



## HANDS-ON LAB

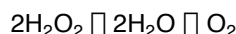
## Experimenting with Catalase

Many chemical reactions take place in the cells of living things. Some of these reactions break down molecules from nutrients to obtain energy. Other reactions synthesize all the compounds that cells need to survive. Together, these two categories of reactions are called metabolism. Metabolism is the total of all the chemical reactions that take place in a living organism.

Catalysts are substances that help speed up chemical reactions by lowering the activation energy required to start the reaction. Within living organisms, these substances are called enzymes. Enzymes are proteins. The reactants that enzymes work on are called substrates, and the resulting substances are called products. We would not survive without enzymes, because the essential reactions that keep us alive would take far too long.

Many factors influence how well an enzyme functions. Temperature, pH, and the presence of inhibitors such as heavy metals can affect the ability of an enzyme to catalyze a reaction.

One important enzyme is catalase. Catalase is found in many cells, and it is highly concentrated in the human liver. Catalase speeds up the decomposition, or breakdown, of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) in the body. Hydrogen peroxide is a toxic byproduct of cellular respiration. Too much hydrogen peroxide in the body can result in death. Catalase is able to speed up the decomposition of hydrogen peroxide into harmless water and oxygen. This chemical reaction is shown below.



Choose a factor, such as temperature or pH, and investigate how it affects the activity of the catalase enzyme.

## PREDICT

How do you think changes in the factor you chose will affect the activity of the catalase enzyme? Give reasoning to support your claims.

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## SAFETY

Hydrochloric acid and sodium hydroxide are corrosive to the skin. Use caution when pouring these chemicals. Raw liver can carry *E. coli*, so be sure to wear gloves or use forceps when handling the liver and wash your hands thoroughly.

## MATERIALS

- beaker
- beef liver
- forceps, scalpel, and tongs
- graduated cylinder, 10 mL
- hot plate
- hydrochloric acid, diluted (1.0 M HCl)
- sodium hydroxide, diluted (1.0 M NaOH)
- hydrogen peroxide (3%)
- ice
- pH paper and pH probe
- ruler, metric
- scissors
- test tubes and test-tube rack
- thermometer
- water, distilled



Name: \_\_\_\_\_

Date: \_\_\_\_\_

## PROCEDURE

Design a procedure to investigate how the factor you chose affects catalase activity. Use the following questions to guide you in writing your procedure. If there is time, you may investigate more than one factor.

- Which variable will you be changing, and how will you change it?
- Which variables will be kept constant?
- How many experimental setups will you need? Which setup will serve as your control?
- How will you measure the activity of the enzyme?
- How many times will you run your test, and what safety considerations need to be made?

Have your teacher check your procedure before moving on. Before carrying out the experiment, make one or more data tables for your measurements and observations.

## ANALYZE

1. How did you know when the activity of the catalase enzyme had increased or decreased?

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2. In your Evidence Notebook, make a graph of your data, and show any calculations you completed. What patterns can you identify in the data?

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Name:

Date:

### EXPLAIN

Explain how the factor you tested affected enzyme activity. Include each of the sections below in your explanation.

**Claim** Was your prediction correct? What conclusion can you make based on the data?

**Evidence** Give specific examples from your data to support your claim.

**Reasoning** Explain how the evidence you gave supports your claim.

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### REFINE

Explain how you would improve this investigation if you were to do it again.

**Precision and Accuracy** Did the equipment used provide the level of precision needed to make a valid conclusion?

**Propose Changes** What improvements would you make in this procedure to obtain more precise data? Why would you make these changes?

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