**AP Biology- ENZYMES (Topics 3.1, 3.2, 3.3)**

**Directions:** The series of diagrams is designed to provide you with information about enzymes and chemical reactions. Be sure to look at the correct numbered diagram for evidence to answer each question.

**Diagrams 1-4.** ***Chemical reactions involve changes in chemical bonds. A chemical reaction starts with one set of molecules and turns them into something new by forming or breaking chemical bonds.***

Explain what the "reactants" are in a chemical reaction.

What does the "arrow" of a chemical reaction represent?

What are the molecules called that come after the chemical change?

**Diagrams 5-8.** ***Enzymes are important molecules that are involved with chemical reactions in cells. Look at the diagrams to start to understand how enzymes are involved with reactions.***

What is another word for the "reactants?"

In order for the reaction to take place with an enzyme, what do the reactants have to do?

At the end of the reaction, what does the enzyme do with the products?

**Diagrams 9-12.** ***Enzymes work with a specific reaction and are only compatible with specific substrates.***

From what you've seen so far, what makes each enzyme different?

Why is the "active site" of the enzyme important?

In diagram 11, explain why no reaction can occur with substrate 1.

In diagram 11, explain why no reaction can occur with substrate 2.

Identify two factors that determine whether an enzyme and substrate are compatible.

Diagram 13-15. ***We know that enzymes are involved with chemical reactions, but what is the purpose of the enzyme?***

Draw one conclusion from the graph in diagram 13.

In a chemical reaction, what happens if activation energy is not reached?

How do enzymes affect activation energy?

**Diagram 16-19.** ***Enzymes are macromolecules. Their specific monomers determine their shape and function.***

What type of macromolecule are all enzymes and what is their monomer?

What are some ways that amino acids can vary in chemical properties?

What determines the tertiary structure of a protein?

Identify two examples of interactions that may occur between R groups in a polypeptide chain.

**Diagrams 20-21.** ***Enzymes are sensitive to environmental conditions.***

According to diagram 20 and 21, how does increasing temperature initially affect enzyme activity?

What does "optimum" temperature mean?

What happens to enzyme activity level when temperature surpasses the optimum level?

**Diagrams 22-24.** ***Enzyme structure is necessary for enzyme function.***

In diagram 22, why can't the substrate interact with the enzyme in an environment above 32$^{o}$C?

According to diagram 23, what happens to enzymes at certain temperatures?

In your own words, come up with a synonym for "denature."

According to diagram 24, explain the process of denaturation in terms of both amino acid interactions and protein structure.

**True or False:** Extremely high and extremely low temperatures can denature an enzyme. _____

Which of the following is true?

a) Denaturation is always permanent and irreversible.
b) Denaturation is always reversible.
c) Denaturation is sometimes reversible.

EXTENSION:

**Diagrams 27-28.** ***Enzymes are sensitive to environmental conditions.***

The pH scale goes from pH 0- pH 14. Which numbers on this scale are considered acidic?

The pH scale goes from pH 0- pH 14. Which numbers on this scale are considered basic?

Which number is neither acidic nor basic, and is therefore neutral?

According to diagram 28, what is the optimum pH level for the stomach enzyme?

According to diagram 28, what is the optimum pH level for the small intestine enzyme?

According to diagram 28, describe the activity level of the stomach enzyme at a neutral pH level.

According to diagram 28, identify a pH level where the intestine enzyme functions, but not optimally.

**Diagrams 29-30.** ***Enzyme activity can be inhibited by molecular interactions.***

Identify what a competitive inhibitor molecule is specifically "competing" for, and "who" is it competing against.

Explain what happens when a competitive inhibitor molecule binds with an enzyme.

Why do you think that allosteric inhibitor molecules are described as "noncompetitive?"

Explain what happens when an allosteric inhibitor molecule binds to an enzyme.

**Diagrams 31-31.** ***The concentration of both substrate and enzyme affects the rate of reaction.***

In diagram 31, how many enzymes are shown at each concentration level in the graph? (Concentration levels are indicated by the X axis and the dotted lines) _____

At 0.1 M substrate, how many enzymes are interacting with substrate molecules? _____

At 0.5 M substrate, how many enzymes are interacting with substrate molecules? _____

At 1.0 M substrate, how many enzymes are interacting with substrate molecules? _____

At 1.5 M substrate, how many enzymes are interacting with substrate molecules? _____

Explain why the rate of reaction no longer increases past the saturation point.

If you wanted to in fact increase the rate of reaction, what could you "add" to this system?

According to diagram 32, explain what happens to the concentration of substrate, product, and enzyme over time.

In diagram 32, explain why adding more enzyme at minute 1 would increase the rate of reaction, while adding more enzyme at minute 3 would have no effect on the rate of reaction.