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Activity 8.2 How can changes in experimental conditions affect enzyme-mediated reactions?

1. You set up a series of experiments to monitor the rates of a reaction. The reaction is an enzyme-mediated reaction in which $A \rightarrow B + C$. For each experiment in this series, you continuously add the reactant A and monitor its concentration so that the amount of A remains constant over time.

For each group of experiments, explain how the differences in experimental conditions could affect the reaction.

- a. You compare two side-by-side experiments. In experiment 1, you use X amount of the enzyme. In experiment 2, you use $2X$ amount of the same enzyme.
- b. You compare two side-by-side experiments. In both you use equal amounts of the enzyme. In experiment 3, you allow the products to accumulate over time. In experiment 4, you remove the products from the system as they are produced.
- c. In the next two experiments, you use equal amounts of the enzyme. You run experiment 5 at 20°C and experiment 6 at 25°C .
- d. In two final experiments, you use equal amounts of the enzyme. You run experiment 7 at pH 6 and experiment 8 at pH 8.

2. Enzyme function can be inhibited or regulated by the presence of chemicals that mimic either the reactants or the products.

a. How do competitive and noncompetitive inhibition of an enzyme differ?

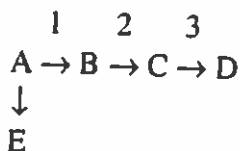
b. What are allosteric enzymes? What function(s) can they serve in reaction sequences?

3. An enzyme catalyzes the reaction $X \rightarrow Y + Z$. In a series of experiments, it was found that substance A inhibits the enzyme.

- When the concentration of X is high and A is low, the reaction proceeds rapidly and Y and Z are formed.
- As the concentration of A increases, the reaction slows regardless of whether X is present in high or low concentration.
- If the concentration of A is high (relative to X), the reaction stops.
- If the concentration of A again decreases, the reaction will ultimately resume.

What type of enzyme regulation is described here? Explain or justify your answer.

4. In an enzymatic pathway, A, B, and C are intermediates required to make D, and 1, 2, and 3 are enzymes that catalyze the designated reactions:



This is analogous to what happens in a factory. In a leather goods factory, for example, the leather (A) is cut (1) into the parts needed for shoes (B). The shoe parts are sewn (2) together (making C), and C is packaged (3) for shipping as D. Now shoe sales are dropping and backpack sales (E) are increasing. As a result, the manager of the factory decides to switch production from shoes to leather backpacks (E).

a. Where should the shoe-making process be shut down: step 1, 2, or 3? Explain.

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- b. In a cell, if an excess of a chemical product D arises, where should this synthetic pathway be shut down in the cell? Explain your reasoning.

- c. What type(s) of enzyme regulation is/are most likely to occur in the cell in this type of feedback system? Explain your reasoning.