

## Toothpickase

Remember that enzymes are proteins that act as catalysts to speed up reactions. The rate of an enzyme-catalyzed reaction can be affected by several factors, including substrate concentration, enzyme concentration, and the presence of inhibitors.

In this activity you will simulate how the function of an enzyme responds to a variety of changes in the environment. We will use the enzyme toothpickase, which breaks toothpicks in half. To perform the reaction, place a toothpick between your thumb and forefinger of both hands and break it in half. Always break the toothpicks one at a time.

### Part A

1. Select 20 toothpicks and spread them out well on a desk. Do not line them up.
2. With one partner timing, determine how long it takes to break the 20 toothpicks as fast as possible.
3. Calculate the rate of enzyme activity in toothpicks per second.

### Part B

4. Select 40 new toothpicks and spread them out on a desk. Do not line them up.
5. With one partner timing, determine how long it takes to break the 40 toothpicks as fast as possible.
6. Calculate the rate of enzyme activity in toothpicks per second.

### Part C

7. Select 20 new toothpicks and spread them out randomly on a desk. Do not line them up.
8. This time both partners will break toothpicks. Measure the time required for both partners to break the toothpicks simultaneously.
9. Calculate the rate of enzyme activity in toothpicks per second.

### Part D

10. If time permits, put on the heat-resistant gloves.
11. Select ten new toothpicks and spread them out on a desk. Do not line them up.
12. Determine how long it takes to break ten toothpicks as fast as possible.
13. Calculate the rate of enzyme activity in toothpicks per second.

### Questions

1. a) What simulated the active site?  
b) What is being used as the substrate?
2. Each part of this activity is meant to model a different factor that affects the rate of an enzyme-catalyzed reaction. Identify what each part is meant to represent.
3. a) Under what conditions did the fastest reaction rate occur?  
b) Why was this the fastest?
4. Review the section in your notes about controlling enzyme activity. Suggest a modification of this activity that could be used model each of the following:
  - a) competitive inhibitor
  - b) noncompetitive inhibition
  - c) change in temperature
  - d) change in pH
  - e) non-reversible inhibitor