Catalytic proteins structural role

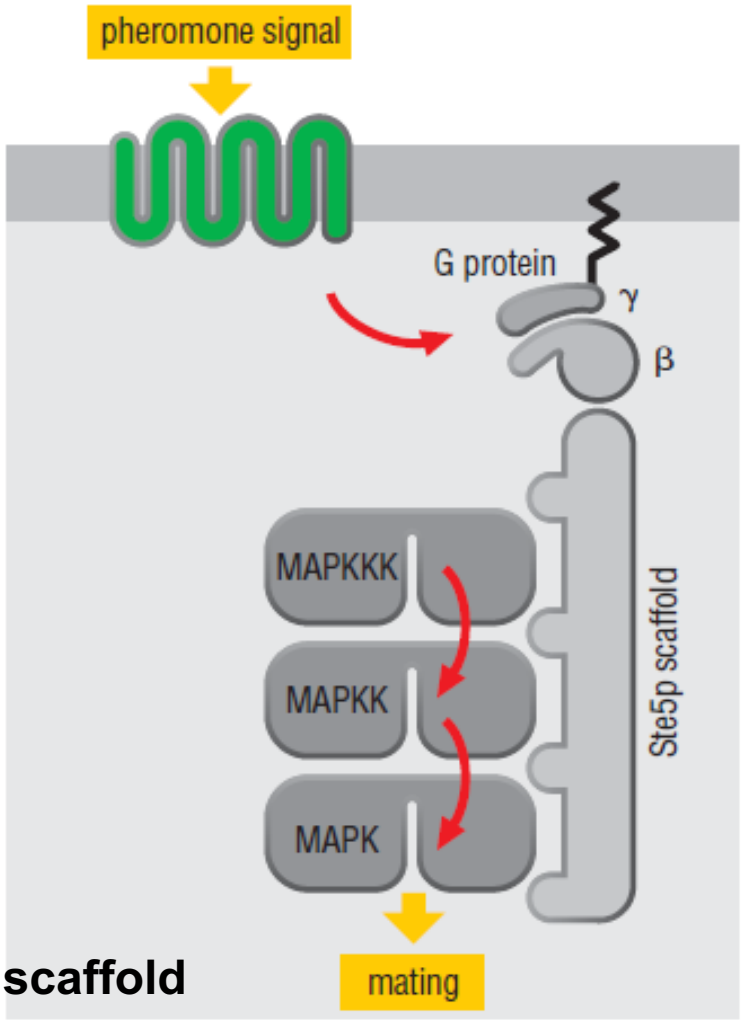
- Time Dependent changes in cellular assemblies
  - Shape or conformation or some other property of the assembly
- Changes are often brought about by changes in the structure of a single component of the multicomponent assembly
  - Derive from the energy released by a chemical process
  - Binding dependent or pH driven
- Muscle is an example of such a multicomponent assembly
- Actin filaments and myosin filaments
  - Myosin II is structural protein (it forms filaments), a catalytic protein (an ATPase), and a motor protein involved in cell motility

ACTIVE SITES CHIEFLY PROMOTE PROXIMITY

- correct orientation probably makes a significant contribution to the catalytic efficiency of all enzymes
- holding them close to each other
- in the proper orientation
- substrate molecules are intrinsically reactive
  - holding them close to each other in the proper orientation

STRUCTURAL PROTEINS SERVE AS SCAFFOLDS

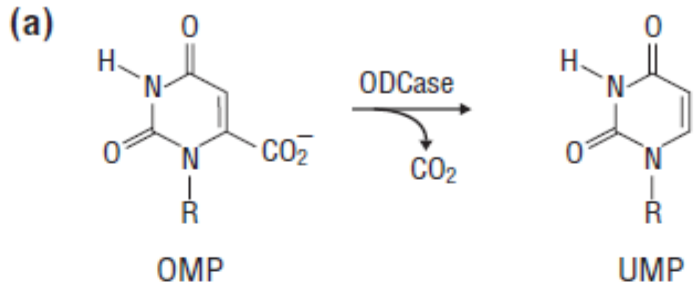
Mitogen-activated protein kinase (MAPK)

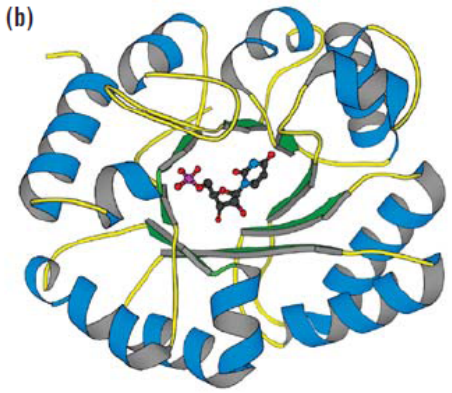


The Ste5p scaffold

Catalysts accelerate the rate of a chemical reaction

- any substance that accelerates the rate of a chemical reaction without itself becoming permanently altered in the process
- Enzymes can be extraordinarily efficient catalysts.
- In free solution, the uncatalyzed reaction is estimated to take approximately 78 million years to go
- OMP decarboxylase or ODCase it is completed in less than a second—an increase in reaction rate of 10^{17}-fold.



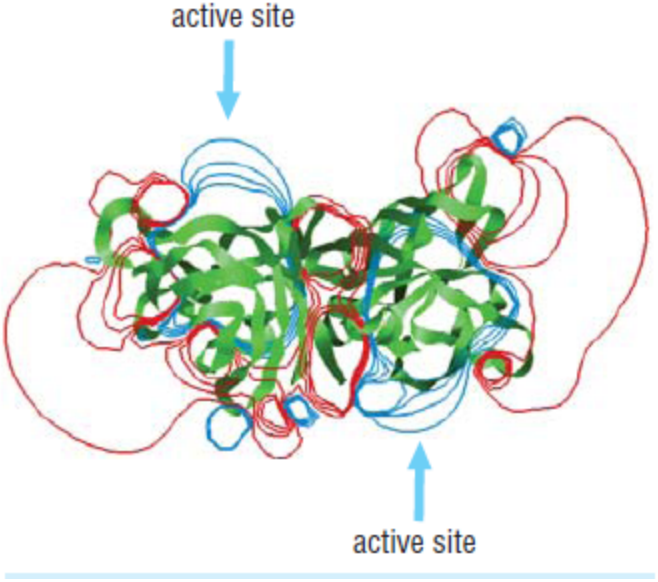


Catalysis usually requires more than one factor

- determination of the atomic structure of many enzyme–substrate complexes
- depend on
  - the structure and physical properties of the enzyme.
  - the ability to orient the ligand very precisely relative to catalytic residues in the active site
  - chemical properties of the amino acids (and cofactors, if any) that make up the enzyme.
  - stabilize unstable chemical species by weak interactions
- Similar enzymes from different organisms may also have subtle differences in the balance of contributions of the different factors.

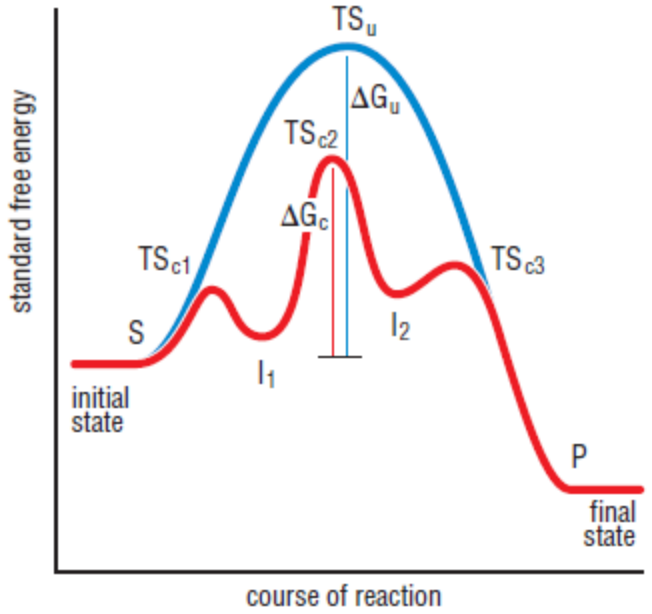
Reactive groups in enzyme active sites

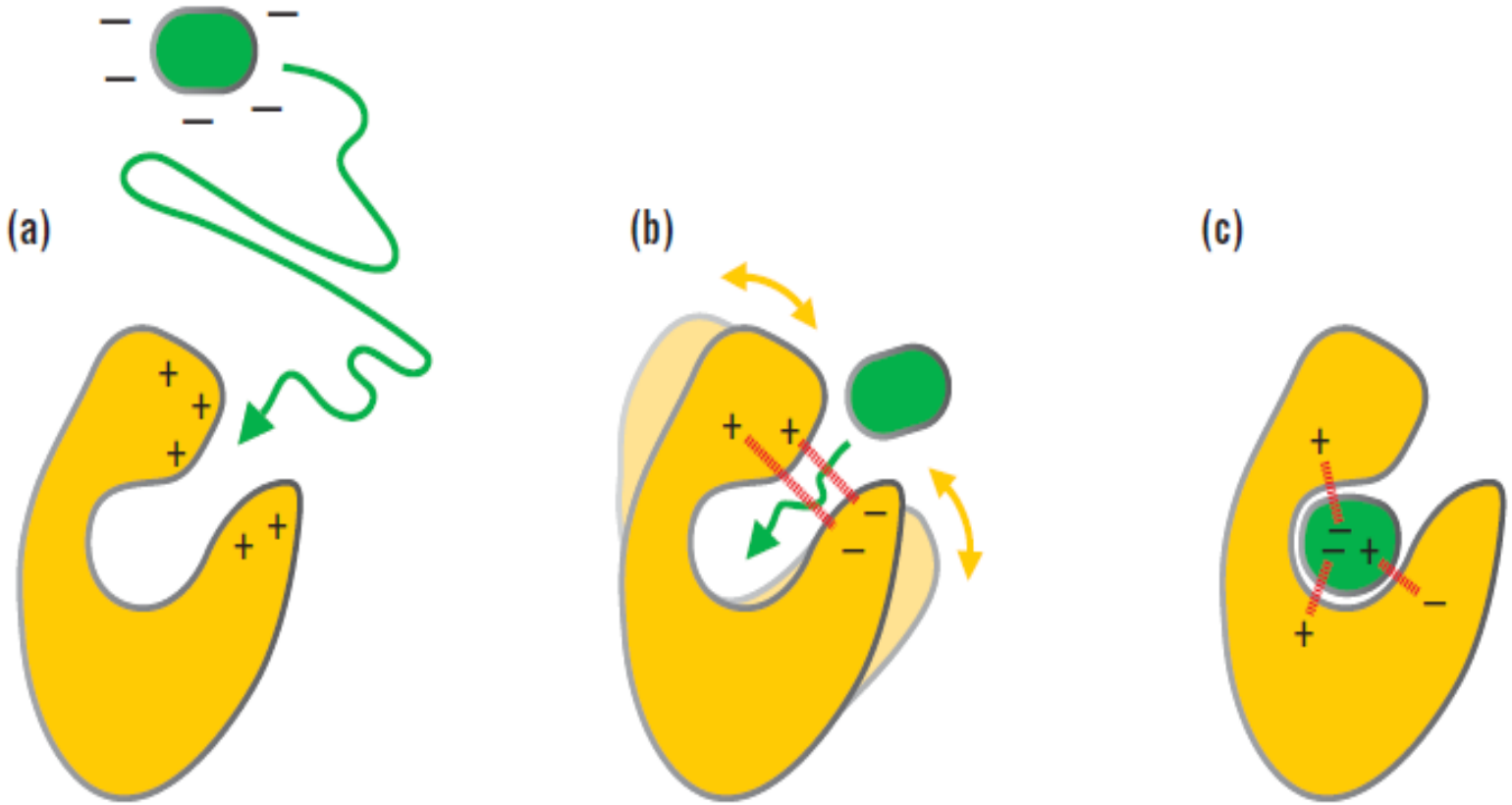
- optimally positioned to interact with the substrate
- van der Waals interactions between the substrate and nonpolar groups on the enzyme
- complementary arrangements of polar and charged groups around the bound molecule.
- Enzyme–substrate dissociation constants
  - range from about 10–3 M to 10–9 M
  - the lower the value
  - the more tightly the substrate
  - is bound.



Catalysis is reducing the activation-energy barrier

- the activation energy
- activation-energy barrier
- transition state is the highest point in free energy on the reaction pathway




(a)
(b)
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