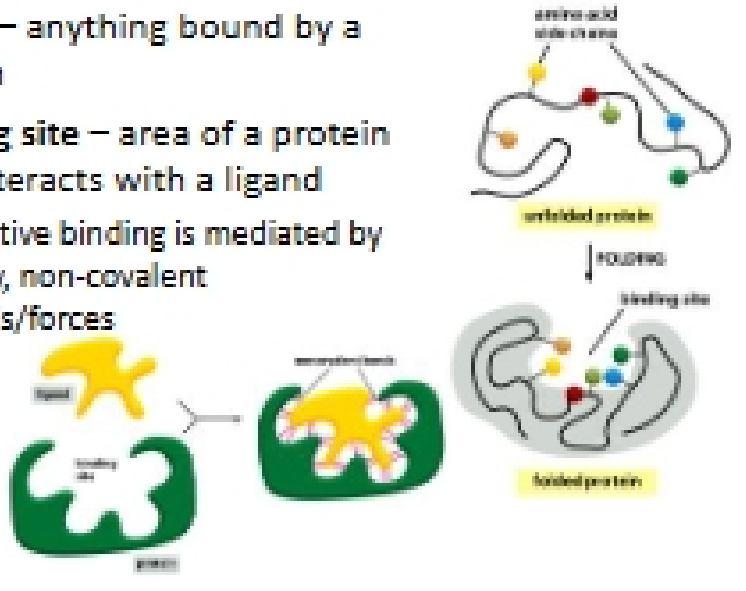
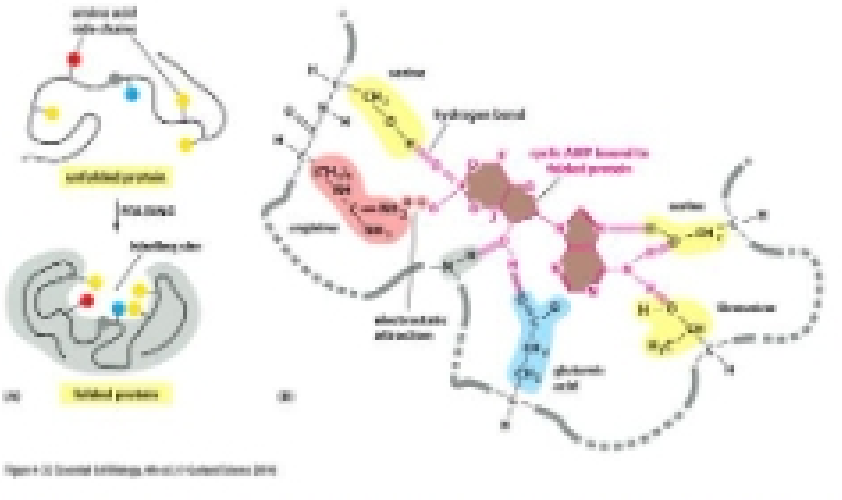
Proteins interact with other molecules.

- **ligand** – anything bound by a protein
- **binding site** – area of a protein that interacts with a ligand
  - selective binding is mediated by many, non-covalent bonds/forces



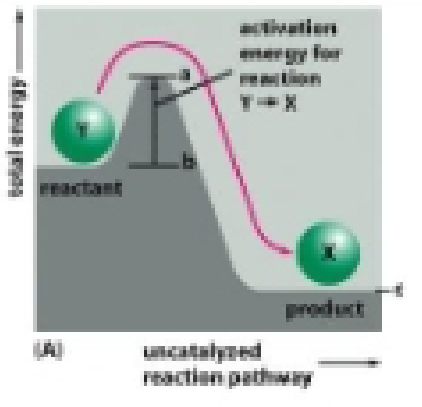


- The folding of polypeptide chain typically creates a cavity on the folded protein's surface, where specific amino acid side chains are brought together.

Proteins have diverse functions.

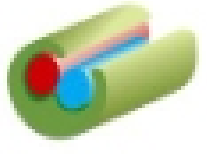
- speed up the rate of chemical reactions (**enzymes**)
- provide support in and outside of cells
- function in storage and transport

Enzymes are **proteins** that act as **catalysts.**



Enzymatic reactions

- the **substrate(s)** (**ligand**) binds to an **active site** (**binding site**)
- **substrate** is altered upon binding so that the desired reaction is favored



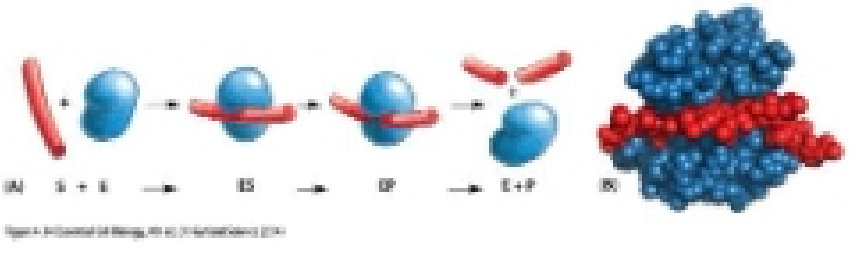
Holds substrates in alignment: encourages reaction

Re-arranges electrons: stabilizes intermediates

Alters bond angles: moves towards transition state

Enzyme example: Lysozyme

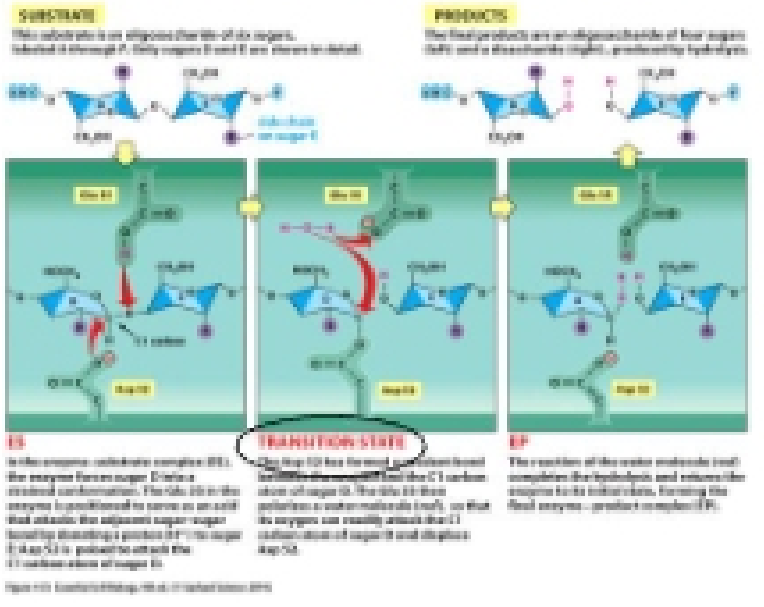
Lysozymes cleave polysaccharide chains found in bacterial cell walls.



S = substrate
E = enzyme
ES = enzyme substrate complex

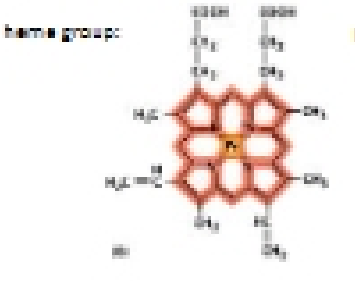
EP = enzyme product complex
P = product

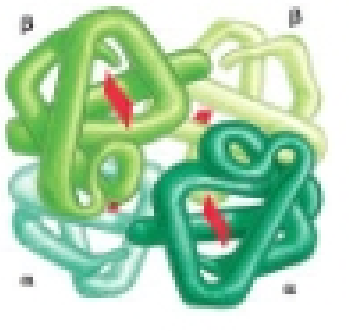
Mechanism of lysozyme action



Small molecules covalently attached to proteins increase protein functionality.

- used for functions amino acids cannot perform
  - Fe binds oxygen in hemoglobin
  - metals near active sites make transient bonds with the substrate

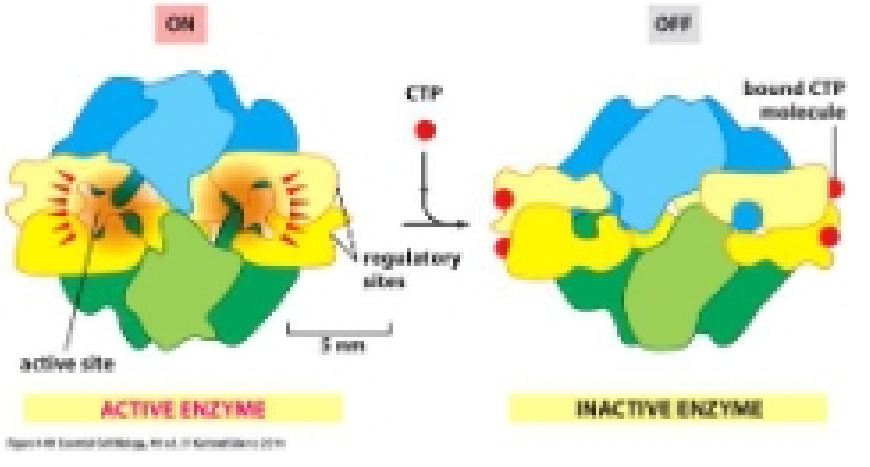




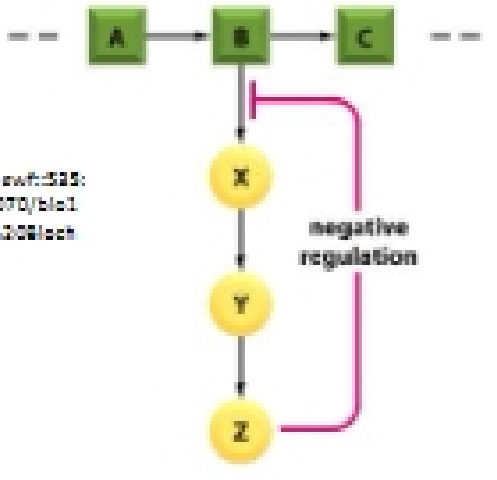
Regulation of protein function

- Amount of protein
- Location of protein
- **Modification of protein activity** (by modifying the protein's shape)
  - feedback inhibition of allosteric proteins
  - positive regulation of allosteric proteins
  - protein phosphorylation
  - other covalent modifications of proteins
  - binding of GTP
  - binding and hydrolysis of ATP

Allosteric proteins undergo **conformational changes** upon ligand binding which alters their activity.



Feedback inhibition occurs when a product of a pathway inhibits an enzyme that acts earlier in the pathway.

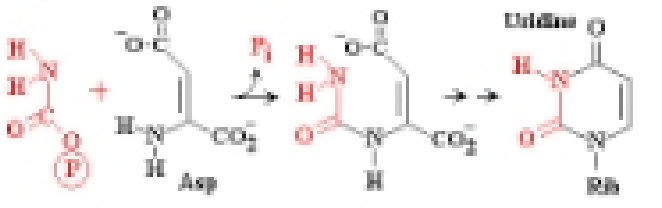


http://highered.mcgraw-hill.com/olcweb/cgi/pluginpop.cgi?it=swf::535::535::/sites/dl/free/0072437316/120070/bio10.swf::Feedback%20Inhibition%20of%20Biochemical%20Pathways

Enzyme regulation can be positive or negative.

ATCase catalyzes an early step in synthesis of pyrimidines

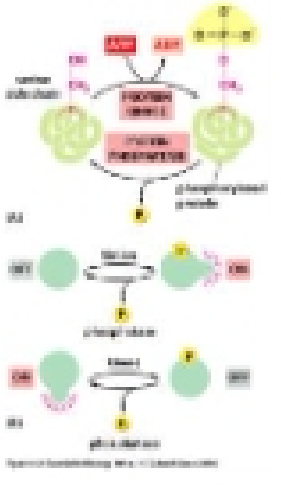
carbamoyl phosphate + aspartate —ATCase→ carbamoyl aspartate →→ uridine, cytidine



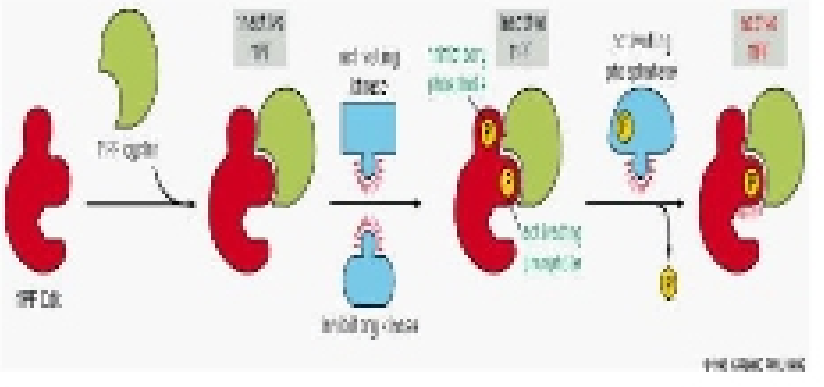
UTP and CTP = inhibits ATCase
ATP = activates ATCase

Protein **phosphorylation** can inhibit or stimulate protein function.

- **kinase** – attaches phosphates to serine, threonine or tyrosine side groups on a target protein
- **phosphatase** – removes phosphates from a target protein

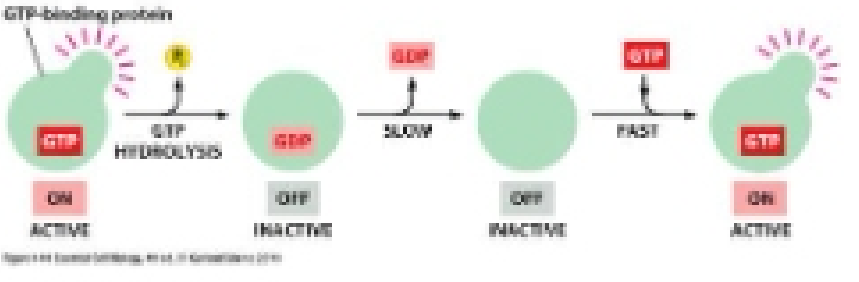


Example: Cell cycle progression is controlled by phosphorylation.

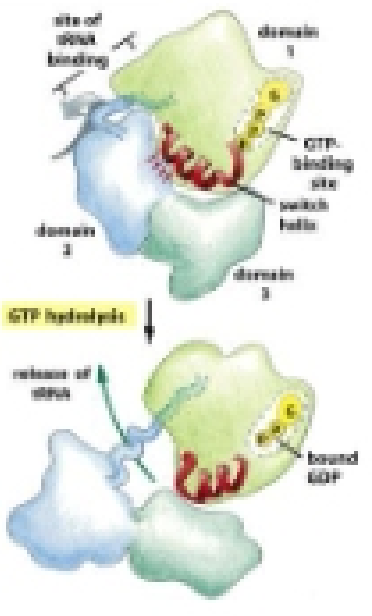


Other covalent modifications also affect protein activity.

Binding GTP activates **GTP-binding proteins.**



Example: The elongation factor (EF-Tu) undergoes a large conformational change after GTP hydrolysis.



Hydrolysis of bound ATP can provide directionality to a series of conformational changes.

Example: myosin walking along an actin microfilament