What is Enzyme Inhibition?

Worksheet

Enzyme inhibition is the decrease or blocking of enzyme activity by an inhibitor molecule; the main types are competitive (binds the active site), noncompetitive (binds elsewhere, changing enzyme shape), uncompetitive (binds only the enzyme-substrate complex), and irreversible (permanently inactivates the enzyme).

Questions

1. A competitive inhibitor primarily affects:

A) Km only
B) Vmax only
C) both equally
D) neither

2. Which inhibition type cannot be reversed by adding more substrate?

A) competitive
B) noncompetitive
C) none of them
D) all of them

3. An inhibitor that permanently disables an enzyme via covalent bonding is called:

A) competitive
B) reversible
C) irreversible
D) allosteric activator

4. Uncompetitive inhibitors bind:

A) only the free enzyme
B) only the enzyme-substrate complex
C) the substrate itself
D) nothing

5. Statins competitively inhibit HMG-CoA reductase. What happens if substrate concentration is raised very high?

6. Cyanide binds cytochrome c oxidase at a site distinct from the substrate, irreversibly blocking it. Classify this inhibition and predict the effect of adding more substrate.

7. A noncompetitive inhibitor lowers Vmax from 100 to 50 M/min but leaves Km unchanged at 4 mM. What does this tell you about where the inhibitor binds?

8. Define: Where does a competitive inhibitor bind?

9. Define: Can competitive inhibition be overcome?

10. Define: Where does a noncompetitive inhibitor bind?

Answer Key

1. A) Km only - Competitive inhibitors raise the apparent Km but Vmax can still be reached at high [S].

2. B) noncompetitive - Noncompetitive inhibitors bind a separate site, so extra substrate doesn't dislodge them.

3. C) irreversible - Irreversible inhibitors form stable, often covalent, bonds that permanently block activity.

4. B) only the enzyme-substrate complex - Uncompetitive inhibitors bind only after the substrate is already attached, forming an inactive complex.

5. Competitive inhibitors compete with substrate for the same active site. At very high [S], substrate outcompetes the inhibitor for binding. So the enzyme can still reach its normal Vmax, just at a higher [S].

6. Binding away from the active site + permanent = irreversible (non-active-site) inhibition. Adding more substrate cannot displace an irreversibly bound inhibitor. Enzyme activity stays blocked regardless of substrate concentration.

7. Vmax drops fewer functional active sites/turnover, consistent with enzyme shape distortion. Km unchanged substrate binding affinity to the active site is unaffected. This pattern (Vmax, Km same) is the signature of noncompetitive inhibition.

8. Directly to the enzyme's active site, competing with the substrate.

9. Yes - by increasing substrate concentration enough to outcompete the inhibitor.

10. An allosteric site separate from the active site, changing the enzyme's shape.