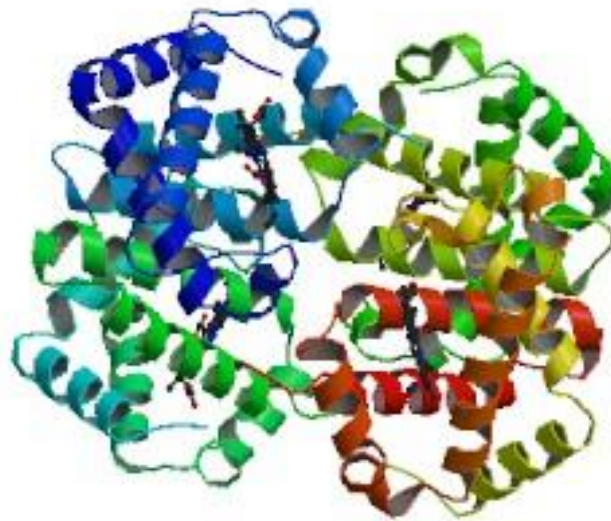


ME 411 / ME 511

Biological Frameworks for Engineers

Class Organization

- Lab 1 – Protein Structure
 - MEB 231



ME 411 / ME 511

Proteins

Protein Functions

- Different shapes and sizes mediate a diverse array of activities
- Function based on proteins binding to themselves, other proteins, small molecules, or ions
- Life is nothing without the function of proteins...

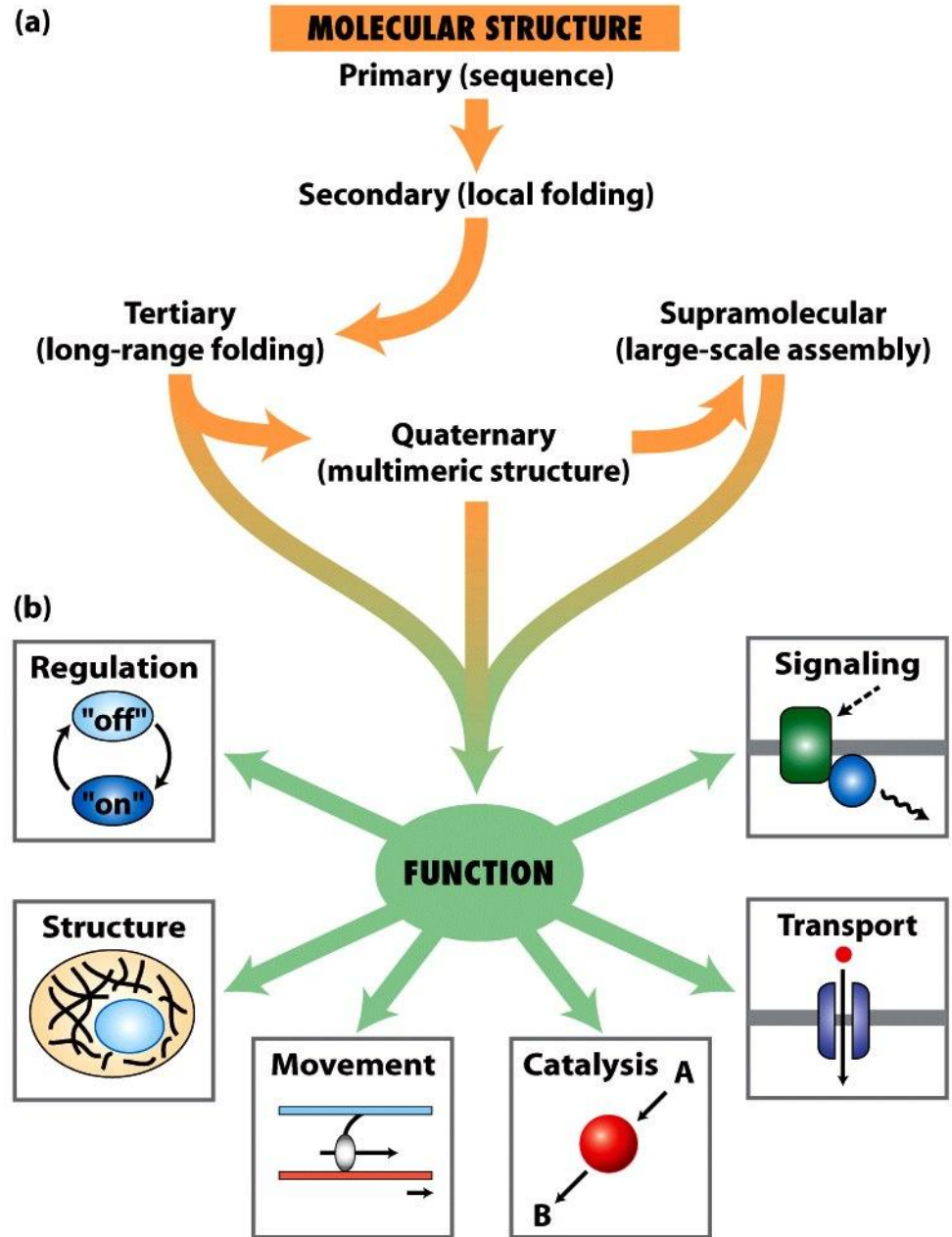
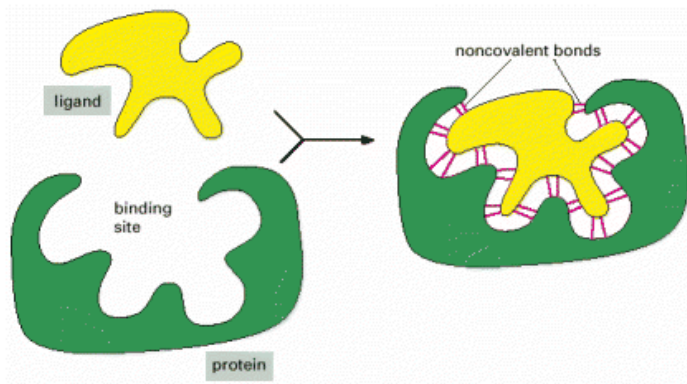


Figure 3-1
Molecular Cell Biology, Sixth Edition
 © 2008 W. H. Freeman and Company

Ligands

- Specific ligand binding makes function

Specificity



Affinity

Binding Reaction:



Dissociation Constant:

$$K_d = [P][L] / [PL]$$

- Binding can induce conformational changes that lead to new 'abilities'

Dissociation Constant

- Tight:

$$K_d \leq 10^{-9} \text{ M}$$

- Moderate

$$K_d \approx 10^{-6} \text{ M}$$

- Weak:

$$K_d \geq 10^{-3} \text{ M}$$

- Biotin-Avidin:

$$K_d \geq 10^{-15} \text{ M!}$$

- Example

- Consider a cell having
 - 10^3 molecules of protein P
 - 10^3 molecules of ligand L
 - 1.66×10^{-12} L volume
- If $K_d = 10^{-9}$ M, then at eq.
 - 270 molecules of P
 - 270 molecules of L
 - 730 molecules of PL
- If $K_d = 10^{-8}$ M,
 - 915 molecules of P
 - 915 molecules of L
 - 85 molecules of PL

Enzymatic Function

- Enzymes – catalyze the rate of reactions inside a cell
- Substrates – ligands for enzymes that become the products of the reaction

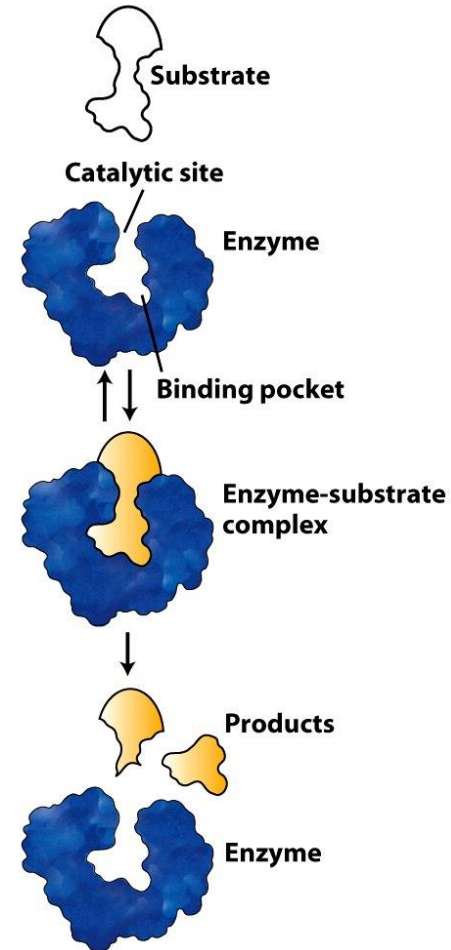
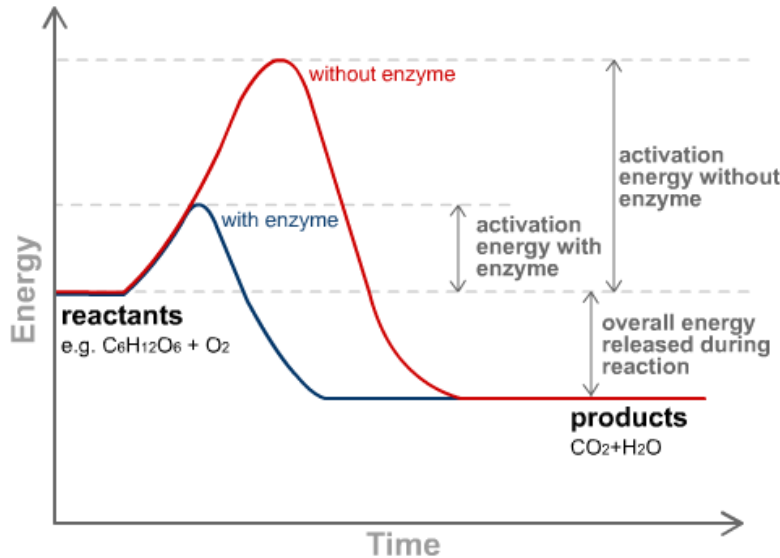


Figure 3-23
Molecular Cell Biology, Sixth Edition
 © 2008 W. H. Freeman and Company

Structure

- Cytoskeleton – actin, microtubules, intermediate filaments, cadherins, integrins, and others
- Extracellular matrix – collagen, elastin, laminin, fibronectin, and others

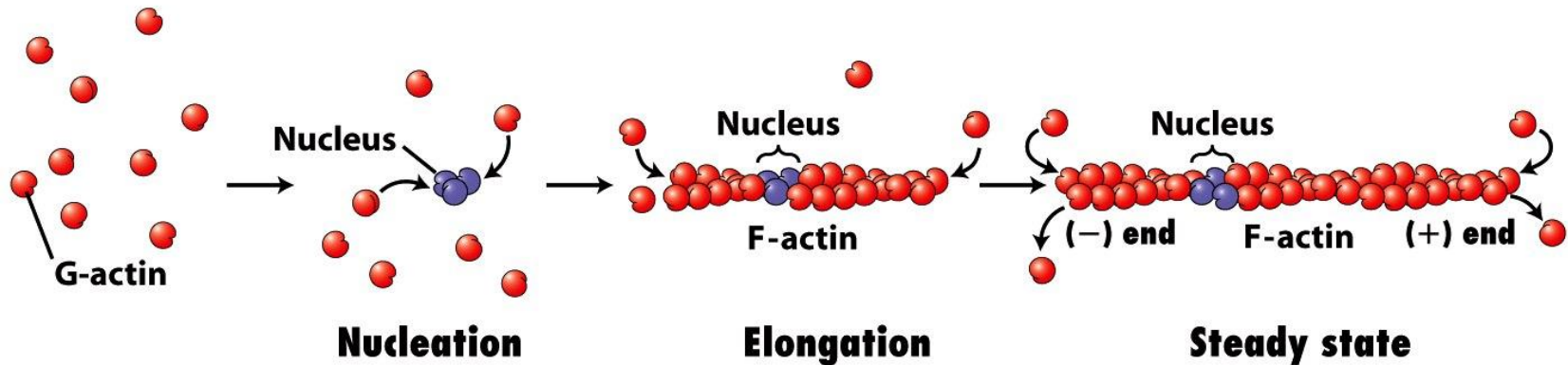
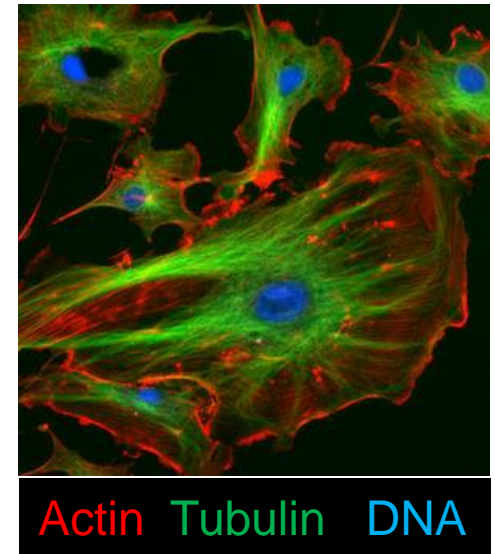


Figure 17-7a
Molecular Cell Biology, Sixth Edition
 © 2008 W. H. Freeman and Company

Signaling

- Signaling Proteins – molecules and receptors
- Membrane receptor joins with co-receptor to initiate a signal cascade inside the cell

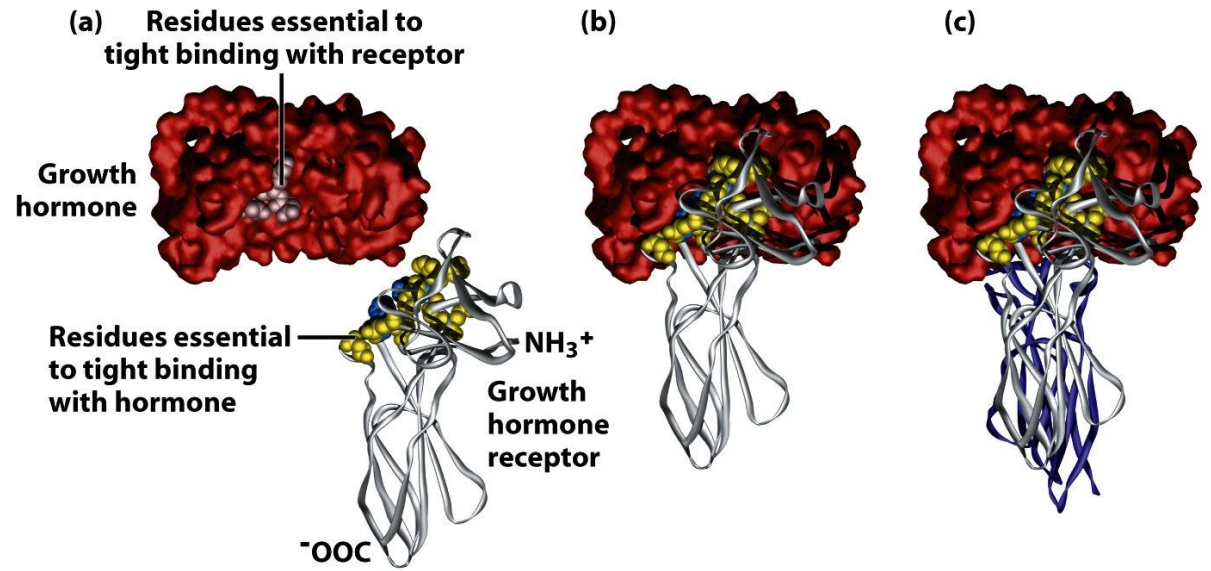
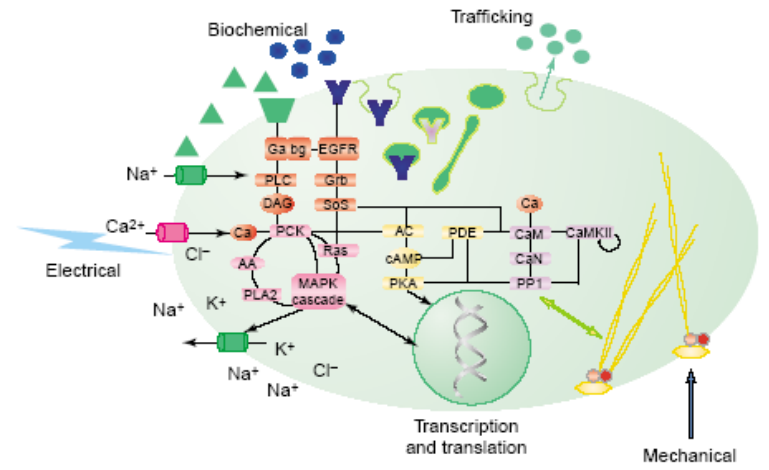


Figure 15-3
 Molecular Cell Biology, Sixth Edition
 © 2008 W. H. Freeman and Company

Co-receptor (blue)

Regulation

- Regulatory Proteins – kinases, phosphatases, GTPases, etc. interpret a receptor signal for gene expression or cell function
- RasGTP has allosteric change in conformation
- Dissociation of GTP to GDP is an “egg timer”

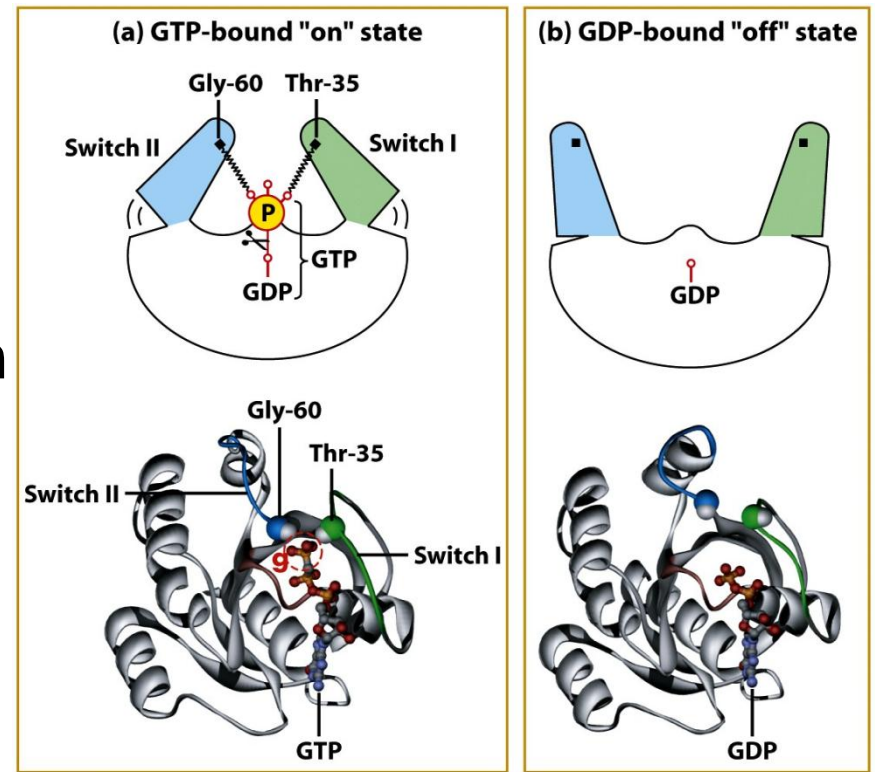
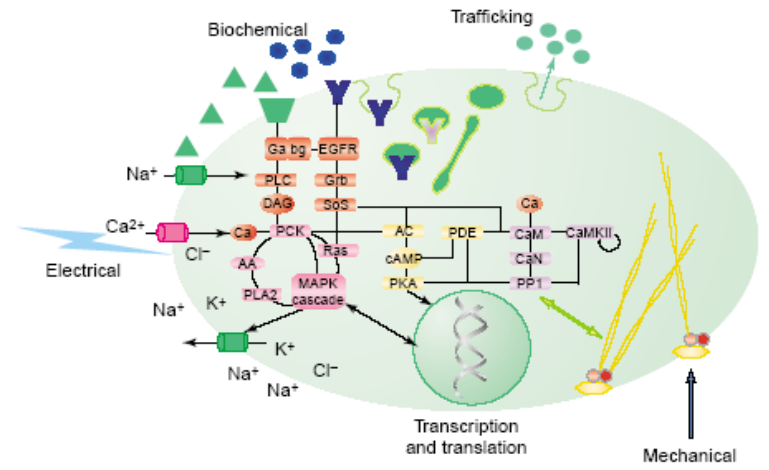


Figure 15-8
Molecular Cell Biology, Sixth Edition
© 2008 W.H. Freeman and Company

Transport

- Membrane transport proteins – control the transport of ions and small molecules across membranes

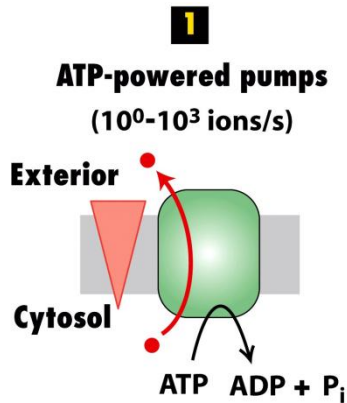
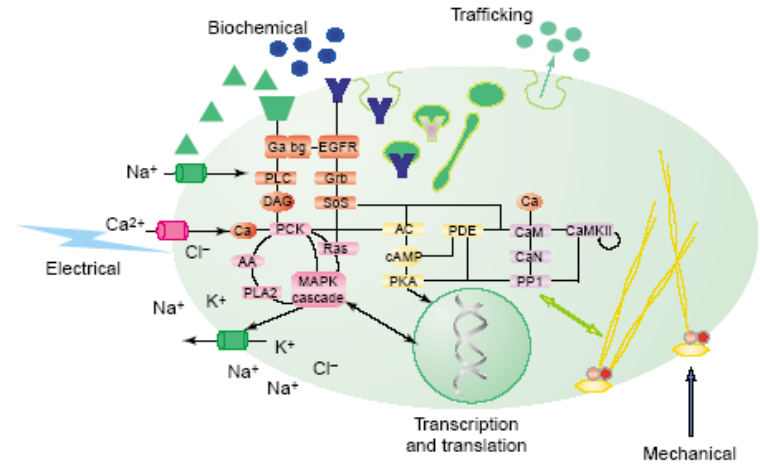


Figure 11-3 part 1
Molecular Cell Biology, Sixth Edition
© 2008 W. H. Freeman and Company

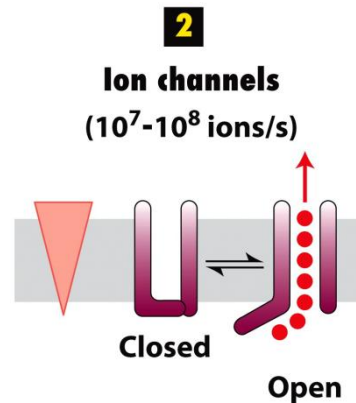


Figure 11-3 part 2
Molecular Cell Biology, Sixth Edition
© 2008 W. H. Freeman and Company

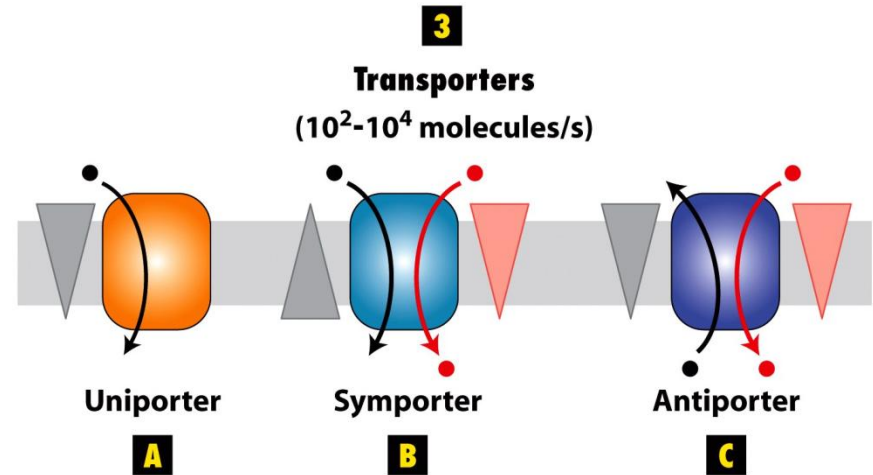
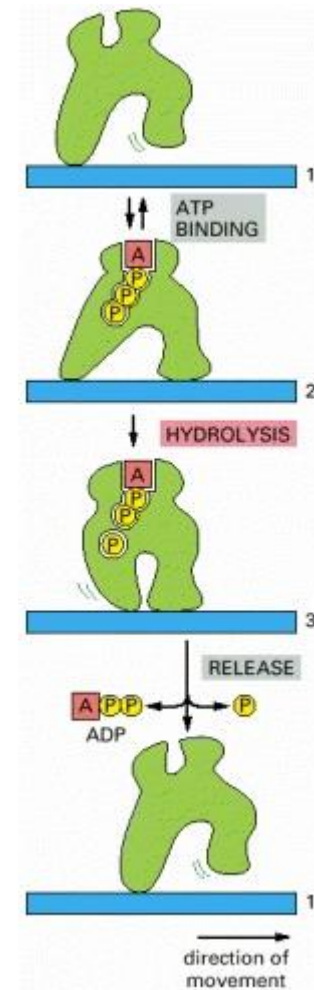


Figure 11-3 part 3
Molecular Cell Biology, Sixth Edition
© 2008 W. H. Freeman and Company

Motor Proteins

- Allosteric motor protein
- Transition between three conformations allows stepping motion
- Regulated by
 - ATP binding
 - Hydrolysis of ATP to ADP
 - ADP unbinding



Questions ?