

Virtual Lab: Enzyme-Controlled Reactions

1. Open the Virtual Lab: Enzyme Controlled Reactions
http://glencoe.mheducation.com/sites/dl/free/0078759864/383930/BL_11.html
2. Click the TV in the lab simulation to watch a video about enzyme action.
3. Click the “Information” bar at the bottom of the lab simulation and read it!
4. Complete the following guided mini “lab report”. (**This will help to ensure that your own homeostasis lab report will be formatted properly!**):

Background Information:

All (or most) reactions that happen in cells depend on enzymes. Enzymes are made up of proteins. They act as ‘catalysts’ for reactions. This means that they speed up reactions, but they are not ‘used up’ in the process. They can be used again and again. If there were no enzymes in the human body, most metabolic reactions would occur at a rate too slow to support life. Another important use of enzymes is that it allows reactions to be controlled so that just the right amount of product is made – not too much or too little.

Enzymes are used for many biological reactions. Amylase is an enzyme found in saliva that starts to break down starch into glucose, while glucose oxidase is an enzyme that helps cells to break down sugar. Glycogen synthase helps to convert glucose to glycogen. Fatty acid synthetase allows fatty acids to be created in the cytoplasm from a molecule that results from the breakdown of glucose. These fatty acids can then be used as the building blocks of more complex lipids. These are just a few examples of how enzymes enable reactions within cells.

Question: How do substrate concentration and pH affect enzyme-controlled reactions?

Hypothesis: *(If...then format)*

You may choose to write two hypotheses – one for substrate concentration, one for pH – if easier.

If I adjust the pH levels of the enzyme controlled reactions and keep the substrate concentration constant, then it will affect the reactions of these enzymes and make the speed faster because pH levels play a factor in the stability of the enzymes.

Variables:

For pH 5, what is the independent variable? the dependent variable? controlled variable(s)?

For 2.0g of substrate, what is the independent variable? the dependent variable? controlled variable(s)?

Independent: pH levels

Dependent: enzyme-controlled reactions

Controlled: Water temperature, substrate concentration

Procedure:

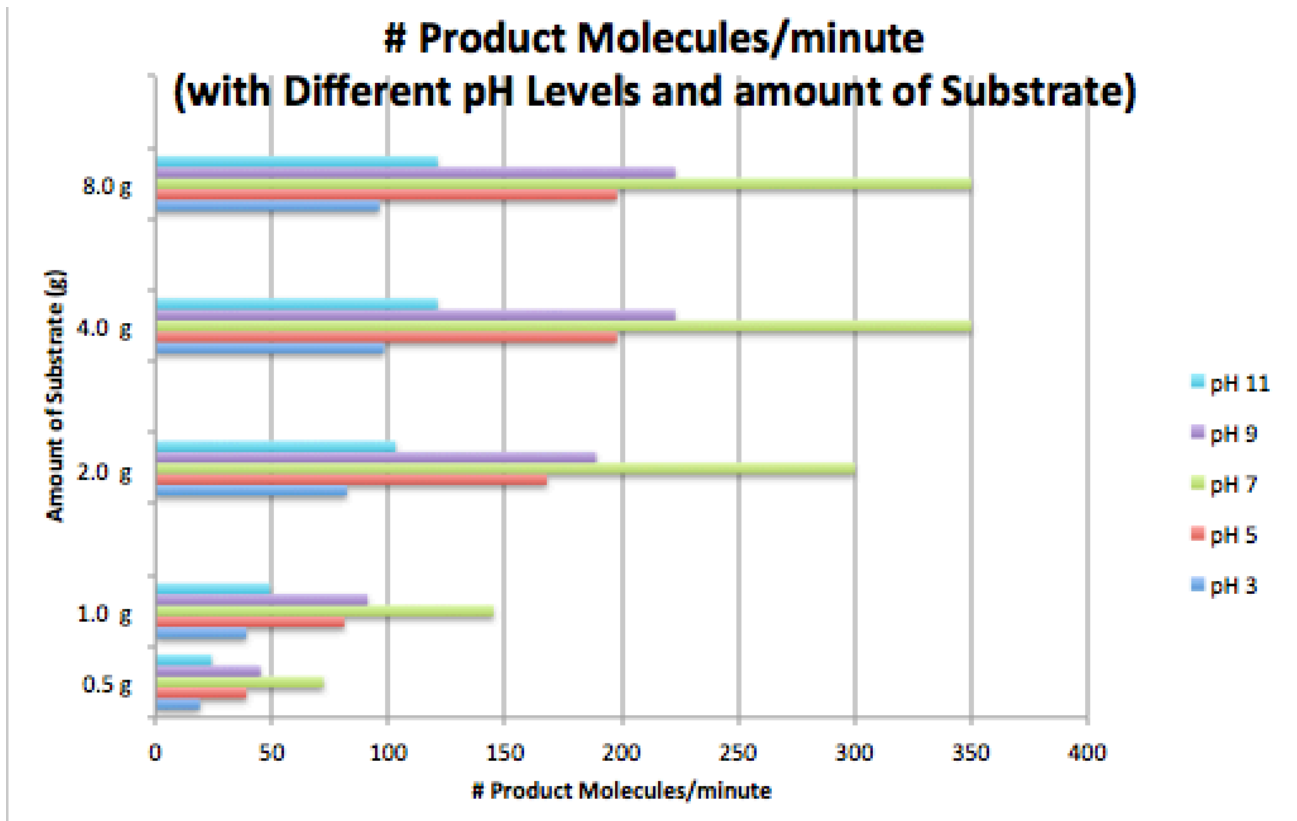
Include a brief description of your method. All significant details should be included, such that another scientist could repeat your experiment.

1. Collect the required materials:
 - a. 5 test tubes (at least)
 - b. liquid concentrations of different pH levels (3, 5, 7, 9, 11)
 - i. water has to be 37 degrees Celsius
 - c. 77.5g of substrate (at least)
2. Pour 5mL of water into each test tube and label them from 1-5
 - a. By least (1) to greatest (5) pH level
3. Pour in 0.5 g of substrate into each test tube
4. Record your results by clicking the computer
5. Repeat steps 3 and 4 for the different amount of substrate (1.0, 2.0, 4.0, and 8.0 g)
6. Repeat experiment for accuracy

Data:**Table 1:** Number of product molecules formed per minute obtained from the virtual lab.

	# Product Molecules/minute at:				
	pH 3	pH 5	pH 7	pH 9	pH 11
0.5 g	19	39	72	45	24
1.0 g	39	81	145	91	49
2.0 g	82	168	300	189	103
4.0 g	98	198	350	223	121
8.0 g	96	198	350	223	121

Create one or more graph(s) illustrate the trends seen between amount of substrate / pH and the initial rate of reaction.



Analysis Questions:

- Describe the relationship between substrate concentration and the initial reaction rate of an enzyme-catalyzed reaction. Is this a linear relationship? What happens to the initial reaction rate as substrate concentration increases?

The relationship between the substrate concentration and the initial reaction rate of an enzyme-catalyzed reaction is seen through the growth (increase) of the number of product molecules made per minute. I think that this is a linear relationship because there is a constant growth, except it does sort of take a turn at 8.0g. The initial reaction rate increases each time as the substrate concentration increases.

- What is the maximum initial reaction rate for this enzyme at pH 7?
The maximum initial reaction rate for the enzyme at pH 7 was 350 products per minute.
- Explain why the maximum initial reaction rate cannot be reached at low substrate concentrations.
The maximum initial reaction rate cannot be reached at low substrate concentrations because the rate of how which product can be formed is limited to the concentration of substrate that is available. However, as the substrate concentration reaches the maximum reaction rate, adding more substrate will not affect the rate of the reaction to any significant effect.
- What does your data indicate about the optimum pH level for this enzyme-catalyzed reaction?
My data indicates that pH 7 is the optimum pH level for this enzyme-catalyzed reaction.
- Enzymes function most efficiently at the temperature of a typical cell, which is 37 degrees Celsius. Increases or decreases in temperature can significantly lower the reaction rate. What does this suggest about the importance of temperature-regulating mechanisms in organisms? Explain.

I think that this shows the importance of temperature regulation in the human body, usually around 98-100 degrees Fahrenheit, which is around 37 degrees Celsius. If the temperature drops, then this anticipates that there will be a lower reaction rate. At the same time, as the temperature increases, so does the rate of reaction. But very high temperatures denature enzymes.

Conclusion:

- *Summarizes data used to draw conclusions.*
- *Conclusions follow data (no wild guesses or leaps of logic).*
- *Hypothesis is rejected or accepted based on the data.*
- *Discusses possible experimental errors.*
- *Discusses applications or real world connections.*

In conclusion, the data that I collected shows that the pH concentration of a neutral liquid increases the rate of production for enzymes the most and pH 5-9, especially 7, serves as the most effective pH levels. This is shown in the graph where the products made by a liquid concentration of pH 7 almost doubles the products made in the pH level 5 and 9.

My hypothesis was rejected because I had earlier stated "If I adjust the pH levels of the enzyme controlled reactions and keep the substrate concentration constant, then it will affect the reactions of these enzymes and make the speed faster because pH levels play a factor in the stability of the enzymes." However, my data showed me that the rate of productivity did not increase due to the increase of pH level, but instead increased due to how neutral the liquid concentration was.

However, during my experiment, some of the experimental errors could have affected my results and one of them include how for 4.0g and anything greater substrate, most of the numbers stayed the same.

Lastly, this applies to our real life situations because this experiment shows how important it is to sustain the temperature of a typical cell, showing us how important it is to sustain a particular body temperature at all times.