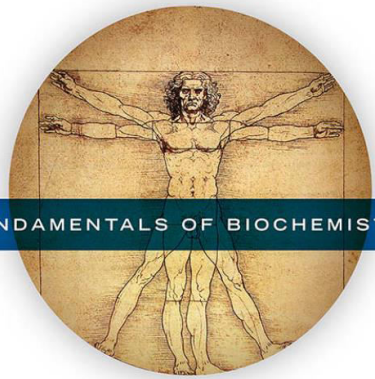


Synzymes/Synthetic enzymes



FUNDAMENTALS OF BIOCHEMISTRY

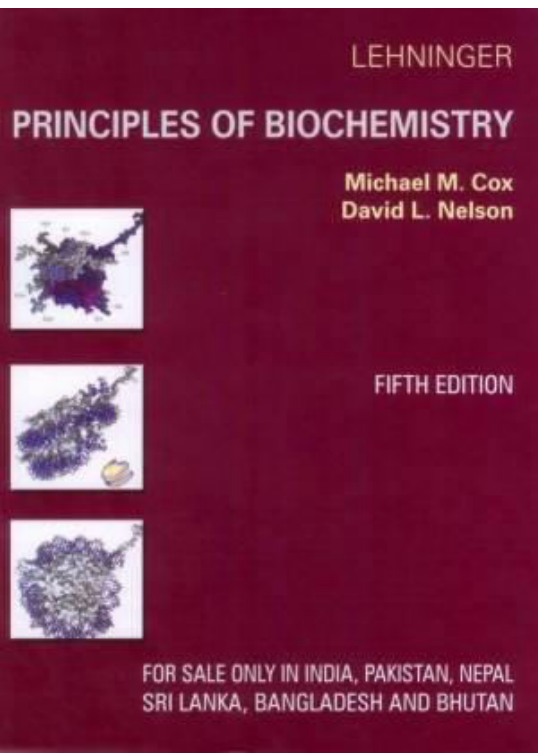
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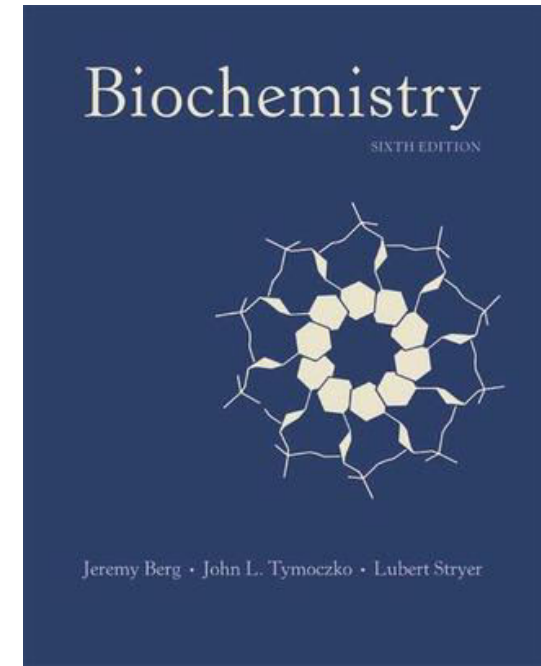
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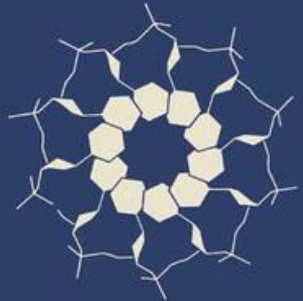
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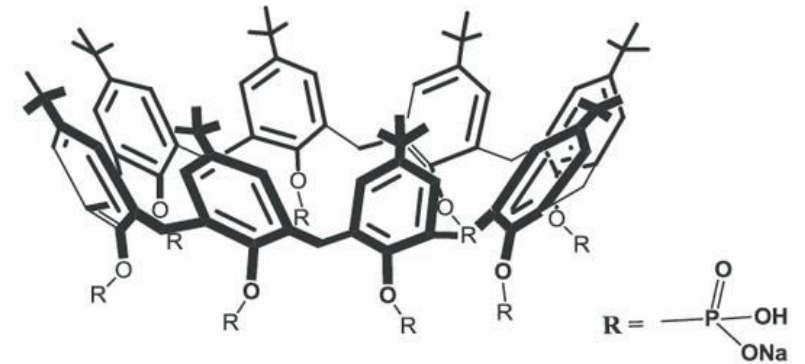
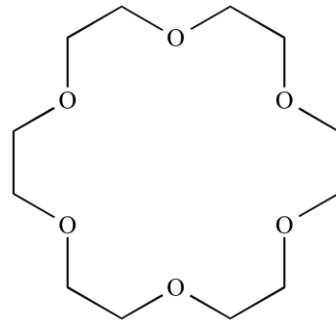
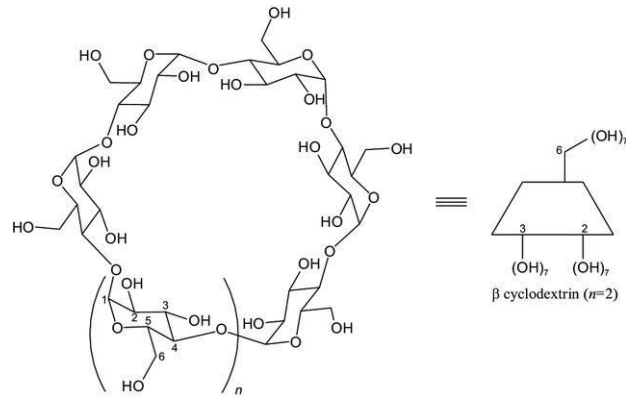
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Synzyme or Synthetic Enzyme

- Synthetic enzyme research is a field that is only 40 years old, starting with the first synthetic enzyme created in **1971** by **Robert Bruce Merrifield**.
- Synthetic enzymes or **Synzymes** are substances with catalytic activity. The name synzyme is derived from synthetic enzyme. These are also called artificial enzymes.
- Current synzymes **consist mainly of organic molecules** tailored in such a way that they catalyze certain kind of reactions. These molecules **bind to a transition state of a substrate in an active site**.

- Synthetic enzymes are also defined as the **synthetic organic molecule** prepared to **recreate or mimic the active site of an enzyme**.
- Synzymes are **designed according to the host molecules** such as **cyclodextrins, crown ethers** or **calixarenes** etc.



Requirement of synzyme activity

- A synzyme should have two structural moieties-
 - A substrate binding site
 - A catalytically effective site
- Both sites **may be designed separately** but it is observed that an enzyme having a binding site for a reactive transition state, exhibits both the function.
- Usually, there is enzyme-substrate formation that is converted into the product and free enzyme gets released.



Types of Synzymes

There are various types of synzymes derived from different sources.

Protein derived synzymes

- Some synzymes are simply derivatised protein. It is significant to mention here that immobilized enzymes are not considered as synzymes.
- An example of protein synzyme is **derivatization of myoglobin** that is the oxygen carrier in muscles by attaching **[Ru(NH₃)₅]³⁺** to **three surface histidine residues**.
- This derivatised myoglobin **oxidized ascorbic acid** with reduction of molecular oxygen. The derivatised myoglobin act as **ascorbate oxidase** is as effective as ascorbate oxidases.
- Protein synzymes are **prone to denaturation, oxidation and hydrolysis**.

Cyclodextrins synzymes

- Synzymic cyclodextrins are usually derivatised to introduce catalytically relevant groups.
- Cyclodextrins are **naturally occurring cyclic molecules** consisted of **6 to 10 α -1,4 linked glucosyl moieties** linked head to tail in a ring form.
- Example of cyclodextrin synzyme is **β -cyclodextrin with C-6 hydroxyl group covalently derivatized by an activated pyridoxal coenzyme** that showed **transaminase activity** with **stereospecificity towards L-amino acids**. It is **not as effective** as natural transaminase.

Organic synzymes

- The **primary amines** have been **alkylated with 1-iodododecane** and the resulted **alkylated amine has hydrophobic binding sites**. If primary amine is **alkylated with 4(5)-chloromethylamdozole**, it creates general **acid-base catalytic sites** and resulting product act as synzymes.
- This synzymes shows the **activity of α -chymotrypsin** against **4-nitrophenyl esters**. However, due to its random structure, it shows **very poor esterase specificity** as well.

Superoxide Dismutase Synzymes

- Superoxide dismutase is an enzyme found in all living organisms.
- **Manganese superoxide dismutase** has been found in mammalian mitochondrion that acts by **scavenging superoxide free radicals**.
- If free **superoxide radicals** are present, these may **attack DNA and proteins**. It is known that many diseases such as **Cancer, Parkinsons, Alzheimers** are associated with **deficiencies in the natural enzymes**.
- The possibility of using mimics of the natural enzymes (synzymes) active site for therapeutic use has been considered.
- The synzyme offers the possibility of treating such diseases with manganese complexes mimicking the function of natural enzyme.