Introduction to Enzymes

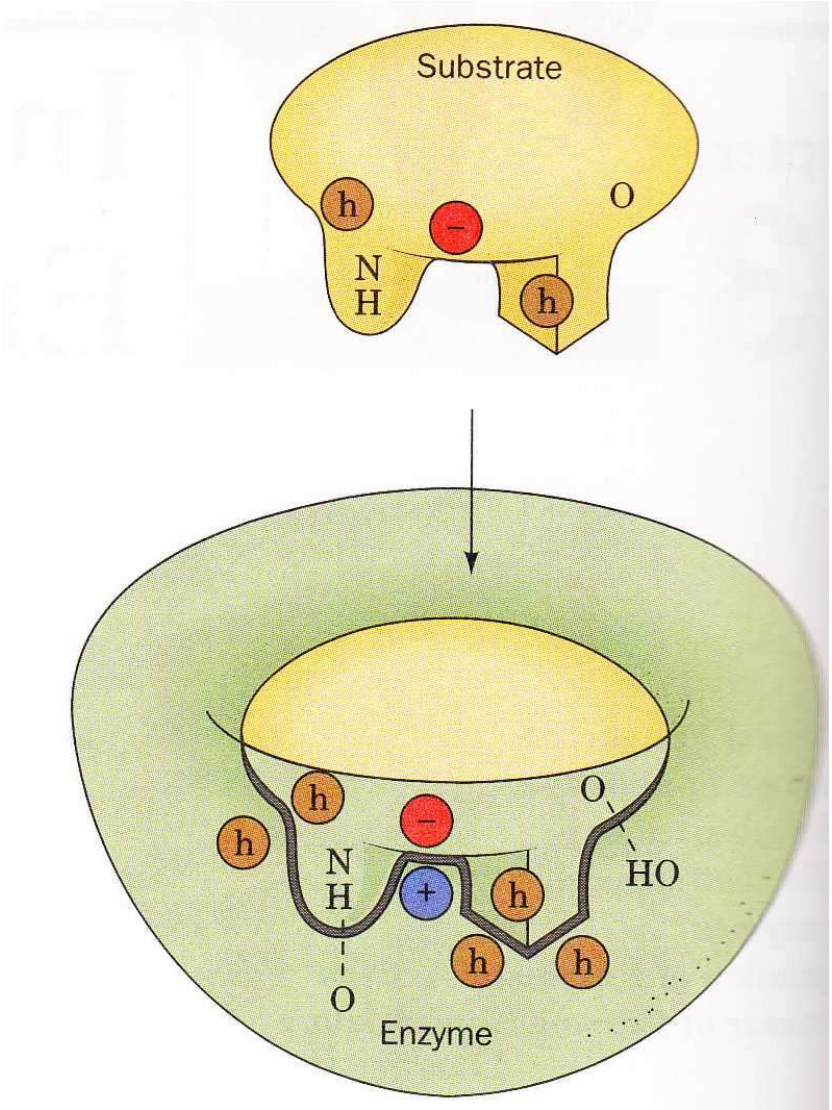
Voet & Voet, Chapter 13

Enzymes offer advantages over chemical catalysts:

- **Higher Reaction rates (10^6- to 10^{12}-fold acceleration)**
- **Milder reaction conditions (<100 ^oC, in water, near neutral pH)**
- **Greater reaction specificity (e.g., the ribosome)**
- **Can be regulated (allostery, covalent modification, product inhibition, gene expression regulation)**
- **Can evolve**

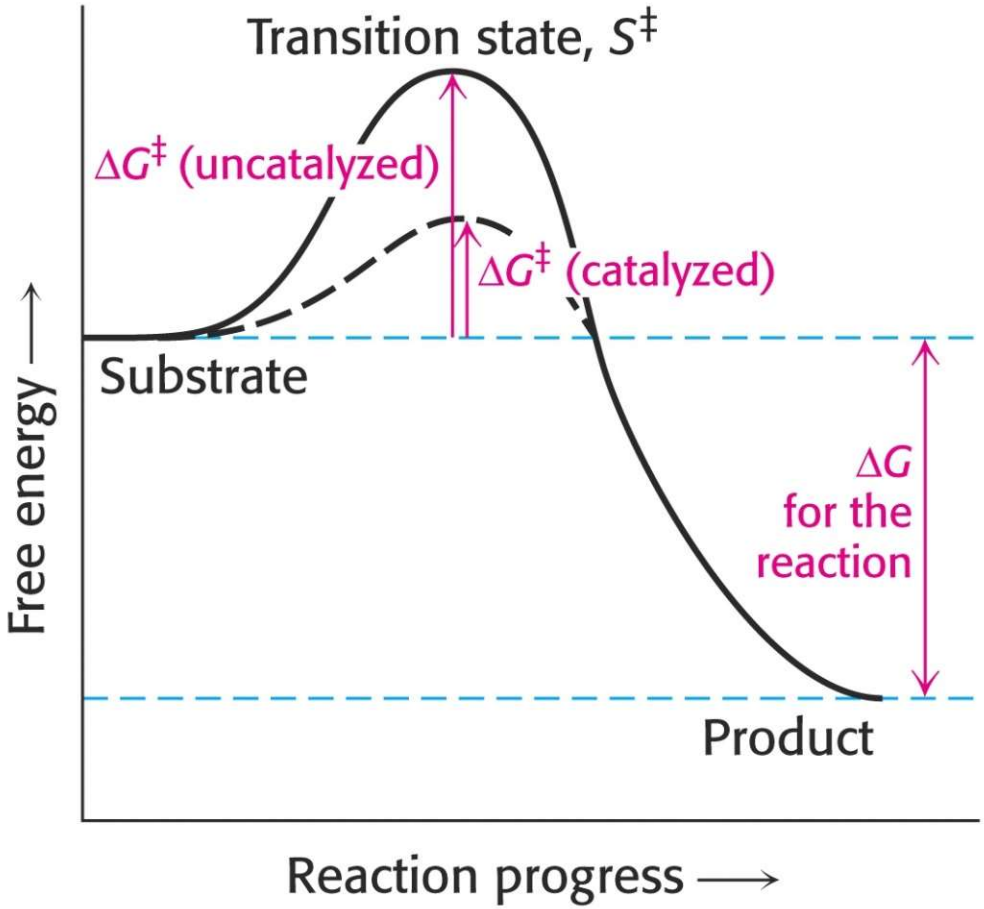
https://www.youtube.com/watch?v=0KRB6fmqvnc

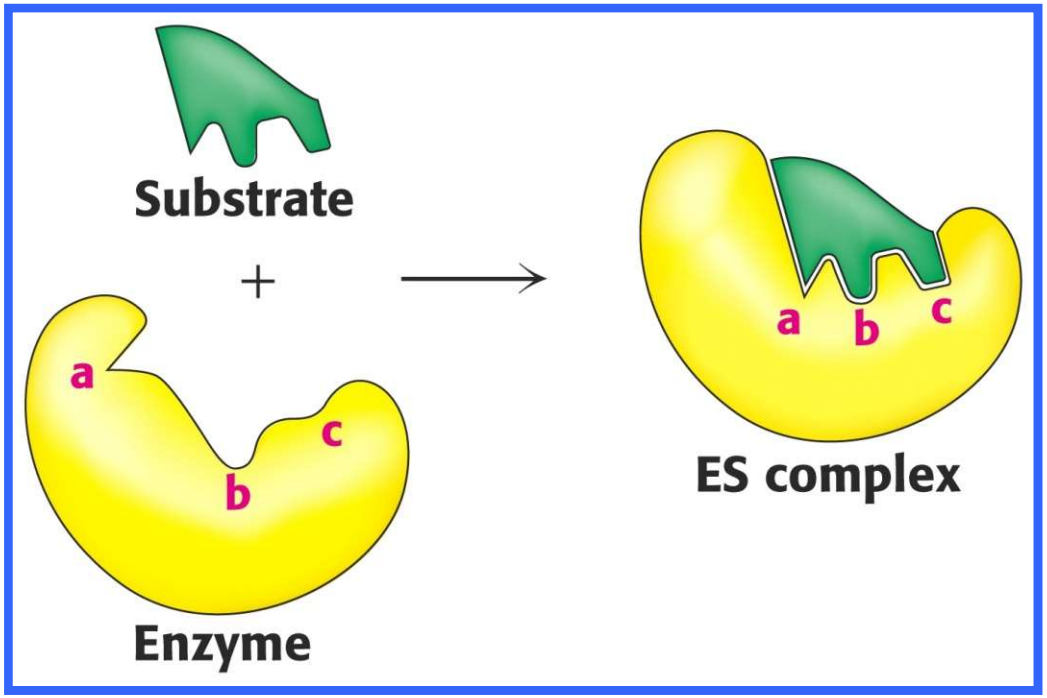
Geometrical (sterical) and physical (bonding) complementarity



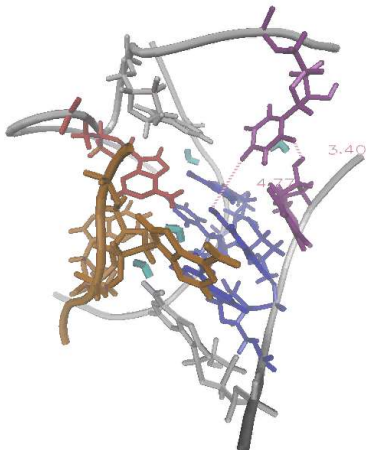
And Water??

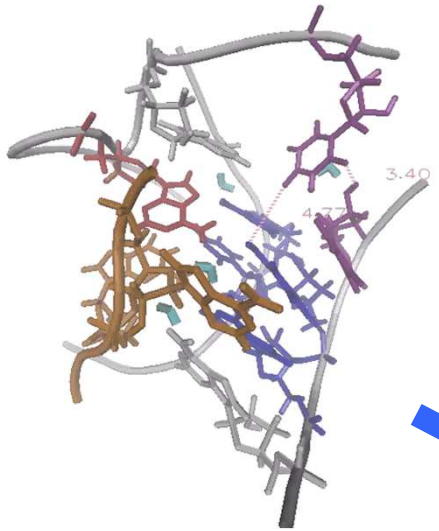
Enzymes lower the activation energy often by induced fit (and substrate strain!)

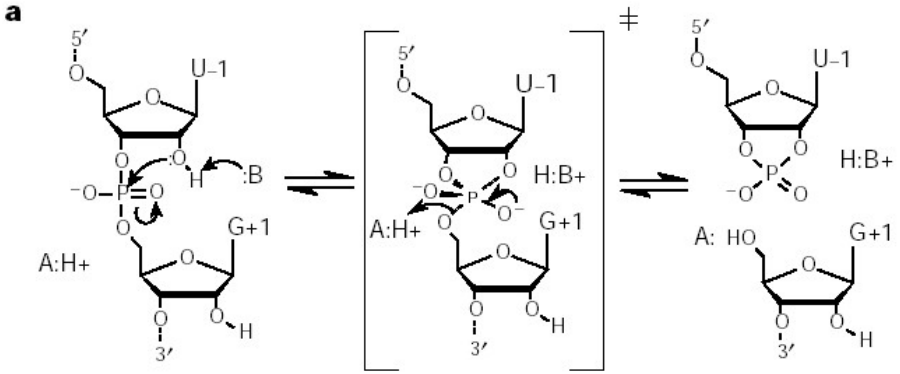




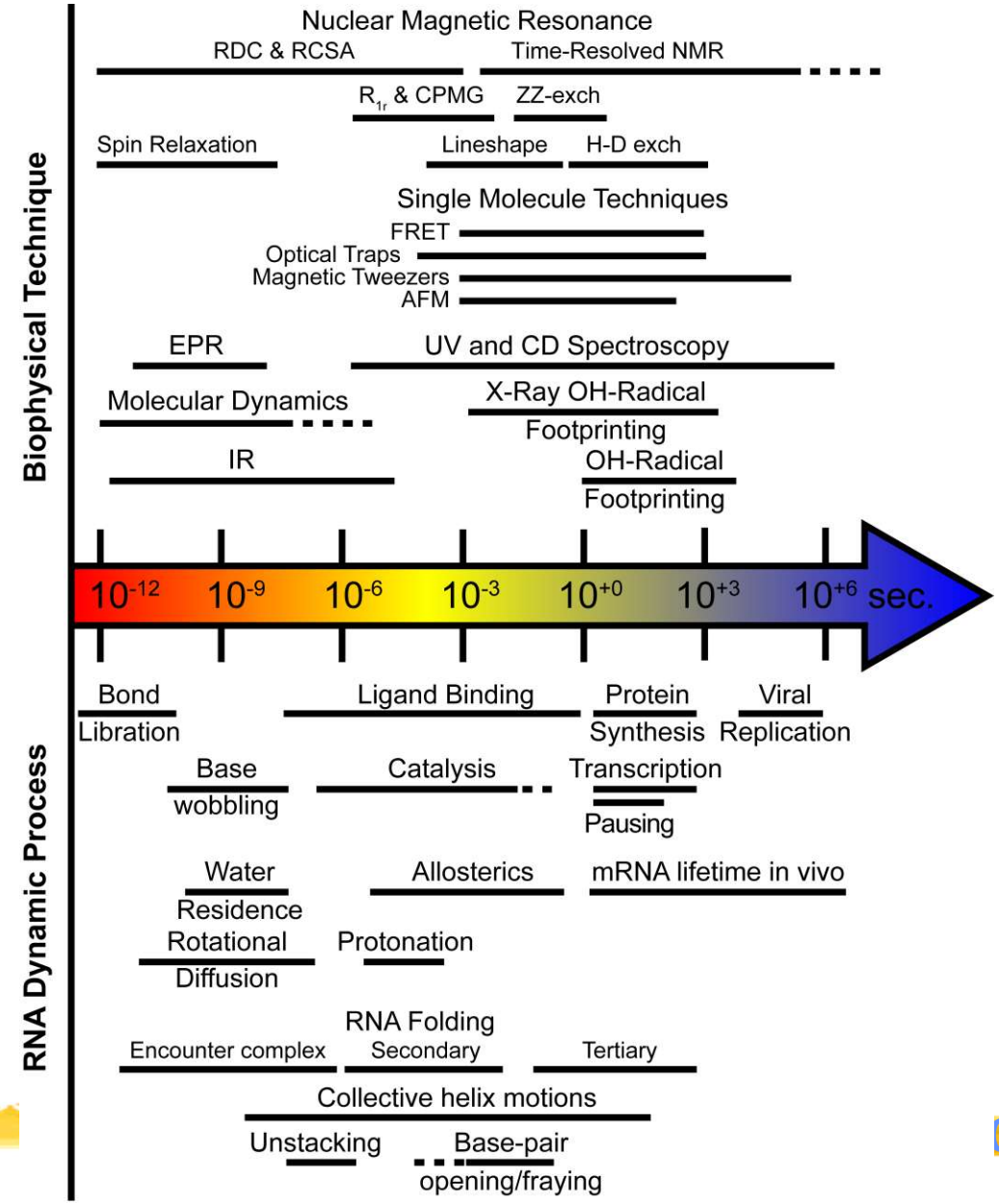
Structure → Dynamics → Function





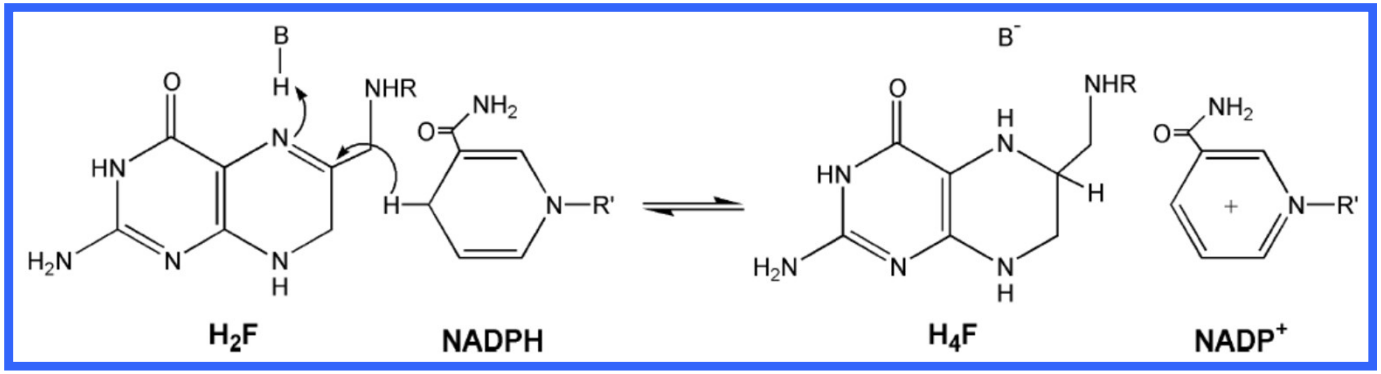


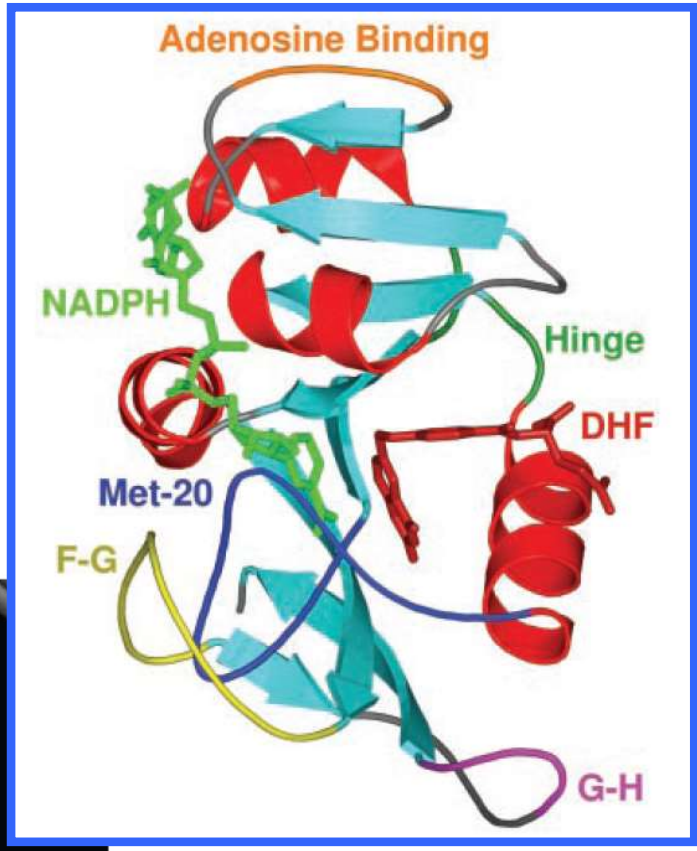
Dynamics can be visualized through biophysical tools



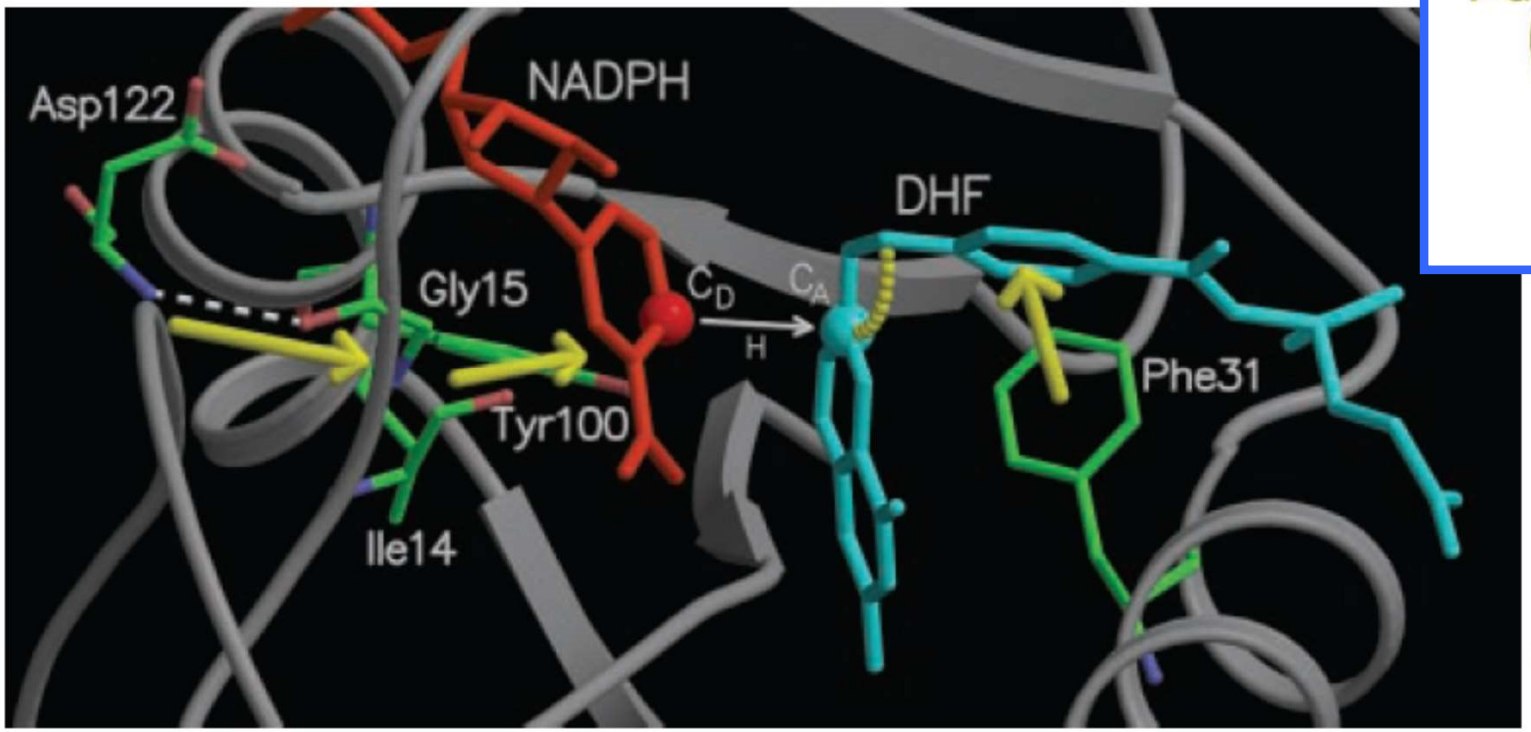
Walter, N.G. and Al-Hashimi, H.M. *Curr. Opin. Struct. Biol.* 18 (2008) 321-329

Dynamics through long-range coupled molecular motions: Example DHFR





https://www.youtube.com/watch?v=KAkBfTQS8P0
https://www.youtube.com/watch?v=Me36VmPOmzw



Benkovic, S.J. and Hammes-Schiffer, S. *Science* 301 (2003) 1196-1202