

**SCIENTIFIC METHOD LAB REPORT RUBRIC****1. Title (5 pts): "The Effect of (A) on (B)"**

*Example: The Effect of pH on the Activity of the Enzyme Lactase.*

**2. Introduction (10 pts)****a. Background**

Present a review of the topic. Place the research/experiment in the proper context of biology. Relate your experiment to the concepts learned in class. Review prior research directly related to the experiment.

*Example: Protein structure determines enzyme function. The shape of the active site controls the catalytic properties of the enzyme. Because of this, most enzymes work within a narrow range of environmental/cellular conditions. In particular, changes in pH, temperature and salinity will significantly affect enzyme function but altering protein structure. This research focused on the effect of changes in pH on enzyme activity. Changes in pH causes changes in hydrogen ( $H^+$ ) and hydroxyl ( $OH^-$ ) ions in solution. These changes in charge in the solution disrupt the secondary, tertiary and quaternary levels of structure of the proteins thereby changing the shape of the active site of the enzyme as the protein begins to denature. In this research, an experiment was undertaken to test the effect of pH on the function of the enzyme lactase. Lactase digests the disaccharide milk sugar, lactose, into the monosaccharides, glucose and galactose...*

**b. Hypothesis**

"If this relationship exists, then when I change (increasing, decreasing, etc.) (A) it will cause (B) to change in a specific way (increase, decrease, etc.)

*Example: If pH affects enzyme function, then when the pH is increased or decreased from pH 8 (the pH of the small intestines) the rate of lactose digestion by lactase will decrease.*

**3. Materials and Methods (20 pts)****a. Materials**

List the materials used in the experiment.

**b. Methods**

Describe the procedures in sufficient detail so that others can repeat your research.

**c. Statistical Methods**

Discuss the statistical tests used to describe or test the data.

**4. Results (30 pts)****a. Dependent Variable: State the dependent (or measured) variable, the (B) in your hypothesis. It must have units and must be measurable.**

*Example: The dependent variable is the production of glucose (the product of lactose digestion) in grams per mL of milk.*

**b. Independent Variable: State the independent (or manipulated) variable, the (A) in your hypothesis. State how the independent variable was modified. If it was measured, it must have units.**

*Example: The independent variable is the pH of the milk at integer values from pH 4.0 to pH 12.0.*

**c. Confounding variables (Constants)**

List all of the confounding variables that were kept constant during the experiment. Be thorough.

*Example: Milk from the same source and same brand of glucose test strips were used for all the samples as well as the same beaker and pH meter.*

## d. Replication / Sample Size

State the number of trials for each modification of the independent variable. You must have a minimum of three trials for each modification of the independent variable. Be sure to also present the average of your data from the trials

*Example: Each pH trial was repeated 3 times*

## e. Controls (positive, negative, a base line, or all three)

List the controls used in the experiment and explain what they were controlling for.

*Example: The pH 8.0 trial served as the positive control since it is known that this is the pH of the "native" environment of lactase function in the small intestines. All data will be compared to this control.*

## f. Organize Data

Organize the collected data in a data table. Provide a title for your data table. The title of the data table should describe the research and include both variables (A) and (B). Describe each data table in the text of your report.

*Example*

**Table 1. The Effect of pH on Lactase Activity**

	Glucose production (grams/ml of milk)								
	pH 4.0	pH 5.0	pH 6.0	pH 7.0	pH 8.0	pH 9.0	pH 10.0	pH 11.0	pH 12.0
<b>Trial 1</b>									
<b>Trial 2</b>									
<b>Trial 3</b>									
<b>Average</b>									

## g. Data Analysis

Present the data in a graph: independent variable vs. the dependent variable in the appropriate graph form (line vs. bar) with proper X and Y axis labels, keys, and numerical scales. By interpreting the graph, discuss the trends in the data. Highlight the most noteworthy datum points.

*Example: Graph 1 depicts the amount of glucose found in each of the samples after the milk was treated first with a specific pH buffer and then with lactase enzyme. The graph shows that the optimal pH for enzymatic activity of lactase is pH 8.0. The graph also indicates the enzymatic activity decreased sharply when the pH was either increased or decreased from this optimal with no activity below pH 5.0 or above pH 11.0...*

## 5. Conclusions (30 pts)

Discuss implications of the data. Discuss what your results mean when you consider the original question or hypothesis. Discuss whether the hypothesis was supported or not supported by the data. Point out the statistical significance of your results. Relate your conclusions to the concepts learned in class. If the results are unexpected or contradictory, you should attempt to explain and point out possible avenues for further research.

*Example: Enzyme function is determined by protein structure. The shape of the active site is the critical determining factor for enzyme activity, because that is the catalytic site. Lactase digests the milk sugar, lactose, into the monosaccharides, glucose and galactose. During the experiment, the activity of lactase was measured by the production of glucose in the milk samples. Optimal lactase activity was found at pH 8.0. This is the pH of the lumen of the small intestine where lactase functions in the human body. The enzyme has evolved to function within this environment so the protein has been selected for optimal functioning at this pH. As the hypothesis predicted, enzyme activity declined sharply as the pH decreased or increased beyond this optimum, thus the experimental hypothesis was supported. The change in pH causes changes in hydrogen ( $H^+$ ) and hydroxyl ( $OH^-$ ) ions in solution. These changes in charge in the solution disrupt the secondary, tertiary and quaternary levels of structure of the proteins thereby degrading the active site of the enzyme as the protein begins to denature...*

## 6. Literature Cited (5 pts)

Include all published works consulted in your research. List in bibliographic form.