

## ENZYME BINDING (Science Lesson Plan)

*Original lesson*

**Grade:** 8<sup>th</sup> grade

**Time Allotted:** 1 42 – minute class period

**Prior Knowledge:**

- Atoms and molecules
- Protein

**Materials:**

- Puzzles

**Goals:**

- Learn about amino acids
- Learn about proteins
- Learn how substrates bind to enzymes

**Objectives:** Students should be able to...

- Understand the binding of enzyme and substrate
- Understand how enzymes are formed

**NJCCCS:**

- 5.6.8B 4: Chemical reactions: atoms rearrange when substances interact but mass remains the same.
- 5.6.8A 1: Know that all matter is composed of atom and may join together to form molecules

**Procedures:**

- **What are enzymes?**
- Enzymes are molecules that speed up the rate of chemical reactions by lowering the activation energy. For example, a regular reaction may take 10min for completion while it'll take 0.001s if an enzyme is involved. Most enzymes are made up of

protein. Proteins are made from amino acids; amino acids are the building blocks of protein.

- Substrates are the molecule that binds to enzymes. They are orders of magnitude smaller than enzymes. Enzymes are very large molecules. The enzyme I work with, Dihydrofolate reductase, has a mass of approximately 18,000g/mole. For example, the mass of one molecule of water (H-O-H) is about 18g/mole so dihydrofolate reductase is 1000ce bigger than water molecule.
- Dihydrofolate reductase, DHFR, is an enzyme that catalyzes the formation of tetrahydrofolate and uses dihydrofolate as a substrate. DHFR uses NADPH, nicotinamide adenine dinucleotide, as a co-factor and does its job by reducing dihydrofolate to tetrahydrofolate.
- Tetrahydrofolate is very important in the synthesis of nucleotides and some amino acids. It is also a one-carbon donor in the synthesis of some bio-molecules. Tetrahydrofolate is a derivative of folic acid. Cells need folic acid to be healthy; the help the cell grow.
- The ability to know the function of DHFR help scientists develops anti-cancer drugs. Cancer is a disease caused by rapid growth of cells and these cells find it hard to undergo apoptosis or death.
- Dihydrofolate reductase catalyzes the formation of tetrahydrofolate which aids in the growth of cells. If DHFR can be inhibited or its method of action can be stopped then cancer cells will remain unhealthy and die in the long run. One such drug that inhibits DHFR is methotrexate. Methotrexate binds to DHFR and inhibits its catalysis of dihydrofolate to tetrahydrofolate. This hinders cancer cells from getting healthy thus giving cancer patients better chance of fighting the disease.

### **Lock and Key by Emil Fischer**

- It was believed that the method of enzyme-substrate binding resembles that of a lock and key. A key that fits can unlock the lock. A substrate that fits the active site of an enzyme can activate the enzyme. If it doesn't fit, it doesn't turn on the enzyme. There is a structural complementarity between the substrate and the active site of the enzyme.
- The flaw of the hypothesis is that enzymes aren't rigid. They move about and the conformation of an enzyme can be changed with the binding of a substrate. This is called induced fit hypothesis. It's the recognition between the enzyme and the

substrate. This process helps the enzyme-substrate fit better thus aiding in catalysis.

**Accommodations:**

- Puzzle for visual learner
- Real world application
- Give simple definition
- Student demonstrations
- Pictures

## Enzyme Worksheet

Name: \_\_\_\_\_

Date: \_\_\_\_\_

1. What are enzymes?

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2. What are substrates?

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3. What makes up protein?

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4. What is the lock and key hypothesis?

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5. What is the induced fit hypothesis?

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