

## Title: Toothpick Biochemistry: Toothpickase

### Materials:

toothpicks, paperclips, shallow bowl, stopwatch or timer

### Procedure:



#### Part A: RATE of PRODUCT FORMATION

1. Work in groups of 3: 1 person to time, 1 person to record, and 1 person to be the enzyme *toothpickase*.
2. Select 80 toothpicks and place them in a shallow bowl.
3. The timer starts and stops the reaction every 20 seconds.
4. The enzyme *toothpickase* breaks the toothpicks WITHOUT looking! The reaction products (broken toothpicks) must remain in the bowl.
5. The recorder counts or tallies the cumulative number of toothpicks broken as each time interval is called. (Use the Data Table A below)
6. The recorder shares the data with team members.
7. Calculate the reaction rate (# toothpicks broken / s) for each trial.
8. Graph the results plotting *Product Formed* (the total number of toothpicks broken) vs. *Time*.
9. Describe the shape of the graph and explain ON THE GRAPH what has happened.

#### Part B: REACTION RATE VS. SUBSTRATE CONCENTRATION

1. Remove the broken toothpicks from the shallow bowl. Place 80 paperclips in the bowl. The paper clips represent a "solvent" in which the toothpicks are *dissolved*. Different concentrations are simulated by mixing different numbers of toothpicks in with the paper clips.
2. For the first trial, place 10 toothpicks in the bowl with the paper clip. The enzyme has 20 seconds to react (break as many toothpicks as possible in 20 s). Record the number broken at a concentration of 10. (Use Data Table B below)
3. Remove the broken toothpicks and repeat with concentrations of 20, 30, 40, etc. up to 100 toothpicks (break as many toothpicks as possible in 20 s).
4. Calculate the reaction rate (# toothpicks broken / s) for each trial.
5. Graph the results by plotting *Reaction Rate* (toothpicks broken in 20 seconds) vs. *Substrate Concentration* (10, 20, 30, 40 ... 100).
6. Describe the shape of the graph and explain ON THE GRAPH what has happened.

Time (s)	# Toothpicks Broken	Reaction Rate *
0	0	0
20		
40		
60		
80		
100		

\* # toothpicks / time

Concentration	# Toothpicks Broken	Reaction Rate*
0	0	0
10		
20		
30		
40		
50		
60		
70		
80		
90		
100		

\* # toothpicks / time

**Discussion:** Summarize what you did and describe your results. Make sure that you make specific mention of information from your data tables and graphs. Answer the following questions as well:

1. What would happen if 2 people were breaking toothpicks at the same time?
2. What would happen if you added more toothpicks, altered the pH, or altered the temperature?

**Conclusion:** 1 statement about the product formation rate and 1 statement about the effect of concentration on reaction rate.

**Reflection:** Personal Statement

