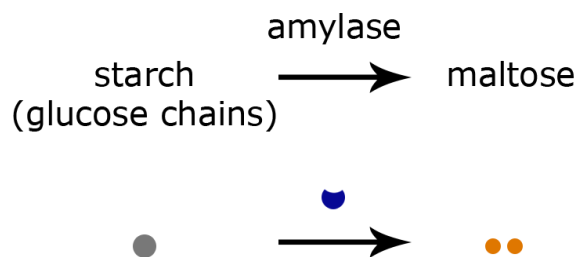


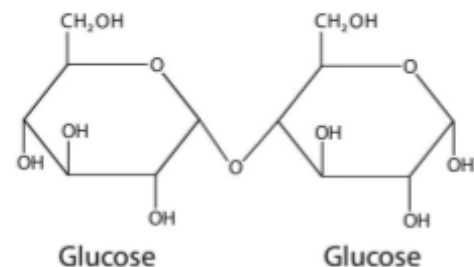
(Simulation) - How Does Concentration, Temperature, and pH Affect Enzyme Activity

Go to the [enzyme simulation](#) at Biology Simulations.

Background Info: The reaction involved in this simulation:



Maltose is a disaccharide formed from two units of glucose



Set starch to 2.5 mmol and amylase to 1 mmol. Set maltose, maltase, glucose, and amylase inhibitors to 0. Set pH to 7 and temperature to 35. Run the simulation.

1. Identify the following:

Enzyme:

Substrate:

Product:

2. What happens to the amount of starch over time? a) increase b) decrease c) stays the same
3. What happens to the amount of maltose over time? a) increase b) decrease c) stays the same
4. What happens to the amount of amylase over time? a) increase b) decrease c) stays the same

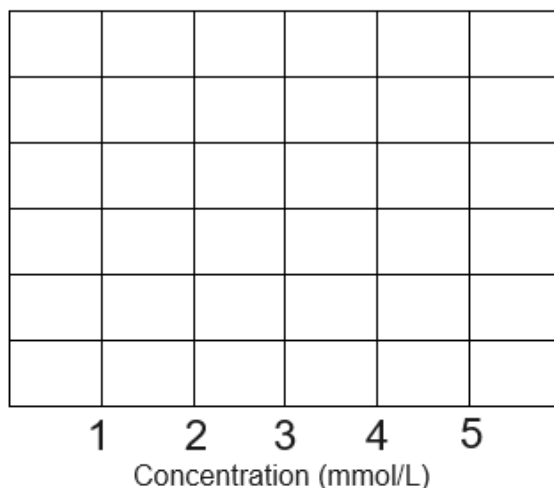
Part 1: Substrate concentration *Experimental Question:* How does starch concentration affect the rate of product production?

- Set maltose, maltase, glucose, and amylase inhibitors to 0. Set pH to 7 and temperature to 35.
- Set amylase and starch to 1 mmol.
- Run the simulation and record the amount of time it takes for all of the starch to be converted to maltose.
- Repeat with the starch set to 2, 3, 4, and 5 mmol.

5. Complete the data table. (Run each experiment until all the starch is consumed.) Calculate the rate of maltose production by dividing the amount of maltose produced by the time it took to consume all of the starch.

Starting starch (mmol)	Time to consume all starch (sec)	Maltose produced (mmol)	Rate of maltose production (mmol/sec)
1			
2			
3			
4			
5			

6. Sketch a graph representing how the starting amount of starch affects the **rate of maltose production**. (Use your data from the table above.) Label the Y axis.



7. Summarize the results of the experiment. How does increasing the amount of substrate affect reaction rate?

Part 2: Effects of Enzyme Concentration

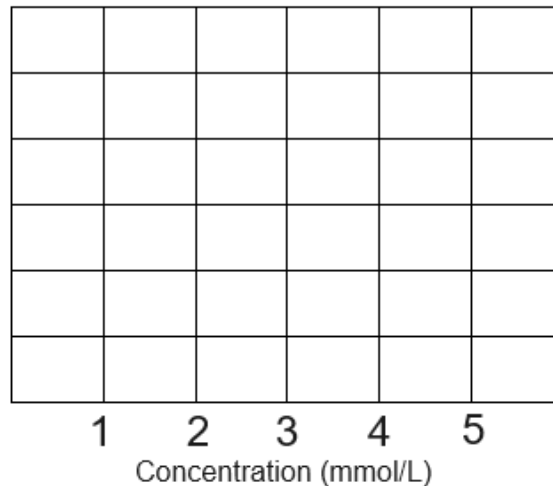
Experimental Question: How does enzyme concentration affect the rate of product production?

- Set maltose, maltase, glucose, and amylase inhibitors to 0. Set pH to 7 and temperature to 35.
- Set amylase to 1 mmol. Set starch to 2.5 mmol.
- Run the simulation and record the amount of time it takes for all of the starch to be converted to maltose.
- Repeat with amylase set to 2, 3, 4, and 5 mmol.
- Calculate the rate of maltose production by dividing the amount of maltose produced by the time it took to consume all of the starch.

8. Complete the data table. (Run each experiment until all the starch is consumed.)

Amylase (mmol)	Time to consume all starch (sec)	Maltose produced (mmol)	Rate of maltose production (mmol/sec)
1			
2			
3			
4			
5			

9 . Sketch a graph representing how the starting amount of starch affects the rate of maltose production. (Use your data from the table above.) Label the Y axis.



10. Summarize the results of the experiment. How does increasing the amount of enzymes affect reaction rate?

Part 3: Effects of pH

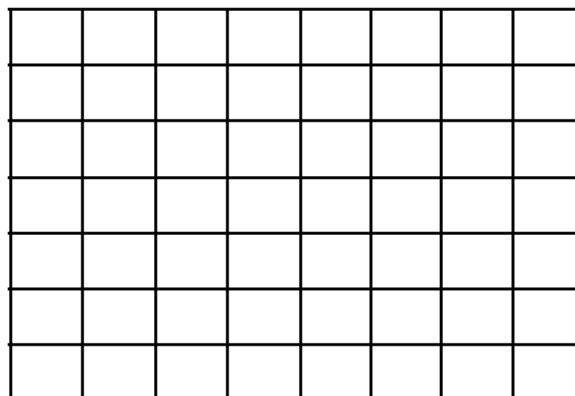
Experimental Question: How does pH affect the rate of product production?

- Set maltose, maltase, glucose, and amylase inhibitors to 0. Set temperature to 35.
- Set amylase to 2 mmol. Set starch to 2.5 mmol. Set pH to 6.
- Run the simulation and record the amount of time it takes for all of the starch to be converted to maltose. *If no reaction occurs, record the rate as 0.*
- Repeat with pH set to 6.5, 7, 7.5, 8.
- Calculate the rate of maltose production by dividing the amount of maltose produced by the time it took to consume all of the starch.

11. Complete the data table. (Run each experiment until all the starch is consumed.)

pH	Time to consume all starch (sec)	Maltose produced (mmol)	Rate of maltose production (mmol/sec)
6			
6.5			
7			
7.5			
8			

12. Sketch a graph representing how pH affects the rate of maltose production. Label the X and Y axes.



13. Summarize the results of the experiment. How does increasing pH affect reaction rate?

Part 4: Effects of Temperature

Experimental Question: How does temperature affect the rate of product production?

- Set maltose, maltase, glucose, and amylase inhibitors to 0. Set pH to 7.
- Set amylase to 2 mmol. Set starch to 2.5 mmol. Set temperature to 25.
- Run the simulation and record the amount of time it takes for all of the starch to be converted to maltose.
If no reaction occurs, record the rate as 0.
- Repeat with the temperature set to 30, 35, 40, 45, 50, 55.
- Calculate the rate of maltose production by dividing the amount of maltose produced by the time it took to consume all of the starch.

14. Complete the data table. (Run each experiment until all the starch is consumed.)

Temperature (degrees C)	Time to consume all starch (sec)	Maltose produced (mmol)	Rate of maltose production (mmol/sec)
25			
30			
35			
40			
45			
50			
55			

15. Sketch a graph representing how pH affects the rate of maltose production. Label the X and Y axes.

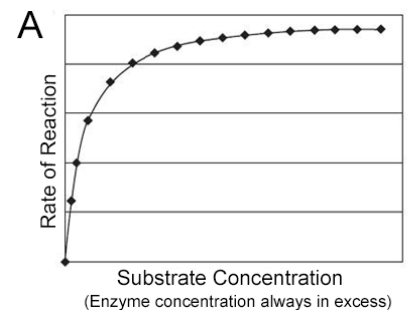
16. Summarize the results of the experiment. How does temperature affect the reaction rate?

Part 5: Final Synthesis - *How Does Concentration, Temperature, and pH Affect Enzyme Activity*

17. Explain **WHY** increasing the substrate concentration increases the reaction rate.

18. Explain **WHY** increasing the temperature increases the reaction rate.

19. Interpret the results in graph A. Explain why the rate of reaction begins to plateau.



20. Interpret the results in graph B. Why does this graph not plateau?

