AP Biology 12 - modelling Enzyme Activity!

* *This lab is a model of* ***enzyme activity****. Your hand is used to represent the* ***enzyme****; the toothpicks are used to represent the* ***substrate****, and the* ***enzyme activity*** *is represented by the breaking of the toothpicks. Only* ***one******partner is to do the activity****. The other partner acts as the* ***recorder****.*

**Purpose**: To understand what controls enzyme activity.

**Materials**: one 1000 ml beaker or wide-mouthed jar, wooden toothpicks, paper clips or pieces of wire, rubber gloves, clock/watch, cold water

**Observations and Results**: make a table for your results similar to the one below

|  |  |  |
| --- | --- | --- |
| **Trial #** | **Experimental Parameters** | **# Broken** |
| 1 | 60 toothpicks, two hands, no gloves, no clips |  |

**Procedure**:

1. Select approximately **60 wooden toothpicks** and place them in a **beaker**.
2. To represent an enzymatic reaction, you will **close your eyes** and break as many toothpicks as you can in **30 seconds**. ***You can only break one toothpick at a time***. You cannot break a toothpick more than once, so **remove the broken ones**. The other partner should do the **timing** and tell you when you should start and stop. Record your answer and calculate the number of toothpicks per second that your broke. It is okay if you get a fraction in your answer.
3. To simulate **inhibition**, select **10 paper clips** and enough wooden toothpicks to make the number in the beaker add up to **60**. The paper clips must be **straightened** and cut to the same length as the **toothpicks**. Make and record a **prediction** about how many toothpicks you will be able to break now.
4. Again, close your eyes and break as many as you can. You can remove the broken toothpicks, but you cannot remove the non-broken paper clips. Record your answer and calculate the number of toothpicks per second that you broke.
5. To simulate the effect of **temperature** on enzyme activity, place your hand in **cold water** for 3 minutes. (CAUTION: I f your hand begins to cramp up and hurt, remove it from the water) Remove the paper clips and add enough toothpicks to bring the total in the breaker to 60. Make and record a prediction about how many toothpicks you will be able to break now.
6. Break as many toothpicks as you can in 30 seconds. Record your answer and calculate the number of toothpicks per second that you broke.
7. To simulate the effect of **slight denaturation** on enzyme activity, cover your hand with a **rubber glove**. Add toothpicks to the beaker. Make and record a prediction about how many of the 60 toothpicks you will be able to break now.
8. Break as many toothpicks as you can in 30 seconds. Record your answer and calculate the number of toothpicks per second that you broke.
9. To simulate the effect of **massive denaturation** on enzyme activity, put on rubber gloves and **use only two fingers** to break the toothpicks. Add toothpicks to the beaker. Make and record a prediction about how many toothpicks you will be able to break now.
10. Break as many toothpicks as you can in 30 seconds. Record your answer and calculate the number of toothpicks per second that you broke.

**QUESTIONS**

1. What would you expect to happen to the **rate** of the “enzymatic reaction” (i.e. how many toothpicks were broken per second?) if we added: a) more substrate (toothpicks)? b) more enzyme (hands)?

2. The following is the equation for a typical enzymatic reaction:

E + S ES E + P

**E** = enzyme, **S** = substrate, **ES** = enzyme-substrate complex, and **P** = product

* Write the equation for the enzymatic reaction that was demonstrated in this activity.

3. Explain how the paper clips act as inhibitors in this enzymatic reaction that was demonstrated in this activity.

4. Explain how lowering the temperature of the enzyme affects enzyme activity.

5. Which do you think will have a greater effect - temperature or inhibition? Explain.

6. How is inhibition related to denaturation?

**Modelling Enzyme Activity**

**Observations – data table**

|  |  |  |
| --- | --- | --- |
| **Trial** | **Hypothesis – Prediction** | **Rate (#/sec)** |
| Enzymatic – normal  (2 hands) |  |  |
| Inhibition – paper clips |  |  |
| Temperature - cold |  |  |
| Slight denaturation (gloves) |  |  |
| Massive denaturation (gloves and one hand) |  |  |

**Questions**: - answer the questions from the other side of the page – here.

1.

2.

3.

4.

5.

6.