

## 1.4 Toothpick-ase – An Example of Protein Activity

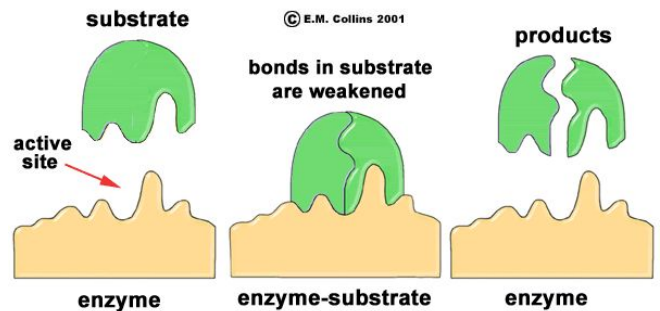
### **Background:**

**Enzymes** are a specific type of protein that control the rate of a chemical reaction. The proteins that are enzymes have unique names usually ending in “ase” to show that they are enzymes. For example, lactase is an enzyme that breaks down lactose.

Enzymes are *specific* for each reaction and *reusable*. The shape of an enzyme is critical because it allows the enzyme to bind with the **substrate** (reactant molecule). The substrate binds to a particular region of the enzyme called the **active site**. The “fit” of the substrate into the active site allows the chemical change to happen. Enzymes are specific; they have a certain shape that only fits one type of molecule.

### **Properties of enzymes:**

1. Enzymes change the rate of chemical reactions in cells.
2. Enzymes have specific shape that allows it to fit with only one type of molecule.
3. Enzymes are not used up in a reaction and can be used over and over again.



Today, one person’s fingers will be acting as TOOTHPICK-ASE; an enzyme that breaks toothpicks. This makes toothpicks the SUBSTRATE.

### **Prediction:**

1. Make a prediction on the function of an enzyme if the shape of the enzyme is changed. Would it be functional or non-functional? Why?

**Activity: How does the shape of the protein affect the ability of a protein (enzyme) to function?**

1. Decide who will act as the enzyme for this trial.
2. The person acting as the enzyme toothpick-ase will break toothpicks without looking at the bowl and all of the substrates and products(broken toothpicks). You may only use one hand to break toothpicks. ***All broken toothpicks must remain in the bowl along with the unbroken toothpicks and you CANNOT re-break toothpicks.***
3. WITHOUT LOOKING AT THE BOWL, break as many toothpicks as possible in 30 seconds and record this on the data table. Broken toothpicks are KEPT IN THE BOWL as products and reactants often mix in cells. DO NOT RE-BREAK TOOTHPICKS.
4. Recorder counts the number of toothpicks broken and records the data. Remember that two halves counts as ONE broken toothpick.
5. Restock your bowl – remove all broken toothpicks and add enough toothpicks so there are ~40 in the bowl.
6. Repeat Steps 3-5 with the same person. Record your data.
7. Now tape your thumb to your middle finger. Restock your bowl to 40 toothpicks and repeat steps 3-5 two more times. Record your data.

Number of Broken Toothpicks after 30 Seconds		
Trial	All Fingers Functioning	Thumb and Middle Finger Taped
1		
2		
3		
Average		
Difference in toothpicks broken		

1. Summarize the results of the activity. How does the shape of the protein affect the ability of a protein (enzyme) to function? (1-2 sentences)
2. What did taping the thumb and middle finger represent in this activity?
3. Draw a representation of the 2 conditions of Toothpickase and how effective the protein was:

All Fingers Functioning	Thumb and Middle Finger Taped