Enzyme

Enzymes: are biological catalysts (عوامل مساعده حيويه) responsible for supporting almost all of the chemical reactions that maintain animal homeostasis (توازن الكائن الحي).Enzymes do nothing but speed up the **velocity** of reversible reactions , (وضيفة الانزيمات هي زياده سرعه التفاعلات العكسية)

Substrate الماده الداخله في التفاعل + Enzyme ⇌ Product (الماده الناتجه) + Enzyme

The velocity of reaction (V) is expressed in micromoles of substrate converted to product per minute. which is expressed (µmol/min)

In terms of thermodynamics, enzymes reduce the **activation energies of reactions**, enabling them to occur much more readily at low temperatures - essential for biological systems (زياده سرعه التفاعل بواسطه الانزيمات ممكن ان تكون عن طريق خفض درجه الحراره اللازمه للتفاعل بحيث تحدث هذه التفاعلات ممكنه بدرجه حراره الجسم الاعتياديه).

The basic characteristics of enzymes includes

(i) Almost all the enzymes are proteins (الأنزيمات هي بروتينات) and they follow the physical and chemical reactions of proteins.

(ii) Enzymes are sensitive and labile to heat. (الأنزيمات تتأثر بالحراره)

(iii) Enzymes are water soluble.(الانزيمات تذوب في الماء)

(iv) Enzymes could be precipitated by protein precipitating agents such as ammonium sulfate and trichloroacetic acid..(الانزيمات يمكن ترسيبها بلماواد التي ترسب البروتينات)

CLASSIFICATION OF ENZYMES

(i) The old trivial names الاسماء القديمه

(ii) Classification of enzymes according to the Union of Biochemists and Molecular Biology (IUBMB). تقسيم الانزيمات حسب تصنيف عالمي

(iii) Classification of enzymes according to their composition. تقسيمالانزيمات حسب مكوناتها

(iv) Classification of enzymes according to the requirement of ATP تقسيم الانزيمات حسب حاجتها لمركب اداينوسين تراي فوسفيت

The old trivial names

- Since earlier days to still date, old trivial names أسماء دارجة such as pepsin, chymotrypsin, etc were used to name enzymes
- Later the suffix “ase” to the substrate was used to name enzymes اضافه مقطع "ايز" الى اسم المركب الداخل في التفاعل. For example the enzymes lactase acts upon the lactate and produces glucose and galactose

Classification of enzymes according to the Union of Biochemists and Molecular Biology (IUBMB).

The International Union of Biochemistry and Molecular Biology have developed a nomenclature تسمية for enzymes, the EC numbers; each enzyme is described by a sequence of four numbers preceded by "EC". The first number broadly classifies the enzyme based on its mechanism الوضيفة. They divided enzymes broadly into six groups:

EC	Classification	Biochemical Properties
1	Oxidoreductases	Act on many chemical groupings to add or remove hydrogen atoms او تضيف تزيل ذره هايدروجين. e.g. Lactate dehydrogenase
2	Transferases	Transfer functional groups between donor and acceptor molecules تنقل مجاميع فعاله بين جزيئات واهبه ومستلمه. e.g. Aminotransferase.
3	Hydrolases	Add water across a bond, hydrolyzing it تضيف جزيئه ماء. E.g. Acetyl choline esterase
4	Lyases	Add water, ammonia or carbon dioxide across double bonds, or remove these elements to produce double bonds. e.g. Aldolase.
5	Isomerases	Carry out many kinds of isomerization: L to D isomerizations, mutase reactions (shifts of chemical groups) and others. e.g. Triose phosphate isomerase.
6	Ligases	Catalyze reactions in which two chemical groups are joined التفاعلات الرابطة (or ligated) with the use of energy from ATP. e.g. Acetyl CoA carboxylase

Classification of enzymes according to their composition.

1- Simple enzyme انزيمات بسيطه: Enzymes composed wholly of protein تتكون من بروتين فقط.

2- Complex enzymes انزيمات معقده: composed of protein and a relatively small organic molecule.

Complex enzymes are also known as **holo-enzymes.** The non-protein component of an enzyme may be as simple as a metal ion ايون معدن or as complex as a small non-protein organic molecule جزيء عضوي. The non-protein component of an enzymes known as (co-enzymes).

Enzymes that require a metal in their composition are known as metallo-enzymes انزيمات معدنيه. Metallo-enzymes bind and retain their metal atom(s) under all conditions with very high affinity. Enzymes with lower affinity for metal ion, but still require the metal ion for activity, are known as **metal-activated enzymes انزيمات تتفعل بوجود المعدن.**

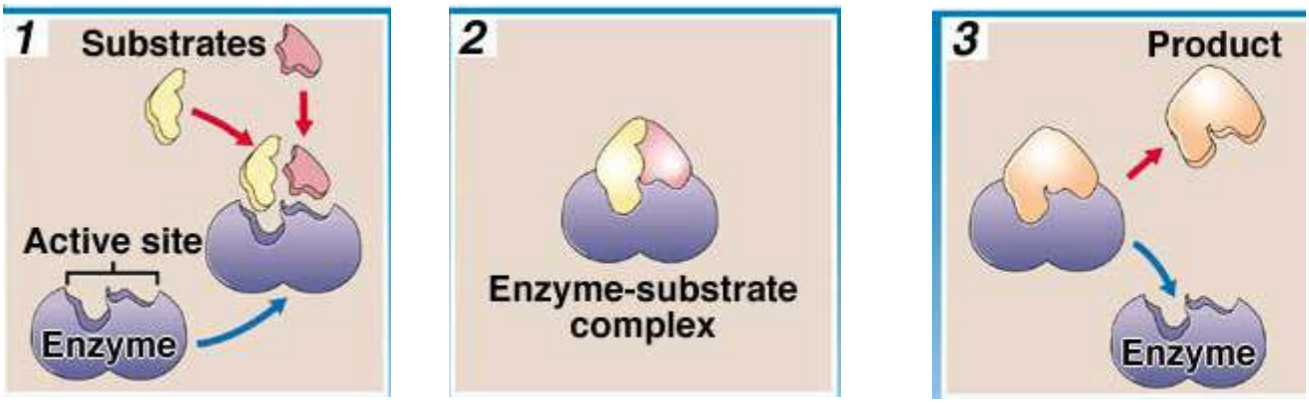
Classification of enzymes according to the requirement of ATP ادينوسين تراي فوسفيت (مركب ناقل للطاقه)

1- **Synthetases:** are ATP dependent enzymes catalyzing biosynthetic تفاعلات حيويه تكوينيه reactions.

2- **Synthases**: are enzymes involves in catalyzing biosynthetic reactions that do not require ATP directly.

Mechanism of Enzyme Activity

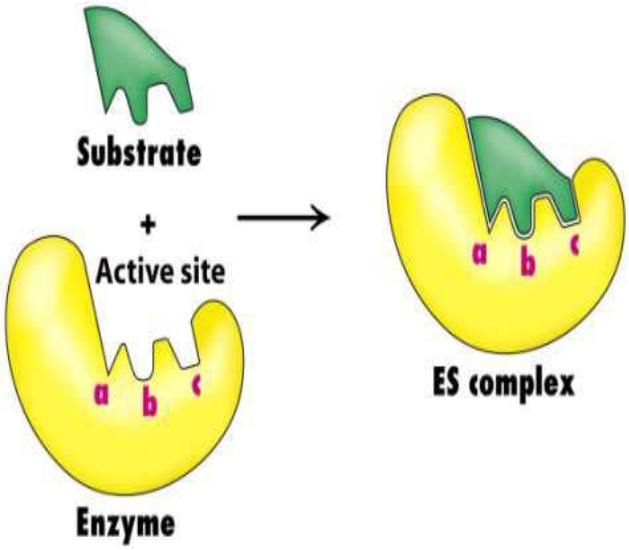
A substrate(s) fits into a binding site on the enzyme. The enzyme lowers the energy required to reach the transition state. The product no longer fits the binding site and is released.

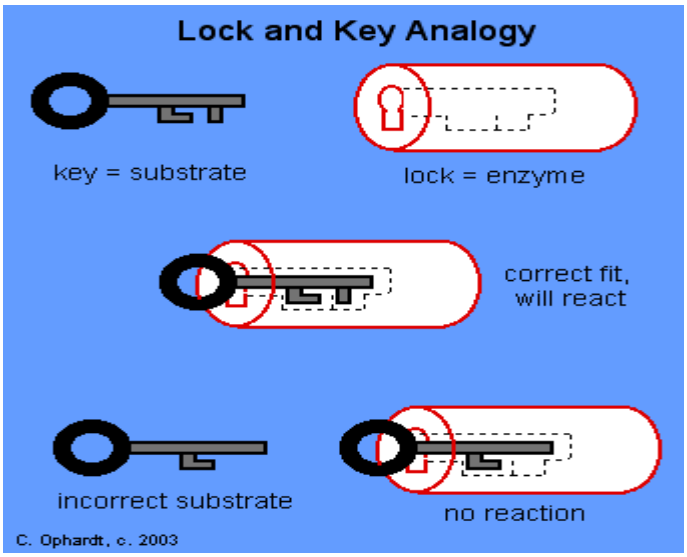


Theories explaining enzyme activity

1- Lock and key theory: “key fits into lock” نظريه القفل والمفتاح

- The catalytic site of the enzyme has a shape that is complementary (fit) to the shape of the substrate.
- The substrate fits in this catalytic site in a similar way to lock and key. The key will only fits its own lock.





2- Induced fit theory نظريه التناسب المستحث

- The catalytic site of the enzyme is not complementary to the substrate.
- Binding of the substrate to the enzyme induces changes in the shape of the catalytic site making it more fit for substrate.