

Review questions for Enzymes lecture

Multiple choice review questions:

- 1) All enzymes are
 - A) inorganic (non-carbon-containing) molecules.
 - B) complex carbohydrate molecules.
 - C) phospholipids and glycolipids.
 - D) proteins.

- 2) *Carbonic anhydrase* is an enzyme that breaks down carbonic acid into water and carbon dioxide gas. The crevice in the enzyme where carbonic acid attaches to the enzyme is known as the enzyme's...
 - A) active site.
 - B) cofactor.
 - C) substrate.
 - D) product.

- 3) *Carbonic anhydrase* breaks down carbonic acid into water and carbon dioxide gas. Carbonic acid would be considered the enzyme's...
 - A) substrate.
 - B) product.
 - C) enzyme.
 - D) coenzyme.

- 4) The reason each enzyme does a chemical reaction on just one specific substrate molecule is because...
 - A) Enzymes denature under non-standard conditions of pH, temperature, etc.
 - B) Allosteric inhibition blocks all non-substrates
 - C) Coenzymes block all non-substrates
 - D) The specific fit of a substrate into the enzyme's active site.

- 5) The *rate* of an enzymatic reaction can be affected by all of the following *except*
 - A) temperature.
 - B) pH.
 - C) osmosis.
 - D) mutations.

- 6) The rate of an enzymatic reaction increases as the temperature rises, up to about 37°C. Above 37°C or so, however, the reaction rate begins to decline because the
 - A) enzyme changes shape at higher temperatures.
 - B) substrate changes shape at higher temperatures.
 - C) enzyme gets used up faster at temperatures above 40°C.
 - D) substrate moves too quickly to bind with enzyme at temperatures above 40°C.

- 7) In *feedback inhibition*, the final end product of a metabolic pathway
- A) cannot be produced.
 - B) binds to the active site of an enzyme earlier in the pathway and slows the enzyme's rate.
 - C) binds to some other site on an earlier enzyme in the pathway and slows the enzyme's rate.
 - D) gets used up as fast as it is produced.
- 8) If an enzyme is placed into a solution that has a much **higher** pH than the enzyme's natural environment, the enzyme will...
- A) Increased its rate
 - B) Denature
 - C) Bind substrate but not perform a chemical reaction on the substrate
 - D) Bind to and perform a chemical reaction on the substrate but not release the product molecules
- 9) If an enzyme is placed into a solution that has a much **lower** pH than the enzyme's natural environment, the enzyme will...
- A) Increased its rate
 - B) Denature
 - C) Bind substrate but not perform a chemical reaction on the substrate
 - D) Bind to and perform a chemical reaction on the substrate but not release the product molecules
- 10) The molecule in the cell that directly provides energy to enzymes:
- A) ADP
 - B) ATP
 - C) glucose
 - D) glycogen

Answers to multiple-choice questions:

- 1 = D
- 2 = A
- 3 = A
- 4 = D
- 5 = C
- 6 = A
- 7 = C
- 8 = B
- 9 = B
- 10 = B

Fill-in-the-blank review questions:

- 1) All enzymes are _____ molecules (hint: One of the four macromolecule types).
- 2) That particular part of an enzyme that binds the substrate molecules is the _____ site.
- 3) The function of enzymes is to _____.
- 4) When an enzyme unfolds, its function is lost: this process is called _____.
- 5) _____ are metal ions needed for the activity of some enzymes.
- 6) _____ are organic molecules needed for the activity of some enzymes.
- 7) At temperatures above 37°C enzyme catalyzed reaction rates begin to slow down due to the fact that the enzyme _____ at higher temperatures.
- 8) In addition to temperature, the _____ of the enzyme's environment has a large effect on the enzyme's rate. To be more specific, the enzyme will denature if this part of the environment is above or below the normal range for that enzyme.
- 9) The optimum pH of an enzyme is usually the same as the pH of the _____ where the enzyme is normally found.
- 10) A _____ is an inherited defect in an enzyme. The defect comes from a mutation in the _____ that encodes the enzyme.
- 13) Molecule A slows an enzyme's rate down by blocking the active site of the enzyme, so that the enzyme can't bind its substrate molecule. Molecule A is called a(n) _____ of the enzyme.
- 14) Molecule X slows an enzyme's rate down but molecule X does not bind to the enzyme's active site. Instead, molecule X binds to a region of away from the active site. This causes the enzyme to change shape in a way that closes its active site. Molecule X is called a(n) _____ of the enzyme.
- 15) Molecule X increases an enzyme's rate. Molecule X does not bind to the enzyme's active site. Instead, molecule X binds to a region of away from the active site. This causes the enzyme to change shape in a way that opens the enzyme's active site. Molecule X is called a(n) _____ of the enzyme.
- 16) Along a metabolic pathway, each enzyme forms molecules called _____, which in turn become the substrates for the next enzyme in the pathway. The last molecules made by the metabolic pathway are called the _____ of the pathway.
- 17) The mechanism by which a final product inhibits an earlier enzymatic step in its pathway is known as _____ inhibition.
- 19) The molecule that directly supplies enzymes with the energy they need is _____.

23) The term ____ means the first molecule to enter a metabolic pathway.

24) For metabolic pathways, feedback inhibition occurs when the concentration of the endproducts are high/low (choose one word).

Answers to fill-in-the-blank review questions:

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| 1) Protein | 10) Genetic disease or Inborn error of metabolism |
| 2) Active site | Gene |
| 3) Perform chemical reactions | 13) Competitive inhibitor |
| 4) Denaturation | 14) Allosteric inhibitor |
| 5) Co-factors | 15) Allosteric activator |
| 6) Co-enzymes | 16) Intermediates |
| 7) Denatures | Endproducts |
| 8) pH | 17) Feedback or endproduct |
| 9) Organ or environment | 19) ATP |
| | 23) Substrate |
| | 24) High |

Short answer review questions:

1) Enzyme A is normally found in the stomach. Enzyme B is normally found in the blood. The optimum temperature of these two enzymes will be similar/different (circle one). Justify your answer.

2) Enzyme A is normally found in the stomach. Enzyme B is normally found in the blood. The optimum pH of these two enzymes will be similar/different (circle one). Justify your answer.

3) For most enzymes found in the body, optimum temperature is body temperature (37 ° C). Above this temperature, the enzyme's rate slows down because the enzyme denatures. Below this temperature, the enzyme's rate also slows down but the enzyme does not denature. Explain (at a molecular level) what causes enzymes rates to decrease at low temperatures.

4) Competitive inhibitors must be similar/different (circle one) in shape to the enzyme's substrate. Justify your answer.

5) What is the benefit of feedback inhibition in a metabolic pathway?

Answers to short answer review questions:

1) Similar. As a general rule, the optimum environmental conditions for an enzyme are usually the environmental conditions of the organ that the enzyme is found in. Since the stomach and blood both

have the same temperature (37 ° C, body temperature) we would expect enzymes A and B to both have that as their optimum temperature.

2) Different. As a general rule, the optimum environmental conditions for an enzyme are usually the environmental conditions of the organ that the enzyme is found in. Since the stomach is very acidic (pH 2) and blood is not (pH 7.4) we would expect enzyme A to have a pH optimum at pH 2 and enzyme B to have a pH optimum at pH 7.4.

3) All molecules move more slowly at lower temperatures. The lower rate of enzymes below body temperature is caused by the enzyme and its substrate molecules moving more slowly than normal, not by the enzyme denaturing.

4) Similar. Competitive inhibitors lower an enzyme's rate by entering the enzyme's active site and blocking the enzyme's substrates from entering. The active site, however, is shaped to fit the substrate molecule. Therefore, the competitive inhibitor must be very similar in shape to the substrate to be able to fit into the active site.

5) The benefit is that the pathway shuts down if the endproduct molecule is not being used, and thus the cell saves resources by not making unneeded molecules. The endproduct's concentration will increase if it is not being used. Eventually the endproduct's concentration will reach a high enough level that it begins to allosterically inhibit one of the first enzymes of the metabolic pathway, this shutting down the pathway.