is able to be used over and over again because it is not destroyed when it is used. An **enzyme** works by lowering the amount of energy required to start a reaction (the “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_”).

**Enzymes** are shape-specific, meaning they only work with a certain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (also known as a reactant). The \_\_\_\_\_\_\_\_\_\_\_\_ binds to the **enzyme** in a specially shaped area called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. When the **substrate** binds to the **enzyme**, an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is formed and the chemical reaction takes place. After the reaction, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is/are released from the **enzyme** and the **enzyme** is able to be used again.

In addition to being shape-specific, **enzymes** also function best in certain \_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ranges. The **pH** or **temperature** where an enzyme is most productive is said to be its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ level. If an **enzyme** is placed in an environment outside of its functioning range, the **enzyme**/protein can become \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, meaning the shape is ruined and the **enzyme** is no longer functional. In this lab, we were working with the **enzyme** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which is used to break down hydrogen peroxide in living things. We were testing the effect of **temperature** on **enzyme** activity.

1. Complete a **discussion** using observations collected in this lab.

In this lab, we tested the effect of temperature on enzyme activity. The enzyme we were using is called catalase, and its job is to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The reason that H2O2 needs to be broken down in cells is because it is toxic to cells, so if it isn’t removed, the cells will die in the presence of H2O2. When the hydrogen peroxide is broken down, bubbles form. These bubbles are actually \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The liquid that remains is \_\_\_\_\_\_\_\_\_\_\_\_\_, which is not toxic to cells (in appropriate amounts, at least).

Since catalase in an enzyme, it is a biological catalyst. This means that it can be used over and over again, unless it loses its shape (and therefore, function). When an enzyme or protein loses its shape, it is said to be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. In this lab, we saw that the \_\_\_\_\_\_\_\_ liver had lost its shape/function and we know this because there weren’t any \_\_\_\_\_\_\_\_\_\_, which means nothing was happening. If we left the liver in the H2O2 for extended periods of time, maybe all of the H2O2 would be broken down, leaving only \_\_\_\_\_\_\_\_\_\_\_\_\_ in the cups.

**Rubric:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Topic** | **Excellent (3)** | **Average (2)** | **Weak (1)** | **Points Earned:** |
| **Data Table** | Data table is completely filled in, using the key provided on the lab handout. Responses are correct, meaning they match the results expected. | Data table is completely filled in, using the key provided, but some (1-3) responses obtained align with results expected. | Data table filled in incorrectly, the key provided was not used. Responses obtained and recorded do not match expected results. |  |
| **Questions** | All five questions are answered in entirety (student addresses hows/whys). Answers are written using complete sentences (aside from number 1). All answers provided are correct. | All five questions are answered, but either missing the explanation (how/why) OR no more than two responses are incorrect. Answers are written in complete sentences. | Either not all questions are answered OR they are not answered correctly OR they are not written using complete sentences. If not answered at all, student earns a zero here. |  |
| **Introduction** | Student wrote an introduction in their own words, including all vocabulary terms provided. Definitions given when necessary (what is a substrate?). Student explains what an enzyme is, how they function, and how this lab applies to enzymes and their activity. | Student wrote an introduction in their own words, but failed to include between one and three vocabulary terms or student failed to define key terms. OR student wrote an introduction, doing all of the above but not tying the lab in with enzyme activity. | Student introduction is not entirely original. At least one phrase or sentence comes from the lab, the notes, or other resources. Student introduction is too similar to another introduction in the class. If student did not write the introduction, they earn a zero here. |  |
| **Discussion** | Student wrote a discussion at least one paragraph in length. All questions provided in the lab handout are both addressed and answered in the discussion submitted. | Student wrote a discussion, but did not address all questions provided in the written instructions. All work is original. | Student failed to respond to at least two of the questions provided in the instructions. Or, student work is similar to another discussion submitted. If discussion is missing, a zero is earned. |  |