"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 drop in 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 playing field.)   Throughout the activity, notice that the enzyme (your hands) remains unchanged throughout the reaction.

MATERIALS

FLAT Toothpicks, approx 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.
3. You must break each toothpick completely in half.
4. You cannot begin before the teacher calls Go!
5. You must stop <u>precisely</u> when teacher says STOP!
6. You must keep your eyes closed throughout the entire activity.
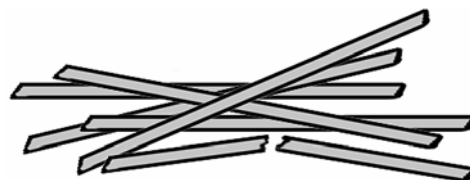
The Game
1. Spread the toothpicks on the lab table in a random pile.
2. When the teacher yells GO! begin breaking toothpicks.
3. After **10 seconds**, the teacher will yell STOP!
4. Count and record the number of toothpicks broken.
5. When the teacher yells GO!, begin breaking toothpicks again.
6. At end of **20 <u>more</u> seconds** (30 sec. accumulated), the teacher will yell STOP!
7. Count and record the total number of toothpicks broken
8. When the teacher yells GO!, begin breaking toothpicks again.
9. At end of **30 <u>more</u> 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 <u>more</u> seconds** (120 sec. accumulated), the teacher will yell STOP!
13. Count and record the total number of toothpicks broken

Compiling Data
1. Add total number of toothpicks broken by class at end of each time interval.
2. Calculate the class average for each time interval.
3. Record the data on a table on the white board.

CALCULATIONS

1. Calculate both initial and final reactions rates, using the formula:

$$\frac{M_2 - M_1}{T_2 - t_1}$$

M = number of toothpicks metabolized
T = time

2. Record the class data in a data table, properly labeled and titled.
3. Construct a graph (properly labeled and titled) and plot the data.

Table 1. Reaction rate of Toothpickase

TIME (SEC)	# OF TOOTHPICKS	CLASS AVERAGE	REACTION RATE
0			--------------
10			
30			
60			
120			

DISCUSSION

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?

6. What if I had taped your thumbs to your pointer finger? (or put socks on your hands?)