LAB 10. TOOTHPICKASE

INTRODUCTION:

Enzymes are proteins that are used as catalysts in biochemical reactions. A catalyst is a factor that controls the rate of a reaction without itself being used up. In biological systems, enzymes are used to speed up the rate of a reaction. However, there are a number of factors that can affect the rate of an enzyme-facilitated reaction, in addition to the presence of the enzyme, amongst them are:

1. substrate concentration

2. temperature

Here is a set of quick activities designed to simulate how substrate concentration and temperature affect enzyme function.

In the activities that follow:

- one person's fingers are the enzyme TOOTHPICKASE
- the toothpicks are the SUBSTRATE
- Toothpickase is a DIGESTIVE ENZYME. It breaks down toothpicks into two units. To hydrolyse the toothpick, place a toothpick between the thumb and the first finger of each hand. Break the toothpick in two pieces.

PROCEDURE:

PART A: RATE OF PRODUCT FORMATION IN AN ENZYME-FACILITATED REACTION

1. Select 80 toothpicks and place them in a shallow bowl.

2. In your group of three, one person will be the timer, one will record the data, and the third person will be the enzyme, toothpickase. The enzyme is to break the toothpicks *without* looking at the bowl and all of the products ("broken toothpicks") must remain in the bowl. Remember toothpicks can only be digested once; do not break toothpicks already broken!

3. The experiment is conducted in 20 second intervals. The timer calls out start and then marks each 20 second interval. The recorder tallies the cumulative number of toothpicks broken as each interval is announced by the timer.

4. Graph the results.

5. Calculate the rate of enzyme action in toothpicks per second for each 60 second interval: How many toothpicks were broken after 1 minute, 2 minutes, 3 minutes, etc.

PART B: EFFECT OF SUBSTRATE CONCENTRATION ON REACTION RATE

1. Remove the broken toothpicks from the shallow bowl. Place 80 paperclips in the empty bowl. The paper clips represent a "solvent" in which the toothpicks are "dissolved". Different concentrations are simulated by mixing different numbers of toothpicks in with the paper clips.

2. For the first trial, place 10 toothpicks in the bowl with the paper clip. Mix them up. The enzyme has 20 seconds to react (break as many toothpicks as possible). Remember the enzyme breaks the toothpicks *without* looking at the bowl and all of the products ("broken toothpicks") must remain in the bowl. Remember toothpicks can only be digested once; do not break toothpicks already broken! Record the number broken at a concentration of 10.

3. Remove the broken toothpicks and repeat with concentrations of 20, 30, 40, 50, 60, 70, 80, 90, and 100 toothpicks, each time mixing them with the 80 paper clips.

4. Graph the results.

5. Discuss your results and explain why the rates were different at different concentrations. Summarize the effect of substrate concentration on enzyme action.

PART C: EFFECT OF TEMPERATURE SUBSTRATE CONCENTRATION ON REACTION RATE

1. Select 10 toothpicks. Time how long it takes to break the 10 toothpicks as fast as you can.

2. Place your hands in the pail of iced water for 10 minutes. Repeat step 1.

3. Calculate the rate of enzyme action in toothpicks per second. Compare the two rates.

4. Discuss your results and explain why the rates were different at different temperatures. Summarize the effect of temperature on enzyme action.