

Toothpickase: An Introduction to Enzyme Kinetics

Enzymes work to speed up biological reactions by lowering their activation energy. There are certain conditions that must be met for an enzyme to work efficiently. One of these conditions is substrate concentration. You will observe the affects of different substrate and enzyme concentrations on “toothpickase.” You will also be determining the rate of enzyme activity of toothpickase. The toothpicks represent the substrate. Your thumb and index finger represent the active site of the enzyme toothpickase. To catalyze the reaction (breaking the toothpick completely in half), you may only use ONE hand. Toothpicks not broken completely in half do not count as products.

Purpose: To determine the rate of enzyme activity for the enzyme “toothpickase” and observe the effects of different substrate concentration on that rate.

Materials

150 Toothpicks

Stopwatch

Small paper plate

Procedure

Part A

- Assign the following parts:
 - Toothpickase (person who will break toothpicks)
 - Timer (will tell toothpickase when to start and stop)
 - Counter (counts the # of toothpicks broken)
 - Data Recorder (record all #s in the tables)
- Place 50 toothpicks on the small paper plate in front of Toothpickase.
- When told to do so by the Timer, Toothpickase will begin picking up and breaking toothpicks in half while NOT LOOKING at the plate and only using ONE HAND and at a constant pace (it is not a race).
- As Toothpickase breaks toothpicks, the Counter will count the number of broken toothpicks and make sure that the broken toothpicks are put back in the pile with the whole toothpicks (because products and reactants mix during the reaction).
- Put 10 seconds on the stopwatch. Count the number of toothpicks broken in 10 seconds. Record the number in Table 1.
- Then, keeping the same pile of broken and whole toothpicks, count the number of toothpicks broken in 20 seconds. Record the number in Table 1.
- Repeat #6, but for 30 seconds. Record the number in Table 1.
- Repeat #6, but for 60 seconds. Record the number in Table 1. **If you run out of toothpicks, record the amount of time it took to do so.

Part B

1. Repeat everything in PART A, but now spread out the toothpicks so that Toothpickase has to reach for them (toothpick concentration decreases).
2. Record all data in Table 2.

Part C

1. Repeat everything in PART A, but now have 2 students break the toothpicks (double enzyme concentration). Record all data in Table 3. (Again, if you run out of toothpicks before time is up, stop the clock and record how long it took to do so.)

Data

Table 1: Toothpickase Activity Part A

| Interval time (seconds) | Cumulative time (seconds) | #TPs Broken | Total Broken |
|-------------------------|---------------------------|-------------|--------------|
| 10 | 10 | | |
| 20 | 30 | | |
| 30 | 60 | | |
| 60 | 120 | | |

Table 2: Toothpickase Activity Part B (Decreased toothpick concentration)

| Interval time (seconds) | Cumulative time (seconds) | #TPs Broken | Total Broken |
|-------------------------|---------------------------|-------------|--------------|
| 10 | 10 | | |
| 20 | 30 | | |
| 30 | 60 | | |
| 60 | 120 | | |

