

Name:

Period:

Date:

Enzyme Action Lab

Introduction:

In this lab, you will be examining how the sugar lactose responds in the presence of the enzyme lactase and how certain environmental conditions might affect the enzyme's function. In part 1, you will see how lactase works under normal conditions.

Lactose is the disaccharide (sugar) in milk that makes it sweet. Some humans produce the enzyme **lactase** that breaks lactose down into the monosaccharides: **glucose** and **galactose**. Lactase is produced in the digestive systems of infants and in some, mostly European, adult humans. Humans that do not produce lactase after weaning are called **lactose intolerant**. These humans cannot digest lactose and may have symptoms characteristic of lactose intolerance (bloating, cramps, diarrhea) if they ingest dairy products.

Glucose test strips can be used to measure the functioning of the lactase enzyme by detecting how much glucose is in a solution. Milk that has not been exposed to lactase will only contain lactose and no glucose. Milk that has been exposed to lactase should have some glucose from the lactose being broken down. The amount of glucose present will correlate with the rate at which the lactase enzyme is working.

Food supplements such as **Lactaid**, contain the enzyme lactase and can be added to a lactose intolerant person's diet to help them properly digest dairy products.

Part I

Prelab Questions:

1. What is the enzyme in this lab? What is our source of the enzyme in this lab?
2. What is the substrate in this lab? What kind of biological molecule is it? Where the substrate is naturally found?
3. What two monosaccharides make up lactose?

Problem Question:

How does glucose production differ in milk exposed to lactase versus milk not exposed to lactase?

Hypothesis:

Come up with one in you group. Make sure to give an explanation.

Variables:

Manipulated:

Responding:

Control (need at least 3):

Groups:

Experimental:

Control:

Materials:

- | | | | |
|--------------------|-----------------------|-----------------------------|--------|
| - 1 Test Tube Rack | - 1 mortar and pestle | - 8 glucose test strips | - milk |
| - 2 Test Tubes | - 2 mL of water | - 2 plastic pipettes | |
| - 1 lactaid tablet | - 2 Thermometers | - 1 10mL graduated cylinder | |

Data Table: (read the procedure to design a data table for this investigation)

Create a data table that will record temperature (°C) and glucose readings (in mg/dl) for test tubes #1 and #2 (include all the rules for making a data table).

Diagram of the Procedure:

Part 1- Action of Lactose Under Normal Conditions Procedure

1. Place two test tubes in test tube racks.
2. Grind up one Lactaid tablet in a mortar and pestle and dissolve in 2ml water.
3. Use tape and a marker to label test tubes: #1 (milk and lactase) and #2 (control)
4. Add 4 ml of 2% room temperature milk to each test tube.
5. Take the temperature of the milk initially and record (time 0). (Rinse both thermometers between uses.)

Take a baseline reading of glucose concentration in test tubes #1 and #2 at Time 0 by adding a drop of liquid from each tube to a glucose detection strip. Wait 30 seconds, and then compare the color of the strip to the chart with the glucose detection kit.

6. Record your readings in milligrams per deciliter (mg/dl)
7. Use a clean pipette to add 2 ml of Lactase Solution to Tube 1 and mix well.
8. Use another clean pipette to add 2 ml of water to Tube 2 and mix well.
9. Take glucose and temperature measurements every 5 minutes for another 15 minutes and record your data.

Data Analysis:

Create a line graph that compares glucose production in both test-tubes. You should have two lines (use different colors with a key for each line) with 4 data points each. You will want to figure out the **rate of the reaction** producing glucose for each test-tube. Include these on the graph or in the data table.

Analysis Questions:**Do some research online to find:**

1. How many amino acids make up lactase?
2. What is the optimum temperature and pH for lactase? What ranges of temperature and pH will lactase still work under?

Conclusion:

Write a conclusion that explains your experimental results. Follow the EOC Lab Rubric.

Enzyme Action Lab Part 2

Now is your chance to test the follow up question you ended part 1 with. With your lab group, agree on under what conditions you want to test the lactase. Keep in mind the optimum and range of temperatures/pH for the lactase when deciding this.

You will need to get your problem question and materials needed checked off by your teacher before the end of the period. Remember that you need **3 levels of manipulation. You can use the control group from part I.

Write the following in your lab book and then type up in formal form before turning the lab in:

Your final copy of the lab should include the following items:

- Problem Question
 - may be the *same* within your group.
- Hypothesis
 - must be *unique* from your group members.
- List of Variables (Manipulated, Responding, 3 Controls)
 - may be the *same* within your group.
- Experimental & Control Groups-You can do a new control or use part 1 at room temperature as a control group.
 - may be the *same* within your group.
- List of Materials (include quantities & sizes)
 - may be the *same* within your group.
- Diagram (include all materials, and label)
 - must be *unique* from your group members.
- Procedures (use the E.O.C. procedure rubric).
 - must be *unique* from your group members.
- Data Table(s)
 - may be the *same* within your group.
- Graph (graph and solve the rate of reaction for lactase, just like in Part 1)
 - must be *unique* from your group members.
- Conclusion (include all aspects from Part 1 and a comparison with the results of part 1)
 - must be *unique* from your group members.