**Investigation of Properties of Catalase**

**Introduction**

Enzymes are biological molecules that catalyze (speed up) chemical reactions. You could call enzymes 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. Fortunately for the cell, enzymes are not used up when they catalyze a reaction, but can be used over and over.

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 it.

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 minute. The rate at which an enzyme works is influenced by many factors including temperature and pH. Enzymes have a temperature and pH at which they work best, and if an enzyme is exposed to extremes of heat or pH it won’t work at all! The interactions that hold the protein in its particular shape become disrupted under these 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. Up to a point, the more substrate that is present, the faster the reaction. However, when the substrate concentration is so high that an enzyme is working as fast as it can, further increases of substrate concentration will have no effect on the rate of product formation.

**Background for this lab**

The enzyme that you will study in this experiment is called ‘‘catalase.’’ Its job is to break down its substrate hydrogen peroxide (H2O2), which is a naturally occurring poison.

Without catalase, H2O2 could kill the cell. The reaction catalyzed by catalase is:

**2H2O2 🡪 2H2O + O2**

The products remaining after catalase does its job are oxygen gas and water; two very non-poisonous molecules.

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 very common. They are found in almost all cells that grow in oxygen, including potato tubers. In this 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 enzymes, 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. When there are enough O2 bubbles, they lift the filter to the surface.

To do this experiment, your team will carry out one version of the experiment using an independent variable of your choosing (**get Mrs. Ancheta’s approval before starting your experiment!**) At the end of the lab, you will create a miniposter to present your findings.

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

**Control #1:** A paper disc that **has not** had potato extract added to it is dipped in H2O2.

**Control #2:** A paper disc that **has** been dipped in potato extract is placed in a beaker of water.

**Control #3:** A paper disc that **has first** been dipped in boiled potato extract **and then** placed into a beaker of H2O2.

**Controls**

A. What is the function of a control?

For control #1, a filter paper saturated with water rather than potato extract was placed in a beaker of 3% H2O2. How long does it take for the filter to lift off?

Explain the significance of the result:

For control #2, a piece of filter paper was saturated with potato extract and then placed in distilled water. How long did it take for the filter to lift off?

Explain the significance of the results:

For control #3, 100% catalase was boiled. A filter paper was then saturated with this extract. The disk containing the extract was then placed in a beaker of 1% H2O2.

How long did it take for the filter to lift off?

Explain significance of the results:

**Materials**

**Your team will need the following supplies**

Potato extract (prepared by your teacher), 3% H2O2 solution, 1 - 250 ml beaker for potato extract, 100 ml graduated cylinder, cups to use as reaction vessels, Forceps, Hole punch, Paper towels, filter paper disks, catalase , stop watch

Your group’s Independent Variable is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Your Dependent Variable is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Get Mrs. Ancheta’s signature:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_