

## Investigation: How Do Enzymes Work?

During normal cell activities, a toxic chemical is produced: hydrogen peroxide ( $\text{H}_2\text{O}_2$ ). This chemical is dangerous to cells, and is the reason why hydrogen peroxide is used as an antiseptic. When you pour it over a wound, it destroys bacteria that may cause an infection.

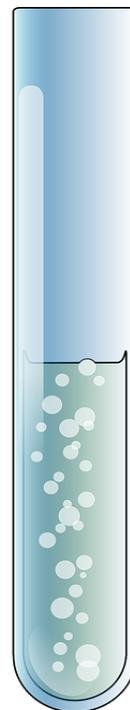
So how do cells deal with the build-up of hydrogen peroxide? They actually have a protein that breaks it down into harmless components: water and oxygen.

**Enzymes** are proteins that speed up the rate of reactions, and there is a particular enzyme that can help break down hydrogen peroxide. The name of the enzyme is **CATALASE**.



In this activity, you will investigate how enzyme activity is affected by temperature.

Materials: 3 test tubes, 3% hydrogen peroxide, forceps, warm water bath, ice water bath, liver (cut into cubes)



### Procedure

1. Place 2 ml of the 3% hydrogen peroxide solution into a test tube with a pipette.
2. Using forceps to add a piece of liver to the test tube.

Observe the bubbles.

What gas is being released? (Consider the equation.) \_\_\_\_\_

*Throughout this investigation you will estimate the rate of the reaction (how rapidly the solution bubbles) on a scale of 0-5. (0=no reaction, 1=slow, ..5= very fast). Assume that the reaction in step 2 proceeded at a rate of "4"*

3. A reaction that absorbs heat is **endothermic**; a reaction that gives off heat is **exothermic**. Feel the temperature of the test tube with your hand.  
Has it gotten warmer or colder \_\_\_\_\_ Is the reaction endothermic or exothermic? \_\_\_\_\_
4. Pour off the liquid into another test tube. What is this liquid composed of? \_\_\_\_\_
5. Add more liver to the liquid your poured into the second test tube. Reaction Rate \_\_\_\_\_ (1 – 5)

### → Analysis

Think about what happened in this experiment. What was in the liquid you poured into the second test tube? **How do you know?**

6. Examine the original test tube (it should have a piece of liver in it, but you poured off the liquid.) Add another 2 ml of hydrogen peroxide to the liver remaining in the first test tube.

What is the reaction rate? \_\_\_\_\_ (1 – 5)

7. Pour the liquid into the sink and add more hydrogen peroxide. What is the reaction rate? \_\_\_\_\_ (1 – 5)

→ **Analysis**

The enzyme catalase is found in the liver. Based on your observations in #6 and #7, is the enzyme used up in the reaction or can it be reused again and again? Support your statement with evidence (observations).



## What is the Effect of Temperature on Catalase Activity?

1. Put a piece of liver into a clean test tube and add a small amount of water. Place it in a warm water bath for 2 minutes.

Remove the test tube from the water bath, pour out the water and add 2 ml of hydrogen peroxide.

What is the reaction rate for the warm liver and peroxide? \_\_\_\_\_

2. Pour off the liquid from the test tube and then place it into an ice water bath for 2 minutes.

Remove the test tube from the water bath and add 2 ml of hydrogen peroxide.

What is the reaction rate for the warm liver and peroxide? \_\_\_\_\_

→ **Analysis**

Consider your observations from #1 and #2, write a statement that summarizes how temperature affects the reaction rate of the enzyme.

When you put hydrogen peroxide on a wound, you can observe it bubbling. Does this mean that it is actually working? Is it a good choice for preventing infection? Why or why not?