

Enzymes Laboratory Investigation

Introduction: Apple Juice

A Connecticut company is in the business of making and selling apple juice. To make apple juice, apple sauce is strained through filters to remove the juice. The company would like your help in testing the impact of different enzymes on the production of the apple juice. You will investigate the ability of these enzymes to remove more juice during this process and decide the most cost effective plan to increase juice production. The following is a list of the enzymes along with their prices:

Pectinase: \$ 50 per liter
Cellulase: \$100 per liter

Enzymes are proteins that catalyze chemical reactions in the cells of all living organisms. Enzymes control many vital functions in the cell, including the release of energy during the breakdown of nutrients into smaller molecules and the synthesis of complex cell materials from the small molecules. In this lab you will work with two plant enzymes – cellulase and pectinase.

Your Task

You and your partner will design and conduct an experiment to determine **which enzyme or combination of the two enzymes maximizes juice production**. Once you complete the laboratory investigation, you will evaluate which enzyme will be the most cost effective to use in juice production.

You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided.

Suggested materials

apple sauce	droppers
pectinase enzyme	stirring rods
cellulase enzyme	graduated cylinder
funnels	access to tap water
filter paper	paper cups
lab aprons	access to a watch or clock with a second
splash-proof goggles	access to a balance
paper towels for clean-up	

Designing and Conducting Your Experiment

1. In your words, state the problem you are going to investigate. Write a hypothesis using an “If ... then ... because...” statement that describes what you expect to find and why. Include a clear identification of the independent and dependent variables that will be studied.

2. Design an experiment to solve the problem. Your experimental design should match the statement of the problem and should be clearly described so that someone else could easily replicate your experiment. Include a control if appropriate and state which variables need to be held constant.

3. Review your design to your teacher before you begin your experiment.

Note: The enzyme(s) should be well mixed into the apple sauce to be effective. Use 5-10 drops of enzyme per 50 grams of apple sauce (approximately two ounces).

Safety notes: As in any laboratory experiment, you must not eat or taste any of the materials. Students must wear approved safety goggles and follow all safety instructions.

4. Conduct your experiment. While conducting your experiment, take notes and organize your data into tables.

When you have finished, your teacher will give you instructions for clean up procedures, including proper disposal of all materials.

Communicating Your Findings

Working on your own, summarize your investigation in a laboratory report that includes the following:

- **A statement of the problem you investigated.** A hypothesis (“If...then ... because...” statement) that described what you expected to find and why. Include a clear identification of the independent and dependent variables.
- **A description of the experiment you carried out.** Your description should be clear and complete enough so that someone could easily replicate your experiment.
- **Data from your experiment.** Your data should be organized into tables, charts and/or graphs as appropriate.
- **Your conclusions from the experiment.** Your conclusions should be fully supported by your data and address your hypothesis.
- **Discuss the reliability of your data and any factors that contribute to a lack of validity of your conclusions.** Also, include ways that your experiment could be improved if you were to do it again.