

Enzymes

Proteins that perform chemical reactions in the body

- Each enzyme is highly specific to perform one and only one chemical reaction
- Active site = The crevice in an enzyme where it binds its substrate molecules (the molecules it works on) and where it performs its chemical reaction on them
  - √ Each enzyme is specific for only one reaction because only its substrate molecule is the right shape to fit into its active site
  - √ After the enzyme finishes its chemical reaction, it releases the product molecules (the molecules it has made). The enzyme then repeats its chemical reaction on the next substrate molecule
- To function properly, some enzymes require a cofactor or a coenzyme in their active site
  - √ Cofactors = Metal ions that are in the active site
    - Examples:  $\text{Fe}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Zinc}^+$
  - √ Coenzymes = Small organic molecules that are in the active site

Fig 2.27

### Enzyme activity (enzyme rate)

The speed at which an enzyme performs its chemical reaction

- Enzyme activity can be changed by the following conditions:
  - Temperature
  - pH
  - Changes in the enzyme's amino acid sequence (mutation)
  - Competitive inhibitors
  - Allosteric inhibitors and allosteric activators
- Enzymes differ from one another in what conditions give them their highest activity, but generally each enzyme's highest activity occurs when it is in its natural environmental conditions (the temperature, pH, etc. of the organ where the enzyme is normally found)

### Temperature's effects on enzyme activity

- Enzymes in the body have their highest activity at body temperature (37 °C)
- Below body temperature, the enzyme activity decreases because all molecules move slower at colder temperatures
- Above body temperature, the enzyme activity decreases because enzymes denature (permanently unfold) at high temperatures

pH's effects on enzyme activity

- Most enzymes have highest activity at the pH of whichever organ they are naturally function in
- Above or below the enzyme's optimum pH, the activity decreases because the enzyme denatures

Mutation's effects on enzyme activity

A mutation is a change in the gene that holds the recipe for the enzyme. Mutations can cause a change in the enzyme's amino acid sequence, which often denatures the enzyme

- Genetic disease = When a person inherits a mutated gene from their parents and therefore one of their enzymes is not functional

Competitive inhibitors' effects on enzyme activity

Competitive inhibitors are molecules that slow an enzyme's activity by fitting into and getting stuck in the enzyme's active site, so that the enzyme's substrate cannot bind

- Competitive inhibitors are able to enter the active site because they are very similar in shape to the enzyme's substrate molecule

Allosteric inhibitors' effects on enzyme activity

Allosteric inhibitors are molecules that slow an enzyme's activity by binding to a site on the enzyme that is not the enzyme's active site

- Allosteric inhibitors change the shape of the enzyme's active site such that substrate molecules no longer fit

Allosteric activators' effects on enzyme activity

Allosteric activators are molecules that increase an enzyme's activity by binding to a site on the enzyme that is not the enzyme's active site

- Allosteric activators change the shape of the enzyme to allow substrate molecules to fit into the active site

Metabolic pathway

A series of enzymes that bring about large changes in substrate molecules by each individual enzyme making a small change.

- Substrate = The molecule that enters a metabolic pathway
- Endproduct = The molecule that exits a metabolic pathway
- Intermediates = All the molecules between the substrate and the endproduct
- Cycle = A circular metabolic pathway

Endproduct inhibition (Feedback inhibition)

When the endproduct of a metabolic pathway is an allosteric inhibitor of the first enzyme in the pathway

- Feedback inhibition stops the pathway if too much endproduct is being made

Enzymes that require energy

Some enzymes (as well as some channel proteins) require energy to perform their tasks in the cell

- ATP molecules are the usual energy source for enzymes and channel proteins that require energy