

TOPIC 2.5: ENZYMES

Catalysis

An enzyme is a globular protein which speeds up the rate of a chemical equation by lowering the activation energy (i.e. it is a biological catalyst)

- Enzymes are not consumed by the reactions and can be re-used

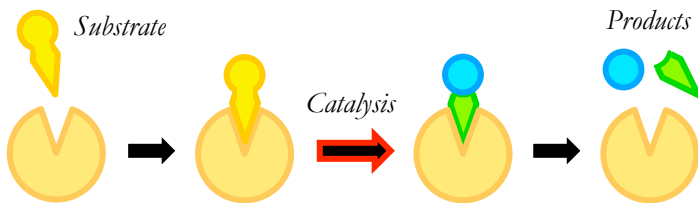
The molecule(s) the enzyme reacts with is called the **substrate**, which binds to a complementary region on the enzyme's surface (**active site**)



Specificity

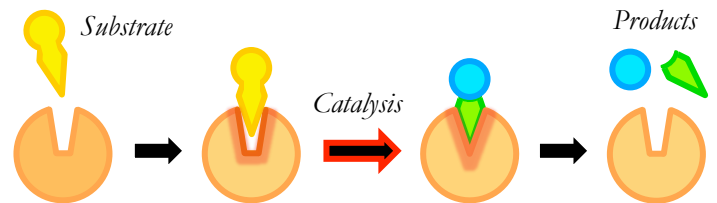
Lock and Key Model

- Enzyme and substrate complement each other precisely in terms of both their shape and chemical properties
- The active site and the substrate will share specificity



Induced Fit Model

- Active site is not a rigid fit for the substrate and changes its conformation to better accommodate the substrate
- This stresses the substrate bonds and induces catalysis



Factors Affecting Enzyme Activity

Temperature

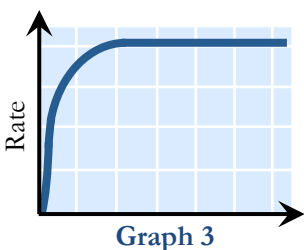
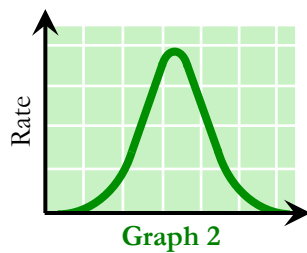
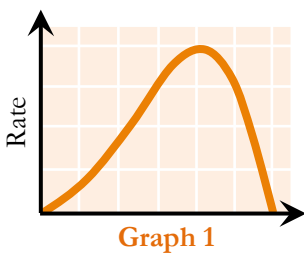
- Increases enzyme activity (*more kinetic energy = more collisions*)
- Enzyme activity peaks at an optimal temperature
- Higher temperatures decrease activity (*causes denaturation*)

pH

- Enzyme activity is highest at an optimal pH range
- Activity decreases outside of this range (*due to denaturation*)

Substrate Concentration

- Increases enzyme activity (*more particles = more collisions*)
- At a certain point, activity plateaus (*saturation of active sites*)



Key:

Graph 1 – *Temperature*

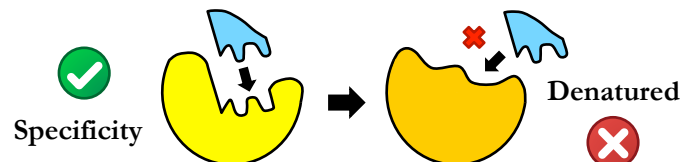
Graph 2 – *pH level*

Graph 3 – *Substrate level*

Enzyme Kinetics

The rate of enzyme catalysis can be increased by increasing the frequency of enzyme-substrate collisions (*molecular motion*)

The rate of enzyme catalysis is decreased by **denaturation**



Industrial Enzymes

Immobilised enzymes are often used in industrial practices

- They are fixed to a static surface to prevent enzyme loss
- This improves separation of product and purity of yield

One application for immobilised enzymes is the production of lactose-free milk and associated dairy products

- Lactase (enzyme) digests lactose into glucose / galactose
- Lactase is fixed to an inert surface (e.g. alginate beads)
- Milk is passed over this surface to become lactose free

There are several benefits associated with lactose-free milk:

- Provides a source of dairy for lactose-intolerant people
- Increases sweetness of milk (less need for sweeteners)
- Reduces crystallization and production times for cheese