

# Enzymes

These are **biological catalysts** – made by cells, normally proteins, can be RNA (viruses)

**Terms to know:** Substrate; Product; Active Site; Enzyme-Substrate (E/S) complex.

Each enzyme is **specific** – i.e. **only catalyses one reaction**.

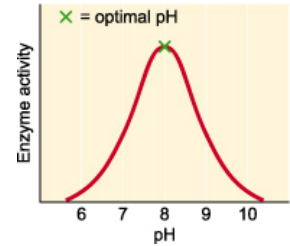
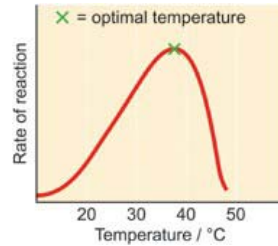
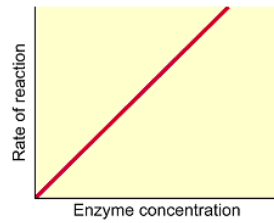
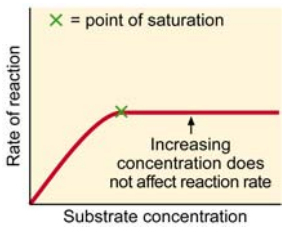
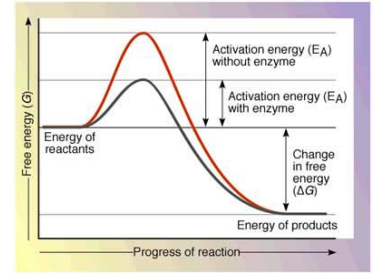
Thus **very efficient**; cells need to have >1000 different enzymes to be ‘alive’.

That limits the minimum size of a DNA molecule that can create ‘life’.

Each enzyme has an ‘**active site**’ comprising a few amino-acids. Any change in shape alters the effectiveness of the enzyme (usually reduces activity, but in **allosteric enzymes**, this shape change may be essential for it to work).

Enzymes work by **lowering activation energy** of the reaction – see right

Enzymes are affected by: [Substrate]; [Enzyme]; temperature; pH (see graphs)

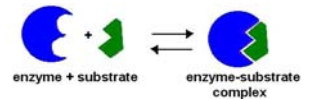


## Theories of enzyme action:

**Lock-and-key:** The shape of the enzymes’ active site is **complementary to the substrate**.

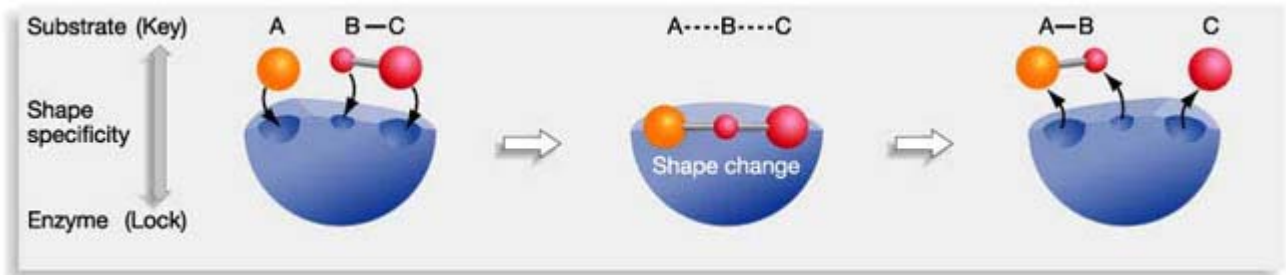
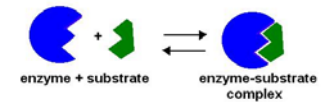
This means that the two fit together ‘like lock and key!’

**Accounts for:** specificity, inhibitors, but **not for** catalytic action, nor release of product at end.



**Induced Fit Theory:**– the active site and substrate are **complementary and ‘mould’ to each other** – like ‘hand in glove’. The **bonds in both substrate and enzyme bend** when the E/S complex forms – thus weakening them.

**Accounts for:** all known facts about enzymes!



## Inhibitors:

**Competitive inhibitors:** similar shape to substrate; bind to active site, blocking it, so E/S complex not formed; overcome by increasing [substrate]

**Non-competitive inhibitors:** **Not** similar to substrate and bind **other** than to active site, distorting active site and so preventing substrate from binding; tend to be permanent in action (poisons); [substrate] has no effect – only increasing **amount** of enzyme restores action

**End-product inhibition:** Common in living cells. End-product of a series of reactions inhibits the first stage, thus reducing the rate of its own synthesis. A kind of homeostasis.

e.g. **ATP inhibits respiration**, whilst ADP and AMP both stimulate it.

