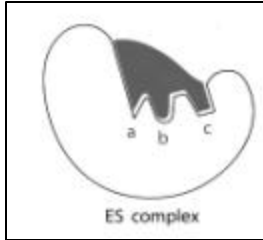


Chemical Basis of Enzyme Specificity

S binds to E at a site called the "active site" to form a complex, called ES complex

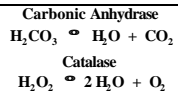


The E active site and the S are complimentary to each other chemically and structurally

Absolute versus General Specificity



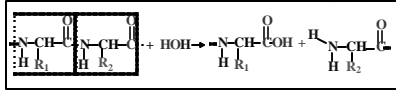
Absolute specificity is a property of an enzyme in which it catalyzes only one reaction



General specificity is a property of an enzyme in which it catalyzes only one type of reaction



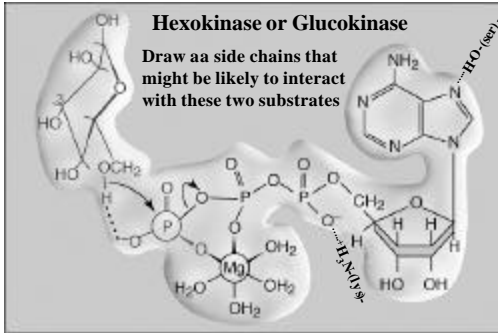
Chymotrypsin

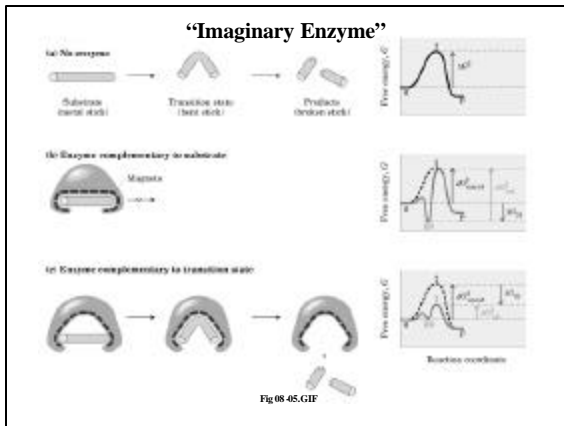


Chemical and Structural Complimentarity

Hexokinase or Glucokinase

Draw aa side chains that might be likely to interact with these two substrates





“Driving Force for Catalysis”

Weak bonding interactions (binding) between the E and the S provide the “driving force” for enzyme catalysis

1. Chemical Basis of Enzyme Catalysis

How do enzymes lower ΔG^\ddagger ?

1. Proximity and Orientation:
S binds to E at a site called the “active site” to form a complex, called ES complex

simple binding

“induced fit”

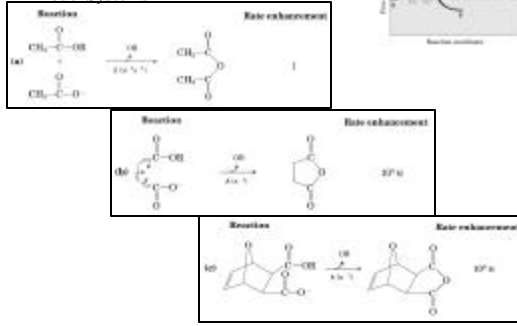
Substrate is chemically and structurally complimentary to enzyme active site

1. Chemical Basis of Enzyme Catalysis: Models

How do enzymes lower DG^\ddagger ?

1. Proximity and Orientation:

Model Systems Fig 08 47a-c.GIF

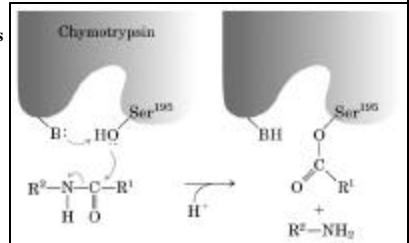


2. Chemical Basis of Enzyme Catalysis: Nucleophiles

2. Functional Group Catalysis:

The E active site has functional groups that can act as the following:

Nucleophiles

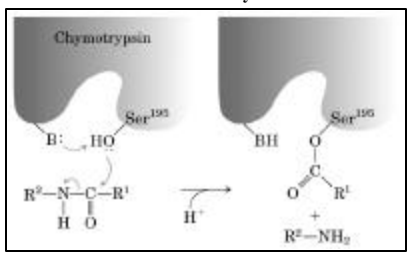


2. Chemical Basis of Enzyme Catalysis: General Acid Catalysis

2. Functional Group Catalysis:

The E active site has functional groups that can act as the following:

General acid/base catalysts



2. Chemical Basis of Enzyme Catalysis:

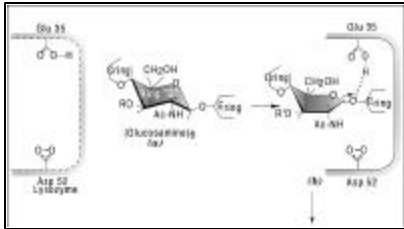
Counter Ion Stabilization

2. Functional Group Catalysis:

The E active site has functional groups that can act as the following:

Counter ion for electrostatic stabilization
(common lys, arg, glu, asp)

Devlin
FM 53A.PCT



2. Chemical Basis of Enzyme Catalysis:

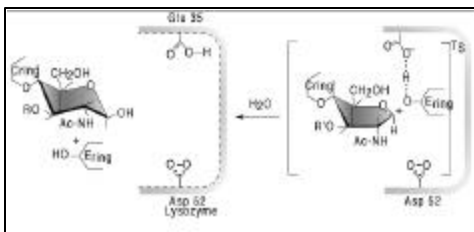
Counter Ion Stabilization

2. Functional Group Catalysis:

The E active site has functional groups that can act as the following:

Counter ion for electrostatic stabilization
(common lys, arg, glu, asp)

Devlin
FM 53B.PCT



2. Chemical Basis of Enzyme Catalysis: H-bonding stabilization

2. Functional Group Catalysis:

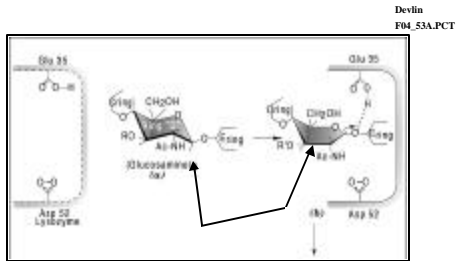
The E active site has functional groups that can act as the following:

H-bonding donors or acceptors for stabilization of transition state:

(common: backbone groups, ser, his, lys, arg, glu, asp)

3. Chemical Basis of Enzyme Catalysis: Strain
Introduction of strain into S:

bond angle and bond length distortion



4. Chemical Basis of Enzyme Catalysis: Ox-Red

Enzymes have prosthetic groups that can act as oxidizing agents and reducing agents (some prosthetic groups are actually substrates)

ENZYMES: INORGANIC COFACTORS

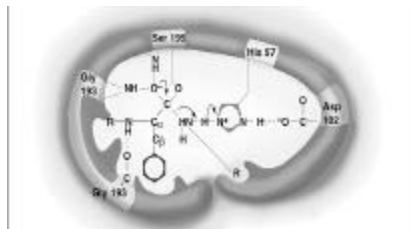
Table 8-1

Some Inorganic Elements That Serve as Cofactors for Enzymes

Cu ²⁺	Cytochrome oxidase
Fe ²⁺ or Fe ³⁺	Cytochrome oxidase, catalase, peroxidase
K	Pyruvate kinase
Mg ²⁺	Hexokinase, glucose 6-phosphatase, pyruvate kinase
Mn ²⁺	Arginase, ribonucleotide reductase
Mo	Dinitrogenase
Ni ²⁺	Urease
Se	Glutathione peroxidase
Zn ²⁺	Carbonic anhydrase, alcohol dehydrogenase, carboxypeptidases A and B

So What?

Do these processes of catalysis explain why an E stabilizes the Transition State?



These other processes help S get to the Transition State!

Weak forces.....stabilize the Transition State!!

“Driving Force for Catalysis”

Weak bonding interactions (binding) between the E and the S provide the “driving force” for enzyme catalysis



“transition state stabilization necessary”
