

Names: _____

Period: _____

Toothpick-ase: Introduction to Enzymes

Enzymes are used in all metabolic reactions to control the rate of reactions and decrease the amount of energy necessary for the reaction to take place. Enzymes are specific for each reaction and are reusable. Enzymes have an area called the active site to which a specific substrate will bond temporarily while the reaction is taking place. In this activity, you will simulate the reaction of an enzyme with its substrate.

Materials:

1. about 120 toothpicks per team
2. pencil and lab sheet
3. clock/watch with a second hand
4. ice water
5. masking tape

Procedure: In this activity, the toothpicks represent a substrate and your thumbs and index fingers represent the enzyme, toothpick-ase. When you break a toothpick, the place where the toothpick fits between your fingers represents the active site of the enzyme.

Part I: **Person:** _____

1. Count out 40 toothpicks and place them in a pile.
2. Break as many toothpicks as you can in 5 seconds and record this data on the table.

NOTE: Broken toothpicks should be thrown into the pile of unbroken toothpicks because products and reactants mix in metabolic reactions. **DO NOT BREAK TOOTHPICKS ALREADY BROKEN!**

3. Break as many toothpicks as you can in 10 seconds and record this data on the table.
4. Break as many toothpicks as you can in 20 seconds and record this data on the table.
5. Break as many toothpicks as you can in 30 seconds and record this data on the table.
6. Calculate the reaction rate in toothpicks broken/second. Divide the number of toothpicks broken by the time allowed to break them.

Time (seconds)	Toothpicks broken (#)	Reaction Rate (toothpicks/second)
5		
10		
20		
30		

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Part II: **Person:** _____

1. Count out 40 toothpicks and place them in a pile.
2. Another person in the group will place their hands in the ice water for at least three minutes. They will then proceed to break toothpicks in the following time intervals and record the data on the table.
 - a. First, break as many as possible in 5 seconds
 - b. Next, break as many as possible in 10 seconds
 - c. Place hands back into the ice water for two minutes
 - d. Break as many as possible in 20 seconds
 - e. Break as many as possible in 30 seconds
3. Calculate the reaction rate in toothpicks broken/second. Divide the number of toothpicks broken by the time allowed to break them.

NOTE: As before, place broken toothpicks into the pile of unbroken toothpicks and do not re-break toothpicks.

Time (seconds)	Toothpicks broken (#)	Reaction Rate (toothpicks/second)
5		
10		
20		
30		

Part III: **Person:** _____

1. Count out 40 toothpicks and place them in a pile.
2. Another person in the group will obtain masking tape and get their thumb taped to the palm of their hand and their fingers taped together on both hands. They will then proceed to break toothpicks in the following time intervals and record the data on the table.
 - a. First, break as many as possible in 5 seconds
 - b. Next, break as many as possible in 10 seconds
 - c. Break as many as possible in 20 seconds
 - d. Break as many as possible in 30 seconds
3. Calculate the reaction rate in toothpicks broken/second. Divide the number of toothpicks broken by the time allowed to break them.

NOTE: As before, place broken toothpicks into the pile of unbroken toothpicks and do not re-break toothpicks.

Names: _____

Period: _____

Time (seconds)	Toothpicks broken (#)	Reaction Rate (toothpicks/second)
5		
10		
20		
30		

Data Analysis & Conclusions:

1. What happens to the reaction rate as the supply of toothpicks runs out?
2. What would happen to the reaction rate if the toothpicks were spread out so that the “breaker” has to reach for them?
3. What would happen to the reaction rate if more toothpicks (substrate) were added?
4. What would happen to the reaction rate if there were two “breakers” (more enzymes)?
5. What happened to the reaction rate when the “breaker” placed their hands in ice water (temperature effect)? Why?
6. What happened to the reaction rate when the “breaker” had their thumbs and fingers taped down (active site affected)? Why?