

# Sodium Chloride's Impact on Enzyme Activity

Delainey Smith, Lizzie Piercy and Sarah Travis

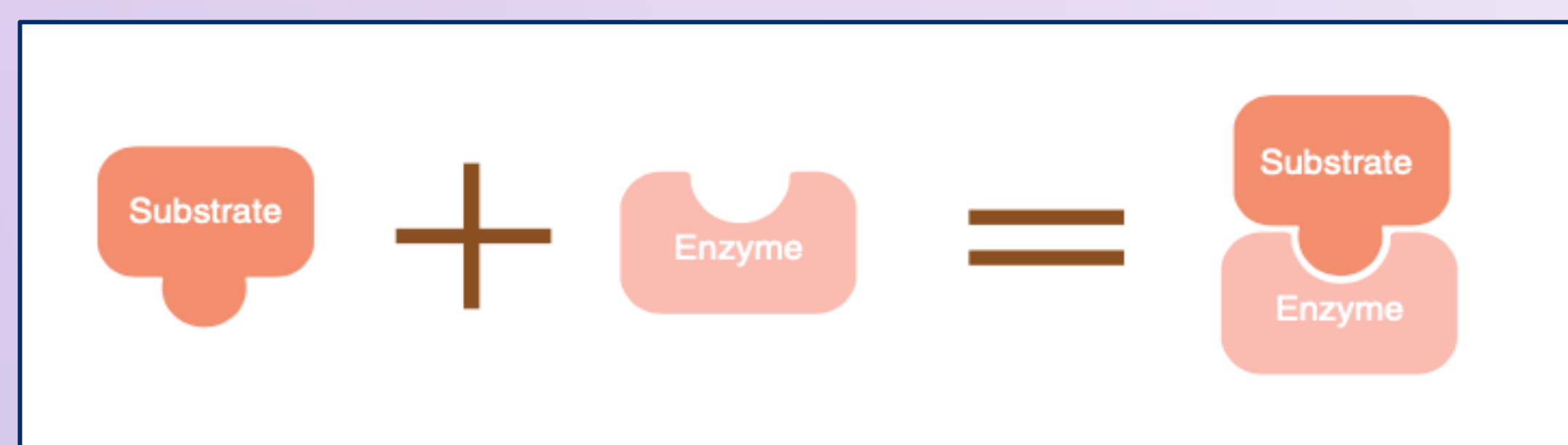
College of Arts and Sciences, Marian University Indianapolis

3200 Cold Spring Rd, Indianapolis, IN 46222

## INTRODUCTION

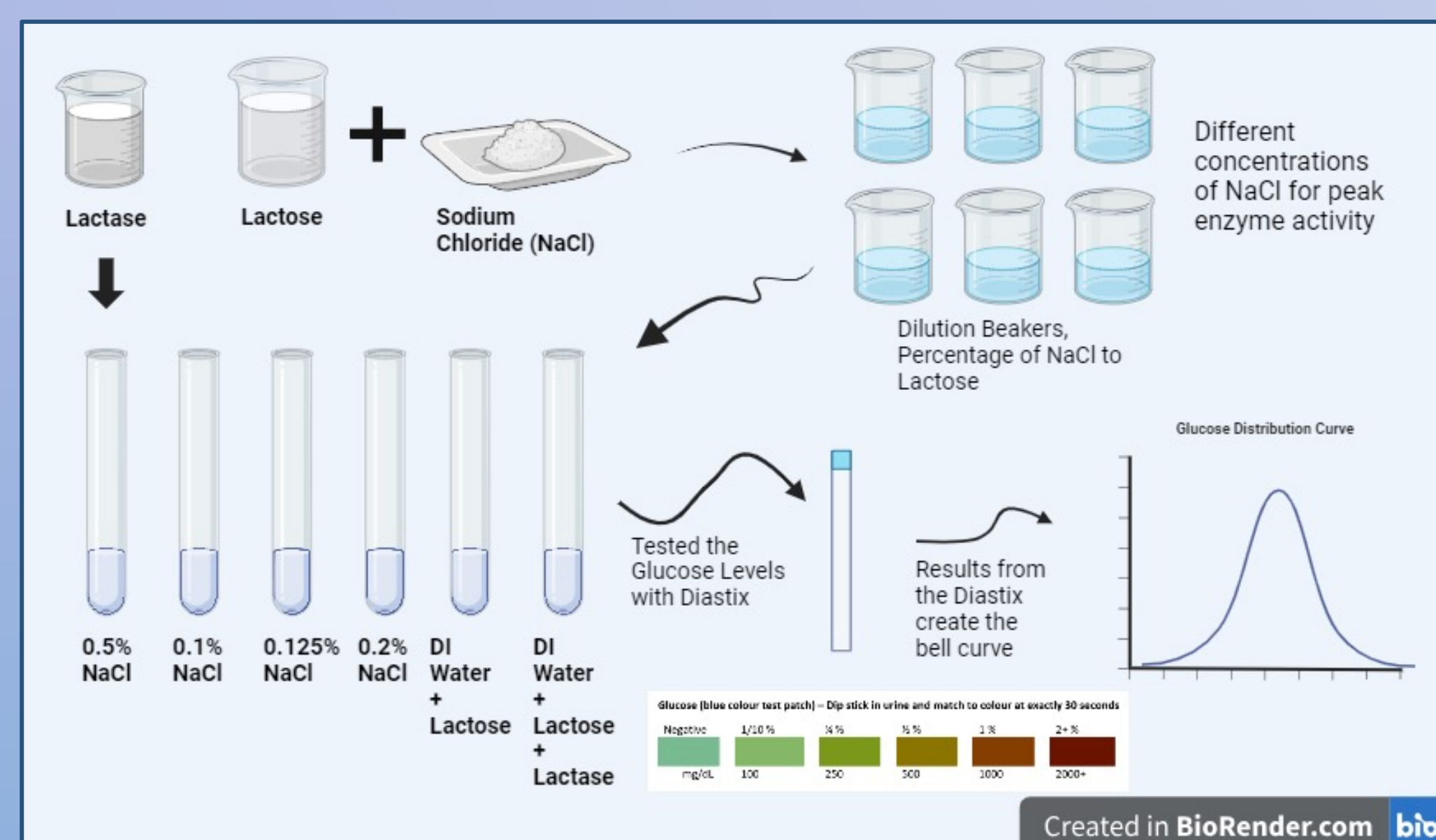
The enzyme lactase reacts with lactose, creating glucose as a product. For some members of the human population, their body does not produce the lactase enzyme, making it difficult to digest dairy products. Environmental factors and mutations can both cause changes in the structure of an enzyme, which can affect how they function. The chosen environmental factor of study was salt concentration. We chose salt concentration because it was an interesting and challenging factor to look at.

We hypothesize change in structure impacts enzyme activity. To test this, we used 5 different concentrations of salt in a lactose and lactase solution and tested the amount of glucose in each solution.



## MATERIALS AND METHODS

We made six different test tubes for our experiment each with a total volume of 2 mL. There was 1 mL of 6% lactase mixed with DI water, and 1 mL of 6% lactose and salt. Four of the test tubes had lactase and lactose with varying salt concentrations. The concentrations were 0.5%, 0.2%, 0.125%, and 0.1% salt in 6% lactose. The salt was mixed into the lactose, which was put into the test tubes with lactase. The positive control test tube that had 1 mL of DI water + lactase and 1 mL of lactose. The negative control had 1 mL of DI water and 1 mL lactose. After mixing the test tubes and letting them develop for some minutes, we tested the glucose levels of each test tube using the Diastix. We tested the Diastix three times. After they developed, we recorded the glucose level. The process can be seen in Figure 2 below.

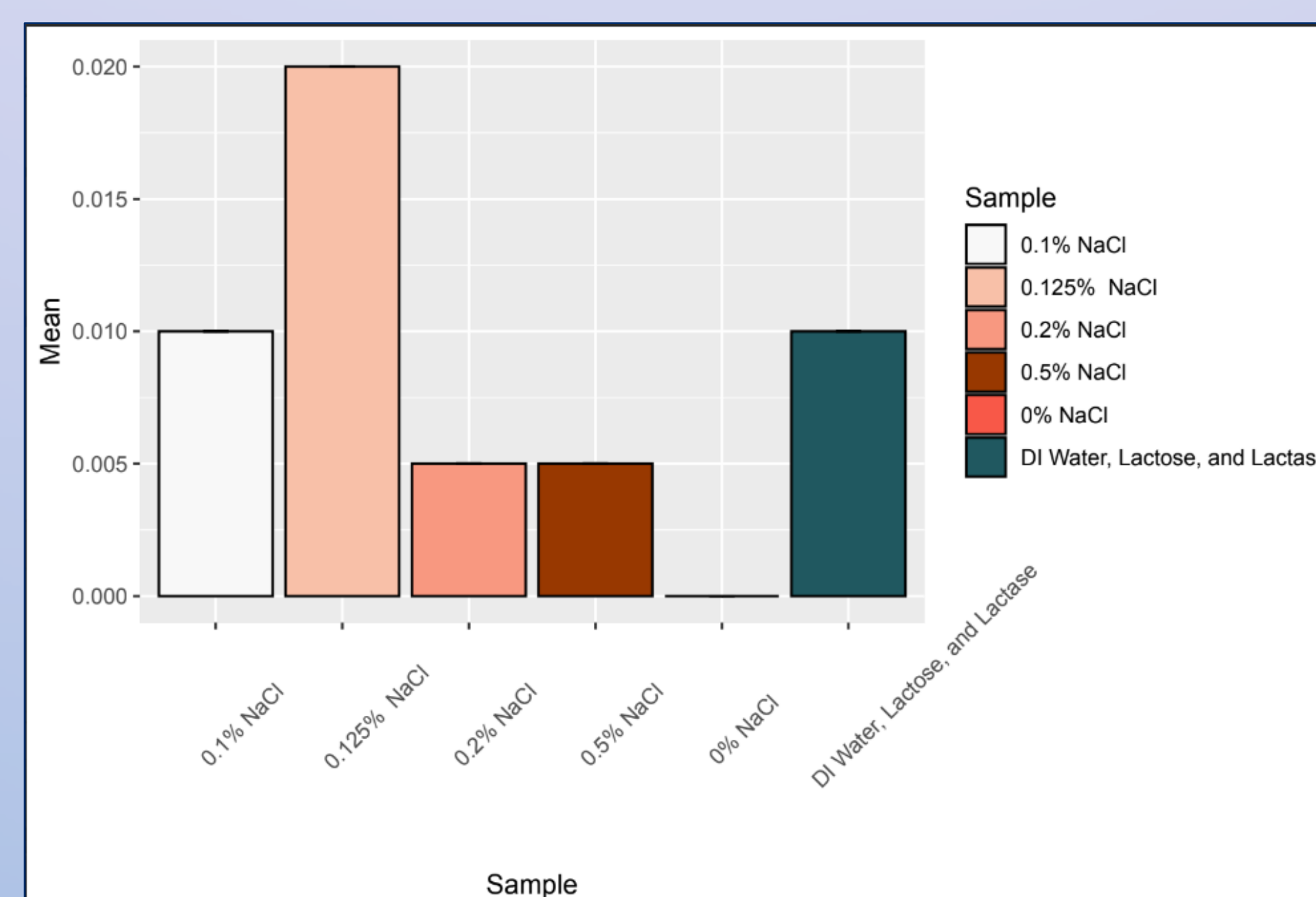


## FINDINGS – GLUCOSE LEVELS

In the experiment, the results suggested that the salt concentration of 0.1% is optimal for enzymatic activity due to the salt concentration is an isotonic solution. Whereas if the salt concentration is anything below that the activity is slower therefore, they produce less glucose. If the salt concentration is higher than 0.1% the production of glucose increases (**Table 1**). In the pictures below, you can see the Diastix on the paper towel. The colors of the Diastix correlate to the amount of glucose that was detected. The darker the color the more the glucose that was detected in the solution.

Sample	Replicate 1	Replicate 2	Replicate 3
DI Water, Lactose, and Lactase	1 % Glucose	1% Glucose	1% Glucose
0.5% NaCl	½% Glucose	½% Glucose	½% Glucose
0.2% NaCl	½% Glucose	½% Glucose	½% Glucose
0.125% NaCl	2% Glucose	2% Glucose	2% Glucose
0.1 % NaCl	1% Glucose	1% Glucose	1% Glucose
0% NaCl	Negative Glucose	Negative Glucose	Negative Glucose

**Table 1:** The table shows the results of the wet lab experiments and the percentage of glucose produced with certain percentages of NaCl.



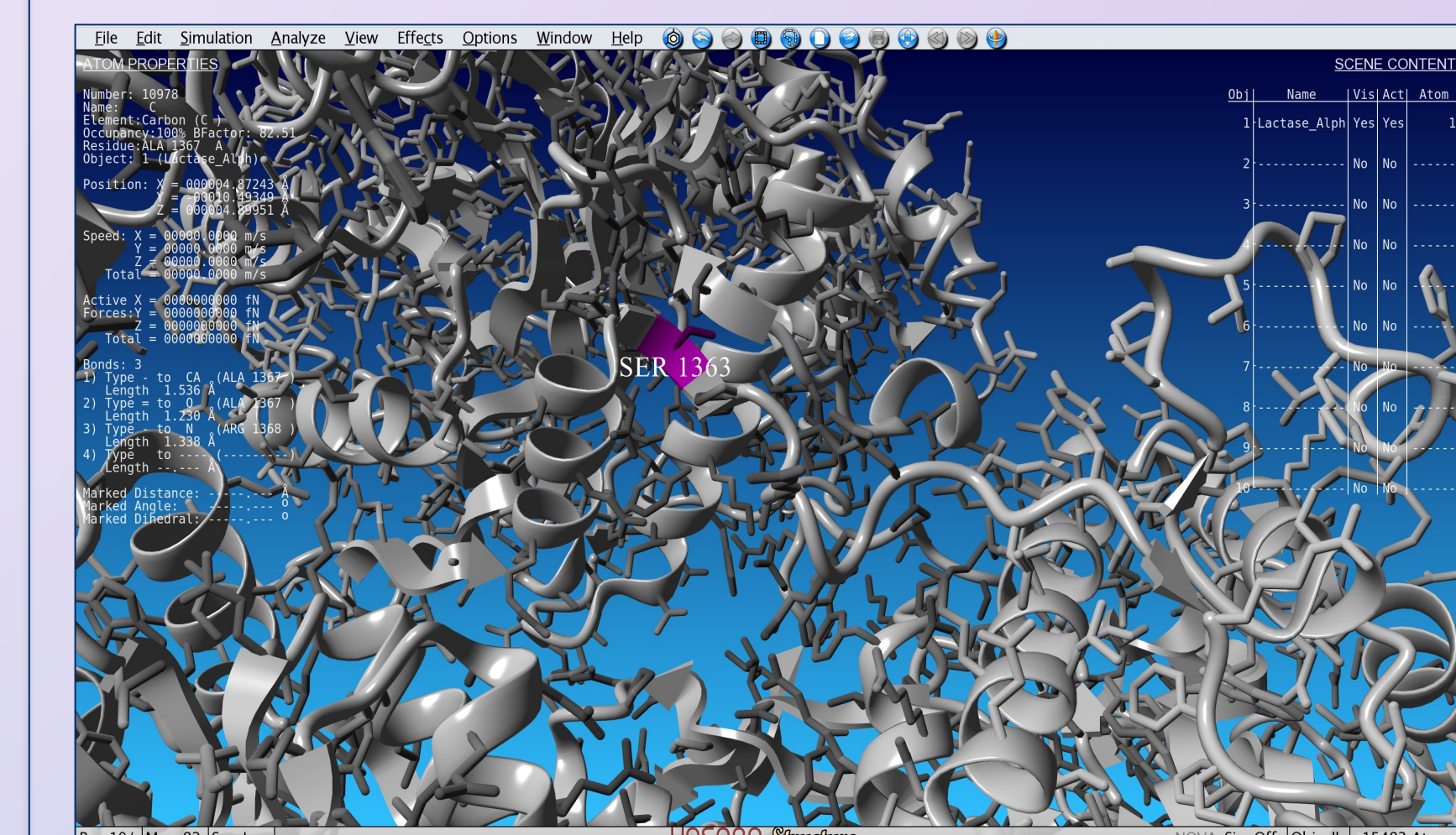
**Figure 3:** The graph on the left shows the data that we collected on the Diastix. They are used to test the level of glucose in the solution. There are no error bars on our graph due to the results being consistent across the replicates.

## CONCLUSIONS

This experiment concluded that salt concentration affects the lactase enzyme and the amount of glucose that is produced. The experiment did meet the goal of testing the enzymatic activity of lactose. The amount of glucose produced in each of the samples shows how the different [NaCl] affected the lactase enzyme. Our hypothesis was supported because the lactase enzyme and the NaCl reacted together to synthesize into glucose. We learned that enzymes have high specificity in terms of salt concentration and the enzyme lactase works best in a [NaCl] of 0.125%.

The implications of these findings show why a high sodium diet is unhealthy and advised against. Too much salt will denature proteins and negatively impact the enzyme.

In Figure 3, if we had more time, we could have done molecular simulations of this experiment to get a closer look at the denaturation of the proteins on a molecular level.



**Figure 4:** YASARA molecular simulation of GLY to SER in lactase

## LITERATURE CITED

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- Braham, Sabrina Ait, et al. “Effect of Concentrated Salts Solutions on the Stability of Immobilized Enzymes: Influence of Inactivation Conditions and Immobilization Protocol.” *Molecules (Basel, Switzerland)*, U.S. National Library of Medicine, 12 Feb. 2021, [www.ncbi.nlm.nih.gov/pmc/articles/PMC7918437/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7918437/).

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