

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_

Toothpickase Lab

# Toothpickase Simulation

**Overview:** in this simulation, you will:

1. Demonstrate how an enzyme works to catalyze enzymatic reactions.

## **Introduction**

Enzymes are used in the body to speed up chemical reactions by lowering the activation energy. In this “hands-on” lesson, you will demonstrate how an enzyme works. You are to pretend that your hand is the enzyme, and toothpicks are the substrate. The reaction is to break the toothpick in half in your “active site” (1<sup>st</sup> and 2<sup>nd</sup> fingers and thumb). Also you will be performing this activity with your **EYES CLOSED** because it simulates the random molecules interacting. **The object of the activity is to break as many toothpicks in half as possible in 90 seconds to test the “enzyme.”**

During the activity, you will also notice that the substrate will not break unless you find *just* the right spot (the bonding site) and that you will naturally find a maximum rate of reaction, the top speed at which your hands can find and break a toothpick.

**GROUP ROLES:** Look for your names in the procedure and do as prompted.

**The Enzyme** — breaks the toothpick in his/her “active site”

**The Timer** — times the intervals

**The Calculator** — mixes the concentrations and calculates the reaction rate

## **MATERIALS:**

Toothpicks, 30 per small group  
Stopwatch or Clock ([projected](#))  
Calculator

## **PROCEDURE:**

### The Rules for the Enzyme!

1. You must break each toothpick one at a time.
2. You must break each toothpick with one hand only.
3. You must break each completely in half and keep them in the same pile as unbroken ones.
4. You cannot re-break any toothpicks. (This means you have to feel for whole toothpicks!)
5. You cannot begin until the timer calls “Go!”
6. You must stop precisely when the timer says “Stop!”
7. You must keep your EYES CLOSED throughout the entire activity. Enzymes don’t have eyes! :)

### The Activity

- The Calculator: Spread toothpicks on lab table in a random pile.
  - The Enzyme: When The Timer says “Go,” begin breaking toothpicks.
  - The Enzyme: After 10 seconds, The Timer will say “Stop!” then stop breaking toothpicks.
  - The Calculator: Count how many toothpicks were broken (2 halves = 1 toothpick!)
- The Calculator: Record number of toothpicks that were broken. Mix them back with the unbroken ones.
  - The Enzyme: When The Timer says “Go,” begin breaking toothpicks again.
  - The Enzyme: At the end of 20 MORE seconds (30 seconds total), The Timer will say “Stop!”
  - Calculator: Count how many total toothpicks have been broken (2 halves = 1 toothpick!)

- The Calculator: Record number of toothpicks (include previous ones). Mix them back with unbroken ones.
  - The Enzyme: When The Timer says “Go,” begin breaking toothpicks again.
  - The Enzyme: At the end of 20 MORE seconds (50 seconds total), The Timer will say “Stop!”
- The Calculator: Count and record the total number of toothpicks again. (*Include the previous ones!*)
- Keep repeating until you have recorded for 90 seconds total.
- Calculate the reaction rate in the following data table.

### DATA TABLE:

Table I. Reaction Rates

Time (sec)	Total Time (sec)	# of TOTAL toothpicks broken since $t = 0$	(# of total toothpicks broken) / (total time) = Reaction Rate
10	10		_____ toothpicks / 10 sec = _____ toothpicks/sec
20	30		_____ toothpicks / 30 sec = _____ toothpicks/sec
20	50		_____ toothpicks / 50 sec = _____ toothpicks/sec
20	70		_____ toothpicks / 70 sec = _____ toothpicks/sec
20	90		_____ toothpicks / 90 sec = _____ toothpicks/sec

### ANALYSIS QUESTIONS:

Answer the following in your laboratory notebook.

Use complete sentences for Questions 2-4.

1. Sketch the picture to the right and label the following:
  - Enzyme
  - Active Site
  - Substrate



Use the following structure: “You would expect the reaction rate to \_\_\_\_\_ if \_\_\_\_\_ because \_\_\_\_\_.”

2. Make a hypothesis about what would happen to the reaction rate (*increase or decrease*) if you had **two enzymes** at your lab station.
3. Make a hypothesis about what would happen to the reaction rate if the enzyme were held in **ice water for 1 minute** before starting the experiment.
4. Listen for teacher instructions to annotate your answers to 2 & 3.