Enzymes Exploration Worksheet

Name: _____

This worksheet is to be used with the online Enzymes Exploration activity.

Introduction to Enzymes

1. Why do the enzyme and substrate form a non-covalent bond rather than a covalent bond?

Models of Enzyme-Substrate Binding

Lock and Key Model

2. What color are the atoms that you see in the active site? Remember that they are in CPK colors - therefore - what atoms are there?

3. Structurally, what is the active site made of - what types of molecules are there?

4. What atoms are present in the substrate?

Induced Fit Model

5. What atoms are in the active site?

6. Structurally, what is the active site made of - what types of molecules are there?

7. What atoms are in the substrate?

8. What is the difference between the open and closed forms of hexokinase?

9. What atoms on the amino acids are coming together to close the glucose into the hexokinase?

10. What two possible interactions could be occurring here to have the hexokinase close?

Exploring the Enzyme Active Site

11. Do you think that the size and shape of the active site affect how the enzyme works? Why?

Binding Site

12. What part of those amino acids is interacting with the substrate?

13. If the enzyme and substrate formed covalent bonds, would they be difficult to separate?

14. What part of the enzyme binds to the substrate in general? Remember that enzymes are proteins.

15. What do you think is the purpose of the binding site?

16. What types of noncovalent interaction could be occurring?

Catalytic Groups

17. What do you think is the function of the catalytic groups?

18. Both the binding site and the catalytic groups are R groups of amino acids. Do you think that the type of R group (hydrophobic, polar neutral, positive, or negative) has an impact on the jobs of the binding site and the catalytic groups? Why?

19. Write a complete sentence describing what occurs at the binding site and the catalytic groups of an enzyme's active site.

Enzyme Specificity

Absolute Specificity

20. What atoms/groups are in the active site of this enzyme?

21. What atoms are in the substrate?

22. What possible interactions could be occurring between the substrate and active site?

23. Why do you think that - speculate - this enzyme has absolute specificity based on the structure that you see?

Group Specificity

24. What atoms of the enzyme/amino acid residues are probably holding the cysteine and persulfide?

25. The iron is necessary for this reaction to occur. Looking at the name of the enzyme and remembering what you learned in general chemistry - what type of reactions are occurring in this enzyme?

26. What would be an advantage and a disadvantage of group specificity?

Linkage Specificity

27. What atoms/groups are in the active site of this enzyme?

28. What atoms are in the substrate?

29. What possible interactions could be occurring between the substrate and the active site?

30. Give another example of linkage specificity that we learned about when studying carbohydrates. (There are 2).

31. What would be an advantage and a disadvantage of linkage specificity?

Stereochemical Specificity

32. Do you think that the other enantiomer, L-lactic acid, would fit in this enzyme's active site? Why or why not?

33. Do you think there are a lot of these types of enzymes? Why?

34. What would be an advantage and a disadvantage of stereochemical specificity?

35. Write a complete sentence for each type of specificity.

Cofactors and Coenzymes

Cofactors

36. What metal atoms are the cofactors in this enzyme? (Hint: you must scroll your mouse over the atom to find its designation)

37. Do you think that this enzyme could function correctly without the metal ions? Why or why not?

Coenzymes

38. Locate the 3-phosphoglycerate and the NAD^+. What atoms of the NAD^+ are near what atoms of the 3-phosphoglycerate? Make an educated guess about what is occurring here.

39. What are two major differences between cofactors and coenzymes?

40. Write a complete sentence describing cofactors and coenzymes.

How Organisms Control Their Enzymes

Allosteric control

41. What do you think the positive allosteric effector molecule - in this case ATP - is doing to the active site of the enzyme to turn it on?

42. What do you think the negative allosteric effector molecule - in this case CTP - is doing to the active site of the enzyme to turn it off?

43. Write a sentence about positive allosterism.

44. Write a sentence about negative allosterism.

Feedback Regulation

45. Which molecule (substrate) will turn off the first reaction's E1 if this enzyme works by feedback inhibition?

Proenzyme

46. What part of the example is missing from the active form but present in the inactive form?

47. Would those missing amino acids have an effect on the final enzyme structure? Why or why not?

48. What parts of the molecule (what colors) are missing from the pepsin that are present in the pepsinogen?

49. Is the shape of the pepsin and pepsinogen the same or different? Why?

Protein Modification

50. What would be an advantage of having the same group activate some enzymes and deactivate others?

51. Write a complete sentence describing each type of enzyme control that humans use to control their enzymes.

Inhibitors

Irreversible Inhibitors

52. Why do irreversible inhibitors have to form a covalent bond to the enzyme to stop the enzyme from functioning?

53. Write a sentence defining irreversible inhibition of enzymes.

Reversible Competitive Inhibition

54. If you were designing another drug like methotrexate to do the same type of thing, what type of structures would you look at to design this new drug?

55. Does a competitive inhibitor have to be the exact same size as the substrate - or does just part of it have to be the same? Why or why not?

56. Do the inhibitor and the substrate compete for the active site?

57. What would be the effect if excess inhibitor was added?

58. What would be the effect if excess substrate was added?

Reversible Noncompetitive Inhibitors

59. Do the inhibitor and the substrate compete for the active site?

60. What would be the effect if excess inhibitor was added?

61. What would be the effect if excess substrate was added?

62. Write a complete sentence describing each type of inhibition.