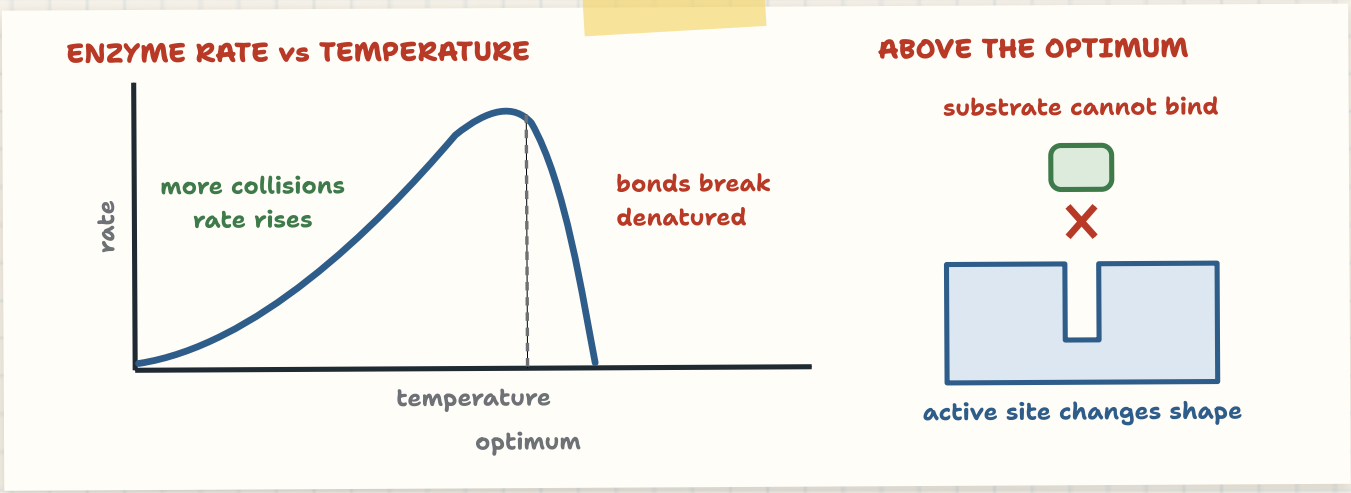
Enzymes: Temperature and pH Effects

Rate rises with temperature to an optimum, then bonds break and the enzyme is denatured.



Key terms

kinetic energy	energy of movement; heat gives it to enzyme and substrate molecules, so they collide more often.
optimum	the temperature (or pH) at which the rate is highest.
denaturation	hydrogen and ionic bonds break, the tertiary structure changes and the active site changes shape; usually permanent.
pH	a measure of hydrogen ion concentration: pH = $-\log_{10}[H^+]$; more hydrogen ions means a lower pH.
tertiary structure	the folded shape, held mainly by hydrogen bonds and ionic bonds, that forms the active site.
denatured, not dead	an enzyme was never alive; the amino acid chain remains but the active site no longer works.

I can...

- ☐ Effects of temperature and pH on the rate of enzyme-controlled reactions
- ☐ Enzyme properties relate to tertiary structure of the active site

EXAM TRAP

Never say an enzyme is killed, dies or is used up. Say it is denatured: the active site changes shape so the substrate cannot fit. Cold does not denature; it just gives fewer collisions.

4 marks: what earns them

1. As temperature rises, molecules have more kinetic energy, so more collisions between enzyme and substrate / more enzyme-substrate complexes form
   Not: enzyme gains energy; more collisions (no link to enzyme and substrate)
2. Above the optimum, hydrogen bonds (and ionic bonds) in the enzyme break
   Not: peptide bonds break; enzyme is killed or dies
3. The tertiary structure changes, so the shape of the active site changes
   Not: enzyme changes shape (no mention of the active site)
4. The substrate is no longer complementary to the active site / cannot bind, so fewer enzyme-substrate complexes form or the rate falls (enzyme is denatured)
   Not: substrate or enzyme used up; denatured, rate falls (no statement that the substrate cannot fit)

Remember

Heat speeds collisions, then breaks bonds.
Wrong pH disrupts the same bonds.
Say denatured, never dead.

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