AP Biology Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per\_\_\_\_\_\_\_\_\_

TOOTHPICKASE ACTIVITY

**INTRODUCTION**

This is a lesson in enzyme action, demonstrating the natural increase in reaction rate, the leveling off of the reaction and the subsequent effect on products produced as the substrate is used up. You are to pretend that toothpicks are the substrate to be broken down and your hands are an enzyme, complete with an active site (between your fingers and thumb.) Notice that the enzyme (your hand) is much larger than the substrate (toothpicks.) As you will be performing the activity with your eyes closed, this simulates the random contact made between substrate and enzyme. The object of the activity is to break as many toothpicks in half as possible in two minutes.

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 an enzyme. This speed may lower during the activity as your hands become tired, the pieces are all too small to break and the substrates get more and more scattered in the solution (your desk top.) that the enzyme (your hands) remains unchanged throughout the reaction.

**MATERIALS**: *Flat* Toothpicks (75 per group) Clock  Calculator

**PROCEDURE:** The Rules:

1. You must break each toothpick one at a time
2. You must break each toothpick with two hands ONLY. Do not use the table or other items.
3. You must break each toothpick completely in half.
4. You cannot begin before the teacher calls Go!
5. You must stop precisely when teacher says STOP!
6. You must keep your eyes closed throughout the entire activity.

The Game

1. Spread the toothpicks on the lab table in a random pile.

1. When the teacher yells GO! begin breaking toothpicks.
2. After **10 seconds**, the teacher will yell STOP!
3. Count and record the number of toothpicks broken.



1. When the teacher yells GO!, begin breaking toothpicks again.
2. At end of **20 more seconds (30 sec. accumulated),** the teacher will yell STOP!
3. Count and record the total number of toothpicks broken
4. When the teacher yells GO!, begin breaking toothpicks again.
5. At **end of 30 more seconds (60 sec. accumulated),** the teacher will yell STOP!

10. Count and record the total number of toothpicks broken

11. When the teacher yells GO!, begin breaking toothpicks again.

12. At **end of 60 more seconds (120 sec. accumulated),** the teacher will yell STOP!

13. Count and record the total number of toothpicks broken

**COMPILING DATA**

1. Record the number of toothpicks broken at each time by YOUR enzyme on the white board.

2. Add total number of toothpicks broken by class at end of each time interval.

3. Calculate the class average for each time interval and record in your data table.

**CALCULATIONS**

1. Calculate the reactions rates for each time interval, using the formula:

 (N = number of toothpicks metabolized T = time )

Table 1. Reaction rate of Toothpickase

|  |  |  |  |
| --- | --- | --- | --- |
| Time (T) in seconds | # of Toothpicks broken by your enzyme (N) | Class Average | Reaction Rate= N/TToothpicks broken/second |
| 10 |  |  |  |
| 30 |  |  |  |
| 60 |  |  |  |

2. Construct a graph (properly labeled and titled) and plot the data.

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**ANALYSIS:**

1. What if we used 100 toothpicks/group?
2. What if the toothpicks were more spread out on bigger table?
3. What if two pairs of hands acted as enzymes at table?
4. What if your hands were very cold?
5. What if I had added some plastic toothpicks to your desk?