**Toothpickase Activity**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_­\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_ Pd: \_\_\_\_\_ #\_\_\_

**Introduction:**

Enzymes are proteins made by living cells. They act as catalysts and affect the rate of a chemical reaction. For example, the enzyme *amylase* in your saliva speeds up the breakdown down of starch (the substrate) into simple sugars. The enzyme itself does not get used up during the chemical reaction.

**Objective:**

In this activity you will become the enzyme called "toothpickase", that breaks toothpicks (the substrate) in timed intervals. Calculations will be completed to determine how many toothpicks are broken per second to determine the rate of reaction of the enzyme toothpickase. Consider that your hands are like an enzyme called toothpickase. Your hands (the enzyme) can split toothpicks (your substrate) in half.

**Materials:**

* Flat Toothpicks (75)
* Paperclips

**Part 1: How fast toothpickase works**

Directions: Break as many toothpicks as you can without looking. Record how many toothpicks are broken in 10 second intervals.

|  |  |
| --- | --- |
| **Trial #** | **# of toothpicks broken**1. How does the number of toothpicks broken change over time?
 |
| **1** (0-10 seconds) |  |
| **2** (11-20 seconds) |  |
| **3** (21-30 seconds) |  |
| **4** (31-40 seconds) |  |
| **5** (41-50 seconds) |  |
| **6** (51-60 seconds) |  |
| **7** (61-70 seconds) |  |
| **8** (71-80 seconds) |  |
| **9** (81-90 seconds) |  |
| **10** (91-100 seconds) |  |

## **Part 2: Adding another substrate into the mix**

Directions: Mix some paperclips in with your toothpicks. Break as many toothpicks as you can without looking. Record how many toothpicks are broken in 10 second intervals.

1. How does mixing in a “wrong” substrate affect how many toothpicks are broken by toothpickase?

|  |  |
| --- | --- |
| **Trials #** | **# of toothpicks broken** |
| **1** (0-10 seconds) |  |
| **2** (11-20 seconds) |  |
| **3** (21-30 seconds) |  |
| **4** (31-40 seconds) |  |
| **5** (41-50 seconds) |  |
| **6** (51-60 seconds) |  |
| **7** (61-70 seconds) |  |
| **8** (71-80 seconds) |  |
| **9** (81-90 seconds) |  |
| **10** (91-100 seconds) |  |

|  |  |
| --- | --- |
| **Temperature** | **Time to break 10 toothpicks (seconds)** |
| **Room temperature toothpickase** |  |
| **Cold toothpickase** |  |

# **Part 3: How temperature affects how fast toothpickase works**

# *Directions: Time how long it takes you to break 10 toothpicks without looking. Then, ice your hands for a few minutes.*

# *Try breaking the 10 toothpicks again while timing yourself.*

# How does temperature affect the time in which toothpicks are broken by toothpickase?

Graph your data from Part 1 and connect the dots to make a line. Then, graph your data from Part 2 and connect the dots to make a line. Use different colors for each line and make a key to the graph. Finally, answer the question.

**Toothpickase Efficiency**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Number of toothpicks metabolized** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Key:

**Time (seconds)**

# **Conclusions:**

1. What is an enzyme? What is the enzyme is this activity?
2. What is a substrate? What is the substrate in this activity?
3. Write a sentence to describe how mixing in another substrate affects how fast an enzyme works.
4. Write a sentence to describe how temperature affects how fast an enzyme works.