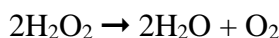


## **Factors that affect enzyme activity** (or, **How to Have Fun with Fresh Liver**)

Like all proteins, enzymes have a specific three-dimensional shape that is important to their activity. In order for the enzyme to catalyze a reaction, the shape of the active site of the enzyme must closely match the shape of its substrate.

In this experiment we will investigate some of the factors that affect the rate of an enzyme-catalyzed reaction. We will use the enzyme catalase which decomposes hydrogen peroxide into oxygen and water as shown in the reaction below:



Hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) is a poisonous byproduct of aerobic metabolism. Cells of organisms that live in an oxygen-rich environment require the enzyme catalase to protect themselves from the harmful effects of hydrogen peroxide.

**Q1.** Propose a hypothesis to predict the effect of a change in the shape of the active site on the reaction rate.

### **Procedure**

1. For EVERY tube, rate the amount of activity using 0 to indicate no reaction, 1 to indicate slow, 2 to indicate moderate, 3 for fast, and 4 for very fast.
2. Label three small test tubes #1, #2, and #3.
3. Add 2 mL of hydrogen peroxide to each tube. Add a few grains of sand to tube #1, a small ( $1 \text{ cm}^3$ ) piece of potato to tube #2, and a similarly sized piece of liver to tube #3.
4. When the reaction has stopped, divide the hydrogen peroxide in tube #3 into two new tubes labeled #4 and #5.
5. Remove the liver from tube #3 and place half in tube #4 and half in tube #5.
6. Add a second piece of liver to tube #4.
7. Add 1 mL of hydrogen peroxide to tube #5.
8. Add a few grains of sand and another fresh piece of liver to the mortar and grind it using the pestle.
9. Remove the liver and place it in a clean tube labeled #6. Add 2 mL hydrogen peroxide.
10. Obtain a fresh piece of liver and place it in a clean test tube labeled #7. Add enough water to barely cover the liver. Boil it by placing the whole test tube in the hot water bath for 2 minutes. Do not start timing until the water inside the test tube has started to boil.
11. Pour off the water and add 2 mL hydrogen peroxide.
12. Place a small piece of fresh liver in another test tube labeled #8.
13. Add 3 drops of dilute HCl and 2 mL of hydrogen peroxide.
14. Label another test tube #9. Add 2 mL hydrogen peroxide and a tiny pinch of manganese dioxide.

### **Questions**

2. What is the purpose of the liver and potato?
3. Account for the degree of activity you observed in each tube.
4. Why was sand tested in Tube 1?
5. Do the results of this investigation support or refute your hypothesis?
6. Identify the factors investigated in this activity and state the effect of each on the rate of the enzyme catalyzed reaction.