Name_____Period_____Assignment #_____

Lab 13: What are the optimal conditions for catalase activity?

See lecture questions 3b, 4, 5, 7, 15, and 16

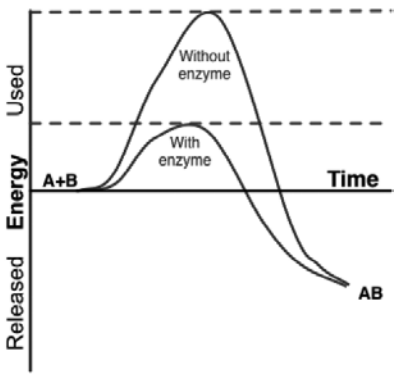
Pre-lab: annotate and answer questions 1-5

_____Teacher initials practice data collection_____Teacher initials procedures_____Teacher initials data collection

Annotating Text
☐ **UNDERLINE** concepts you think might be useful for understanding or solving the problem
☐ **Box** information you think might be helpful for designing your investigation
☐ ← Write **notes** in the left margin
☐ → Write **questions and answers** in the right margin
Each paragraph (including each step of the procedures) must have something underlined or boxed, **AND** have something written in the margins (a question and/or note).

Introduction:

Enzymes are the Builders and Do-ers: in the cell; without them, life could not occur. Every cell makes hundreds of different enzymes to carry out the reactions necessary for life. Enzymes are protein catalysts that speed up chemical reactions without being destroyed or altered in the process. The figure to the right illustrates how an enzyme lowers the amount of energy needed for a reaction to take place. Although reactions can occur without enzymes, the rate of the reaction would be far too slow to sustain life.



The DNA in each cell encodes all the information needed to make its many different enzymes. Enzymes are relatively large molecules of protein. They are produced whenever the cell "senses" a need for that particular enzyme; that is, whenever a job needs to be done in the cell which only that enzyme can do.

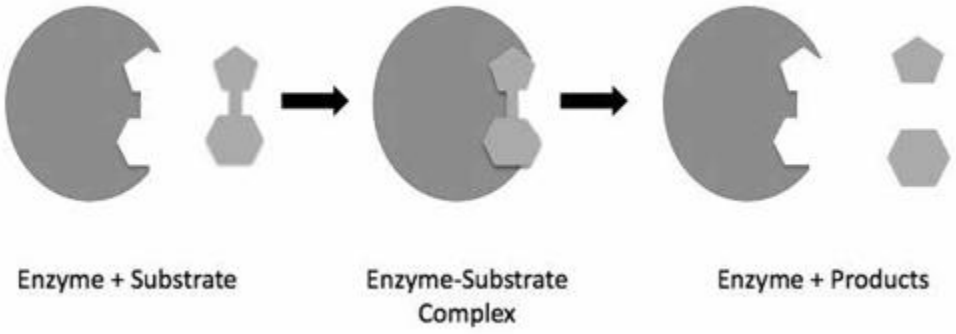
The molecule (or molecules) on which an enzyme acts is called its substrate. Enzymes are said to be very "specific," meaning that they recognize only one substrate (or a few closely related substrates) and convert it into a specific product. You could say that each enzyme can do only one type of job. Each enzyme is specific because it is folded into a particular three-dimensional shape. Within the folds of each enzyme is the active site, the place where the substrate fits and where the chemical reaction takes place.

Enzymes work very quickly, often catalyzing thousands of reactions per second. The rate at which an enzyme works is influenced by many factors including temperature and pH. The interactions that hold the protein in its particular shape become disrupted under extreme conditions, and the 3-dimensional structure unfolds. In this case, the enzyme is said to be denatured. Other important factors that influence enzyme activity are the concentration of substrate and the concentration of enzyme.

The enzyme that you will study in this experiment is called catalase. Its job is to break down its substrate, hydrogen peroxide (H_2O_2), which is a naturally occurring poisonous metabolite. Without catalase, H_2O_2 would kill the cell. The reaction catalyzed by catalase is:

$$H_2O_2\ (\text{liquid}) \xrightarrow{\text{Catalase}} H_2O\ (\text{liquid}) + O_2\ (\text{gas})$$

How an enzyme interacts with a substrate



In the home and hospital, hydrogen peroxide is used as an antiseptic to clean out wounds. Have you ever noticed that when hydrogen peroxide is swabbed on a cut it bubbles? This is because enzymes in the cut from your body and from infecting bacteria catalyze the rapid degradation of hydrogen peroxide into water and oxygen. The bubbles are oxygen. Catalases are found in almost all cells that grow in an environment with oxygen, including potato tubers. In the experiment, a blender is used to grind up a potato in water to release the catalase from the potato cells. The ground up potato is filtered through cheesecloth to separate potato skin and cell debris from the liquid which contains most of the cell's enzyme, including catalase. To actually measure the catalase activity, small disks are dipped into the potato cell extract. When this enzyme containing disk is placed in a solution of hydrogen peroxide, the enzyme begins to work. As the catalysis occurs, oxygen is produced, and bubbles of the gas become trapped in the fibers of the disk. This increases the buoyancy of the disk and causes it to float.

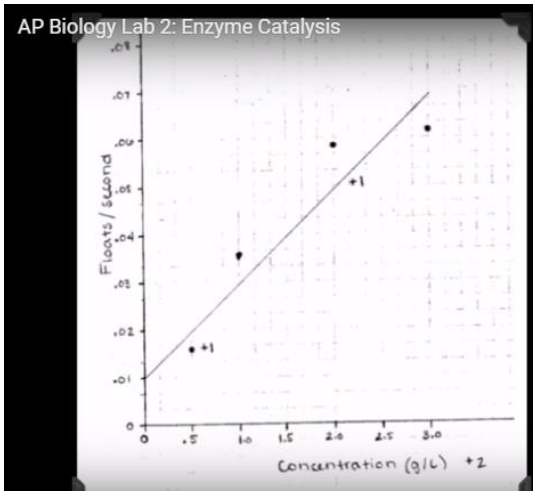
Watch the video before continuing

http://www.bozemanscience.com/ap-bio-lab-3-enzyme-catalysis

1) What is the purpose of each of the four items in the lab setup?

2) Explain why we will be using the unit “floats/second.”

3) Correct the best fit line



For an experiment to be meaningful, there must be controls. Three controls important to this lab will be demonstrated by your teacher:

Control #1: A paper disc that has not been soaked in potato extract

Control #2: A paper disc that has been soaked in potato extract

Control #3: A paper disc that has been soaked in boiled potato extract

4) Predict what will happen when each control is demonstrated

5) Explain why each control is important

Materials:

1) Goggles
2) Reaction chambers
3) Forceps
4) Filter paper
5) Hole punch
6) 100% catalase stock solution at various pHs (you need to make 40% solutions)
7) Other stuff you need to figure out

Procedure:

1) You will need to make your own solutions from stock solutions. Refer to ***Making Solutions*** activity.
    a. 1% hydrogen peroxide from 3% stock solution
    b. 40% catalase from 100% stock solution
2) Make reaction chambers (30mL 1% H_2O_2 solution in a 50mL beaker). Use the same reaction chamber for all trials for a given condition. Make sure you explain why using the same chamber for multiple trials for a given condition is a small source of error.
3) Make paper discs from filter paper using a hole punch
4) Soak disk in catalase solution
5) Use forceps to transfer disc to paper towel to remove excess catalase solution
6) Use forceps to add catalase soaked disc to reaction chamber
7) Record time required for disc to float

Your task:

Design an experiment to figure out optimal enzyme activity for one of the following conditions: enzyme concentration, substrate concentration, pH, or temperature

To determine *what type of data* you will need to collect, think about the following questions:

1) What will serve as your independent variable during your experiment?

2) What will serve as your dependent variable during each of your experiments?

3) What type of measurements or observation will you need to record during your experiment?

To determine *how you will collect your data*, think about the following question:

4) What will serve as your control condition?

5) What will you do to ensure conditions are same if it takes more than one class period to collect data? (Hint: consider all of the factors that could affect enzyme activity)

6) What types of treatment conditions will you need to set up and how will you do it?

7) How many trials will you need to conduct?

8) How often will you collect data and how will you do it?

9) How will you make sure that your data are of high quality (how will you reduce measurement error?)

10) How will you keep track of the data you collect and how will you organize the data?

To determine *how you will analyze your data*, think about the following:

11) How will you determine if there is a difference between the treatment condition and the control condition? What statistics will you use?

12) What type of calculations will you need to make?

13) How will you present your data?

Connections to Crosscutting Concepts and the Nature of Science

As you work through your investigation, be sure to think about the following:

1) The importance of identifying the underlying cause for observations
2) How energy and matter move within or through a system
3) How structure is related to function in living things
4) The nature and role of experiments in science
5) How scientific knowledge develops over time

ADI Investigation Proposal TGB Version

Guiding Question:	
Claim:	
Alternative claims:	

Method:	What data will you collect? How will this data help you answer the guiding question?

Data table(s) and chart(s)

Guiding Question:

Our Claim:

Our Evidence:

Analysis: break it down (Illustrate and describe your data)

Interpretation: What does the analysis mean?

Our Justification of the Evidence:

Use your scientific knowledge and analysis to support your interpretation