

ME 411 / ME 511

Biological Frameworks for Engineers

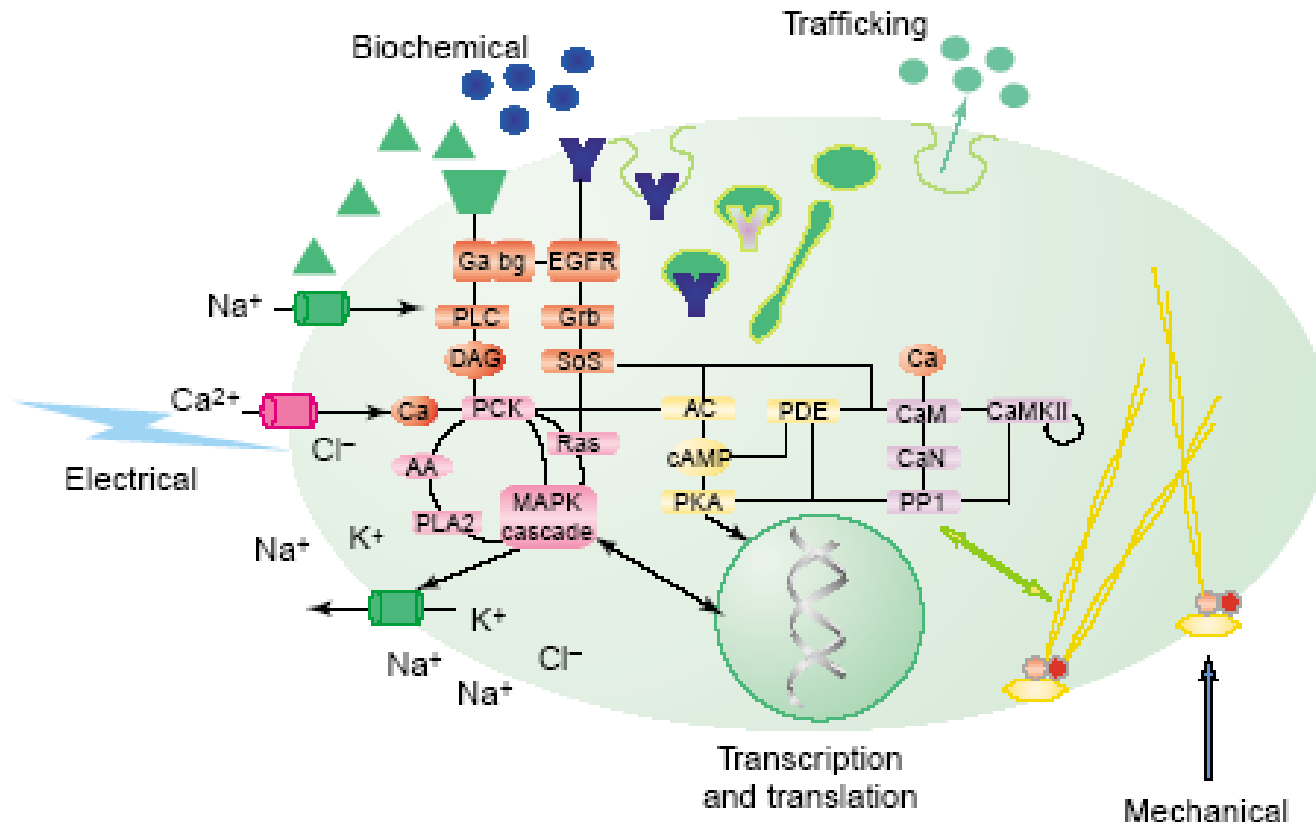
Class Organization

- Exam 1
 - Take-home (honor code)
 - Due Wed 10/31/12

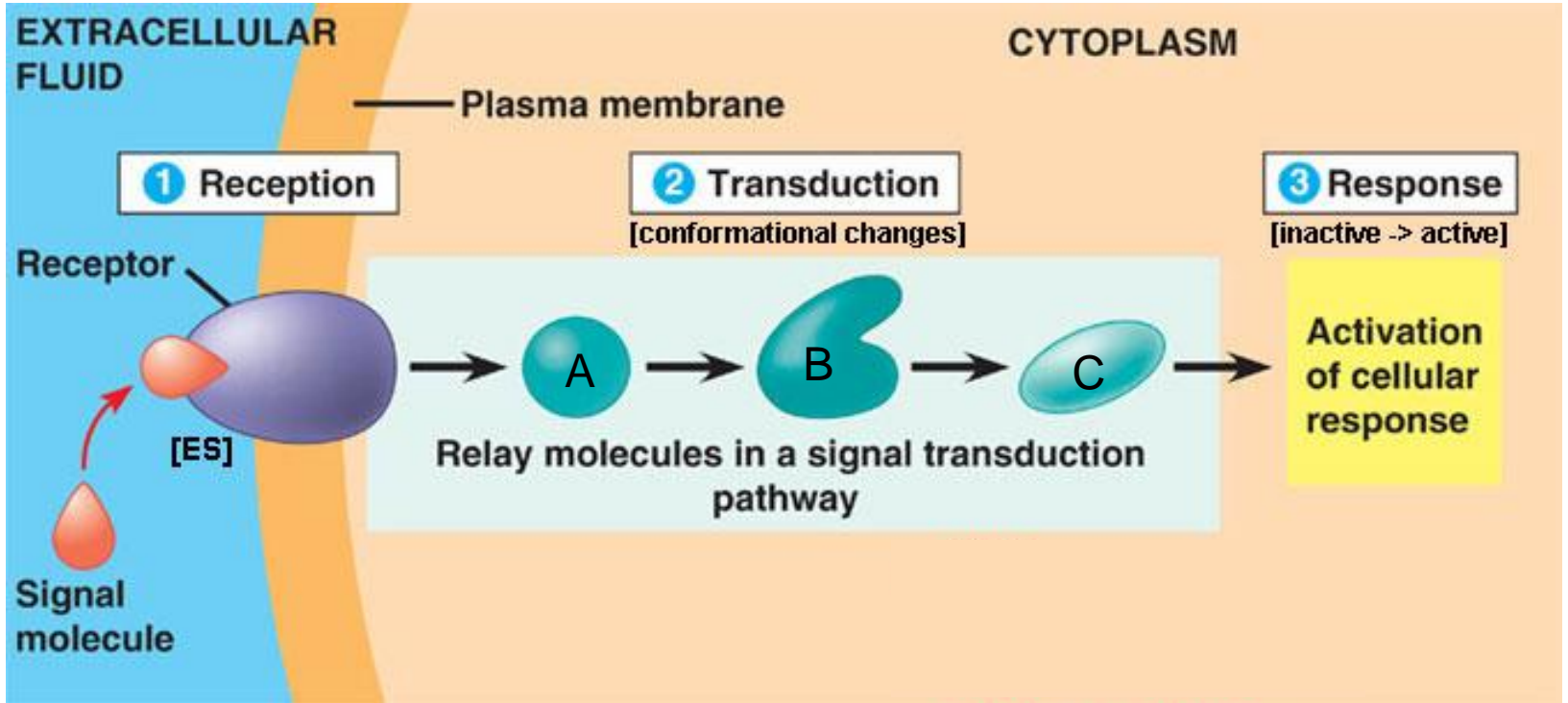
ME 411 / ME 511

Cell Signaling

Cell Signaling



Cell Signaling



Signal Logic

Latent gene regulators activate at cell surface and initiate transcription

Scaffolds cluster proteins together

Relays simply pass along a signal

Adaptors transmit signal between two others

Bifurcators involve multiple pathways

Amplifiers enhance a signal strength

Transducers covert signal to other forms

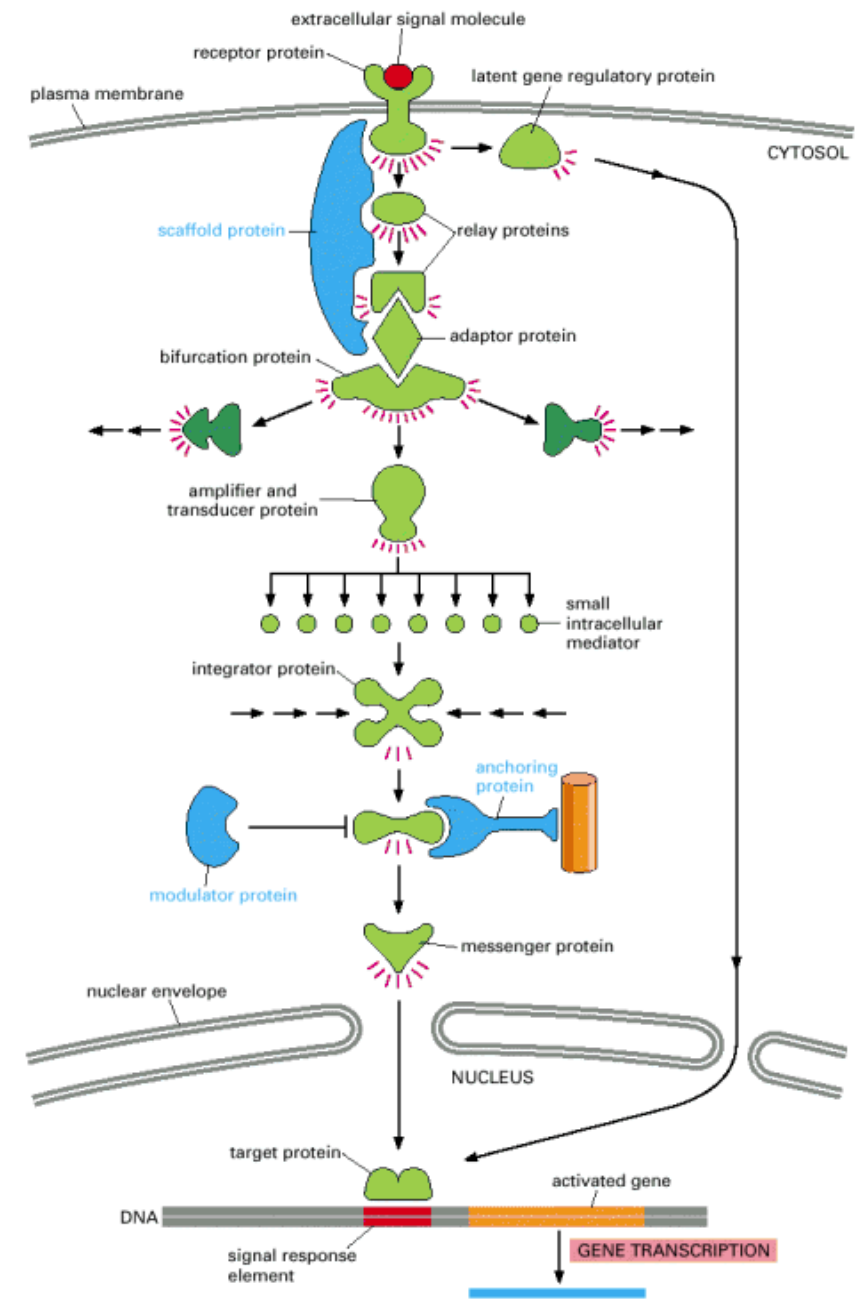
Small intracellular molecules promote rapid signal transport

Integrators cross-reference different signaling pathways

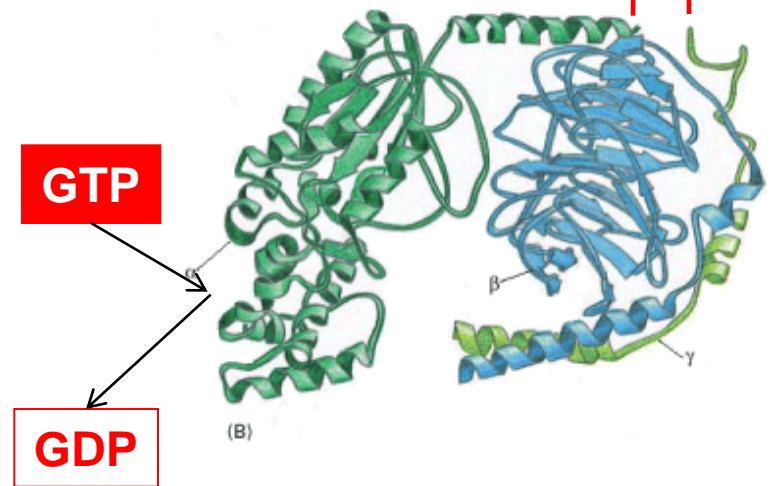
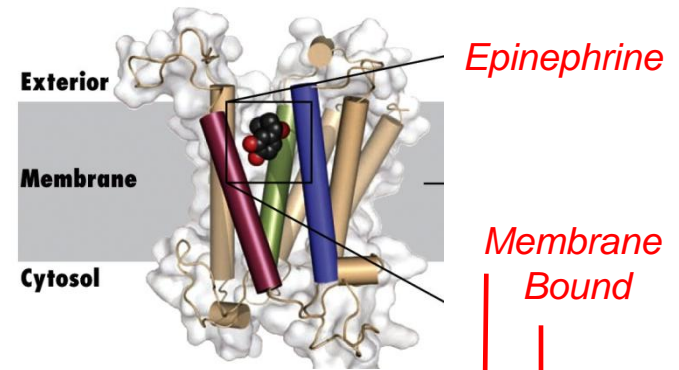
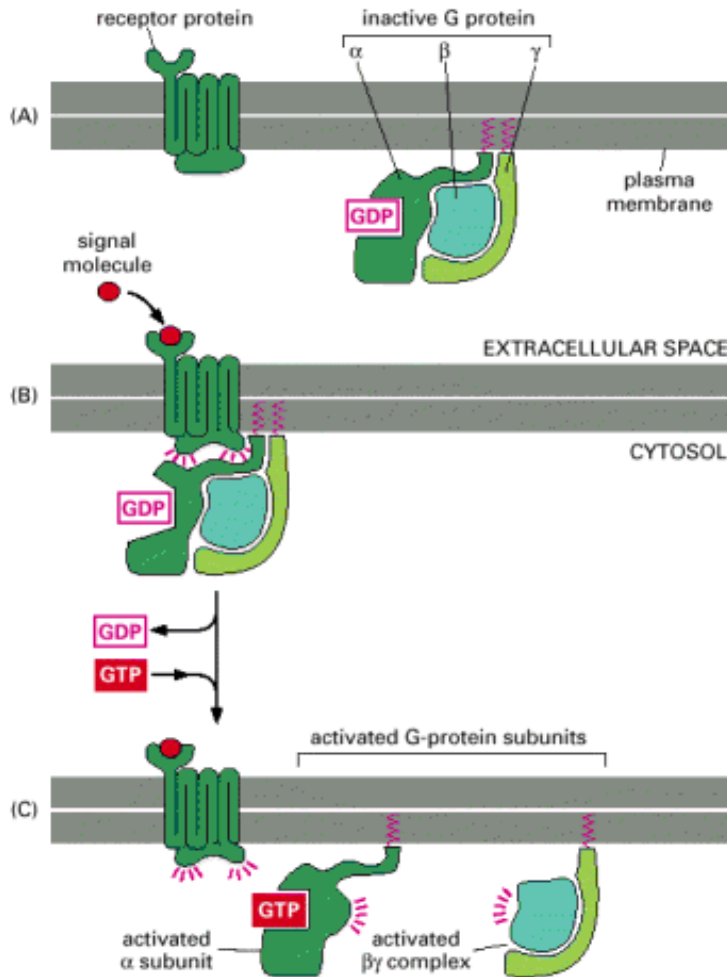
Modulators enhance signaling activity

Anchors localize proteins at key sites

Messengers carry signal into nucleus



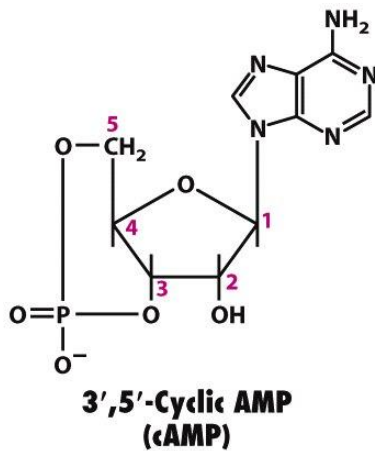
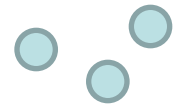
G-Protein Linked Receptors



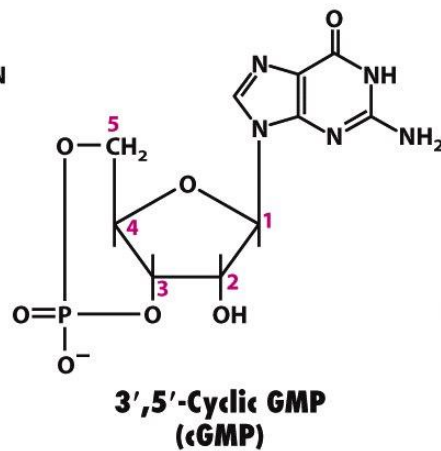
Secondary Messengers

- Carries signal by change in concentration

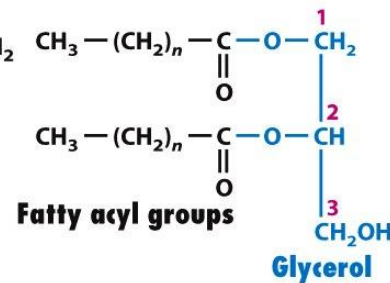
Ca²⁺ ions



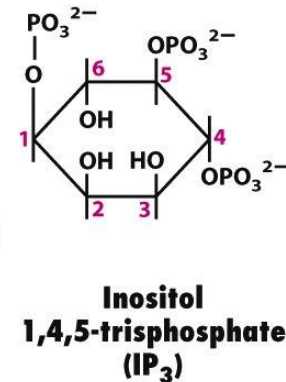
Activates protein kinase A (PKA)



Activates protein kinase G (PKG) and opens cation channels in rod cells



Activates protein kinase C (PKC)

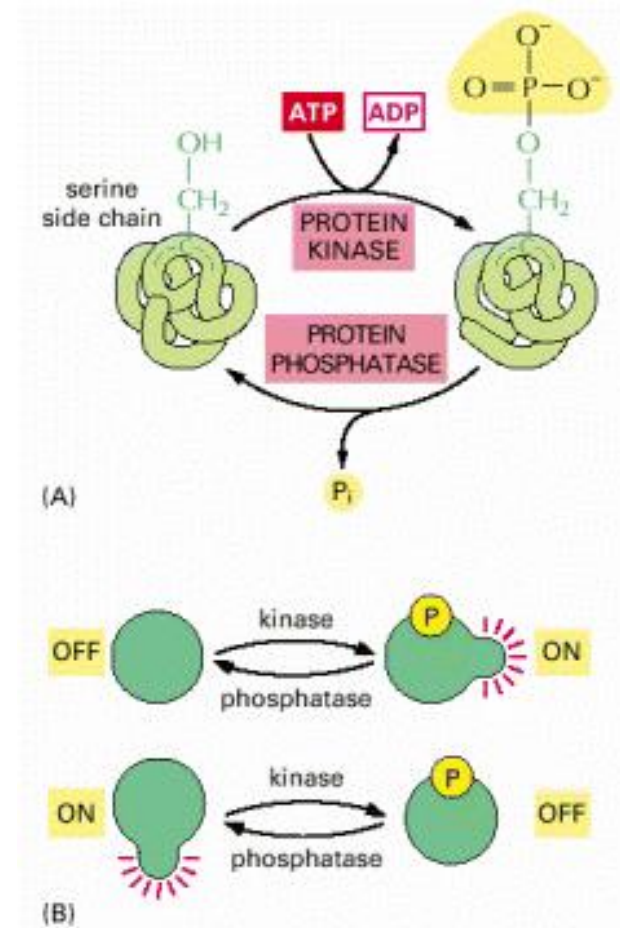


Opens Ca²⁺ channels in the endoplasmic reticulum

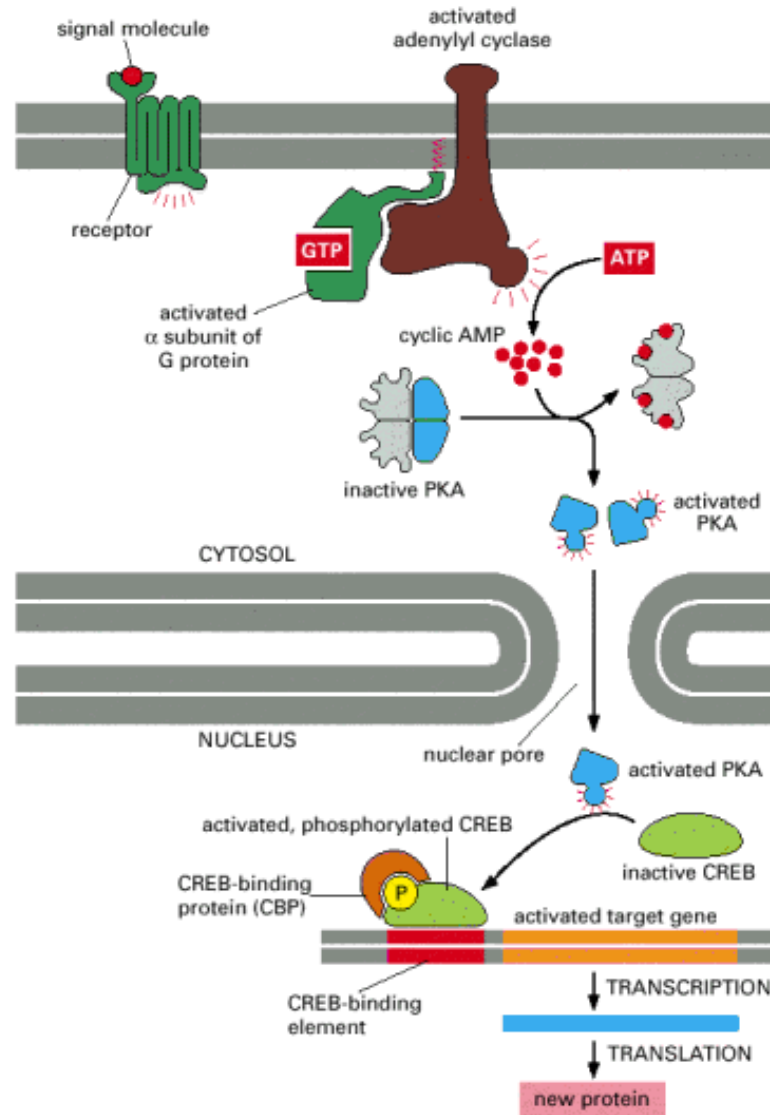
Figure 15-9
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Phosphorylation

- Kinase:
 - attachment of phosphate group from ATP
 - binds to $-OH$ amino acid on Serine (S), Threonine (T) or Tyrosine (Y)
- Phosphatase:
 - removal of (P)
- Conformational Switch
 - Off \rightarrow On or On \rightarrow Off



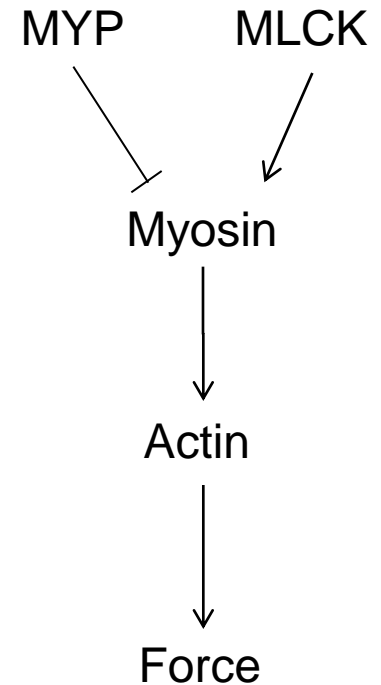
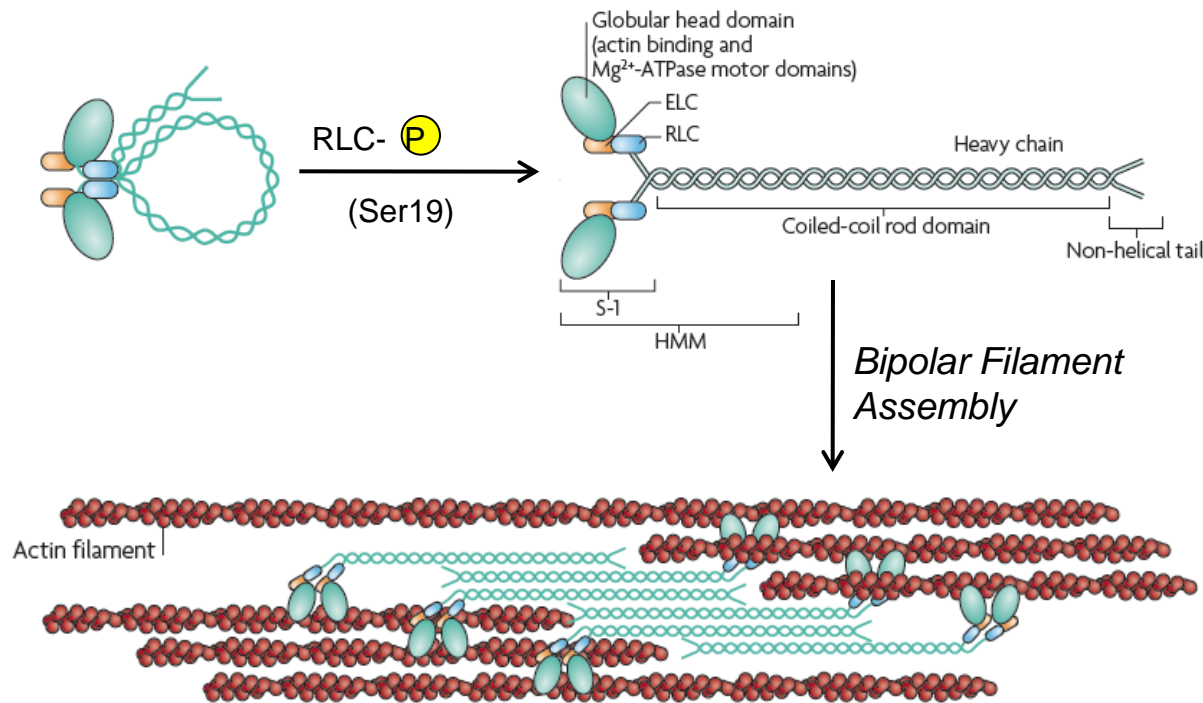
Gene Transcription



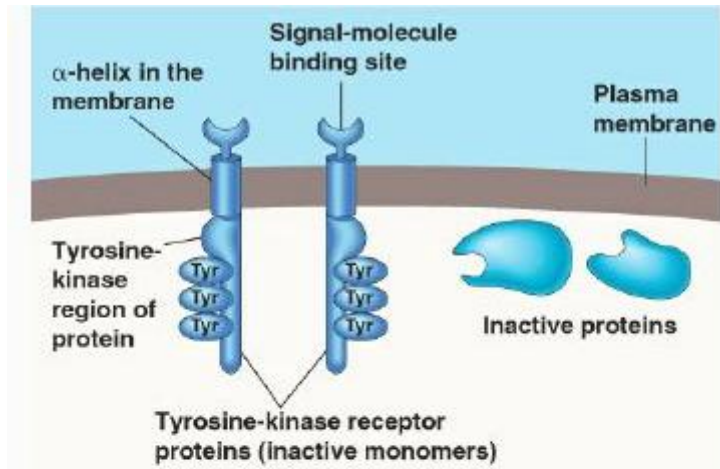
Nonmuscle Myosin Activation

Phosphorylation needed for contractile filament assembly

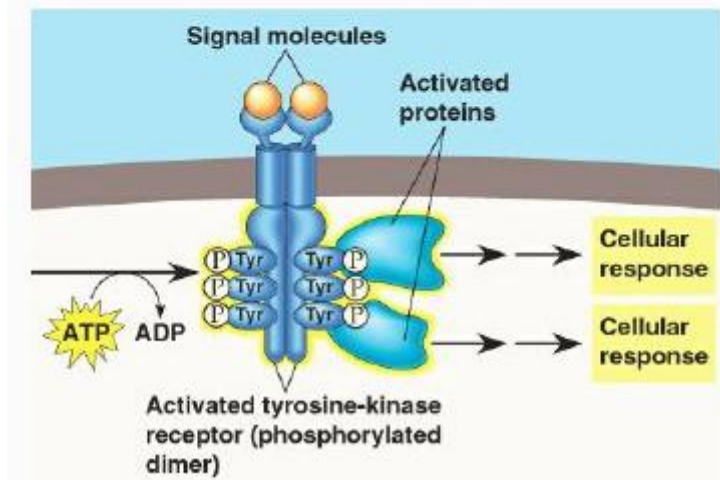
(10S) Folded, Blocked State (6S) Unfolded, Activated State



Receptor Tyrosine Kinase



(a) Inactive tyrosine-kinase receptor system



(b) Activated system

Epidermal Growth Factor Receptor Activates Ras

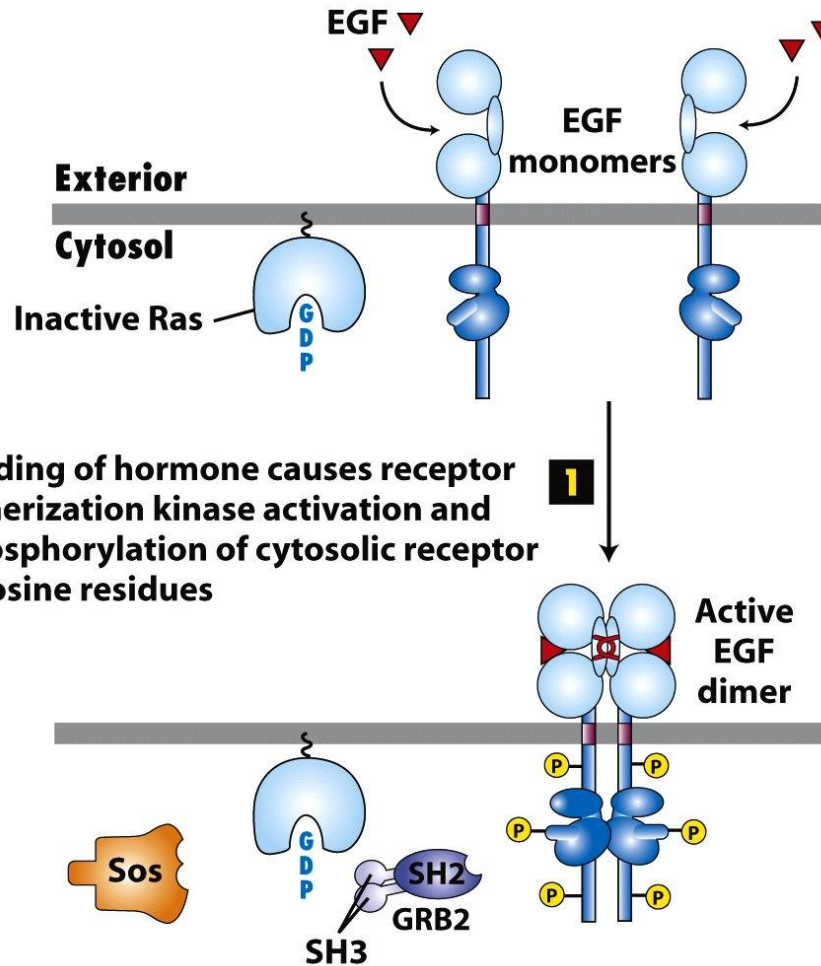


Figure 16-20 part 1
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EGFR-P → GRB2-SOS-Ras

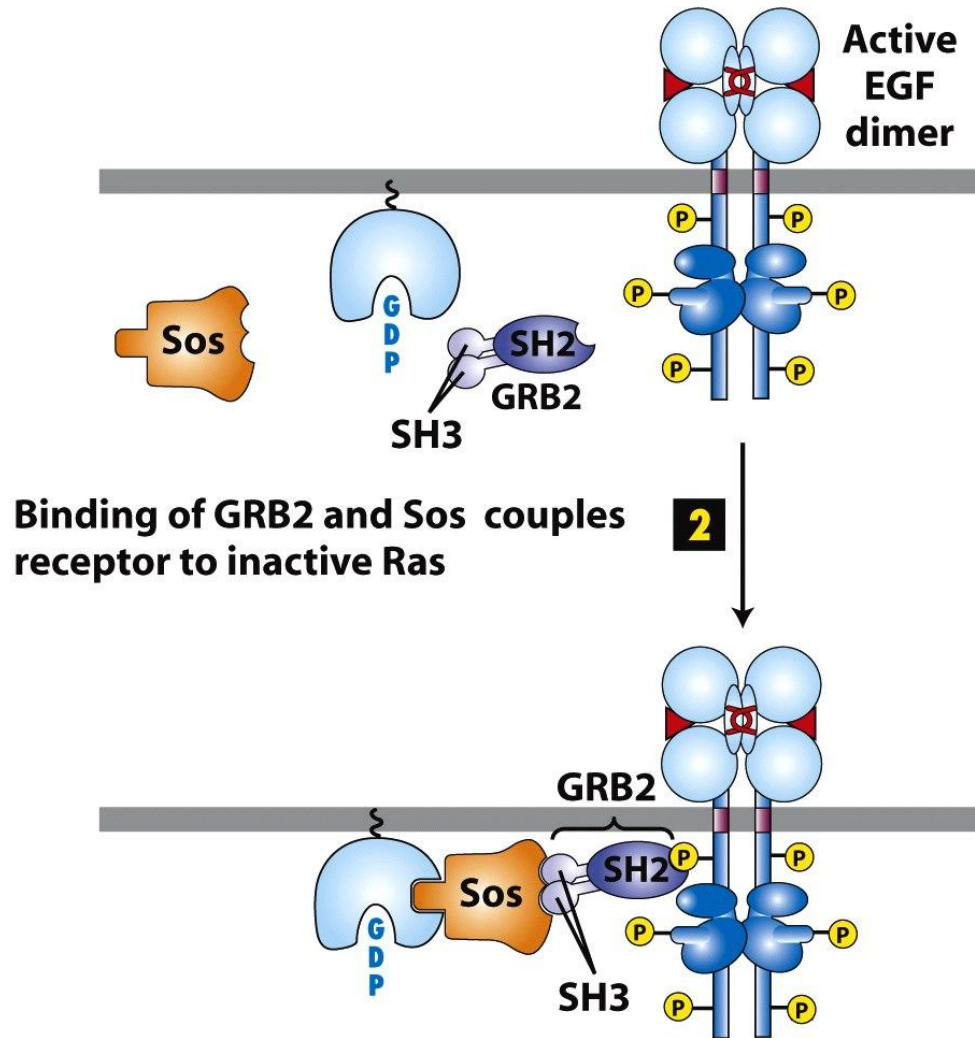


Figure 16-20 part 2
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SOS → Active Ras

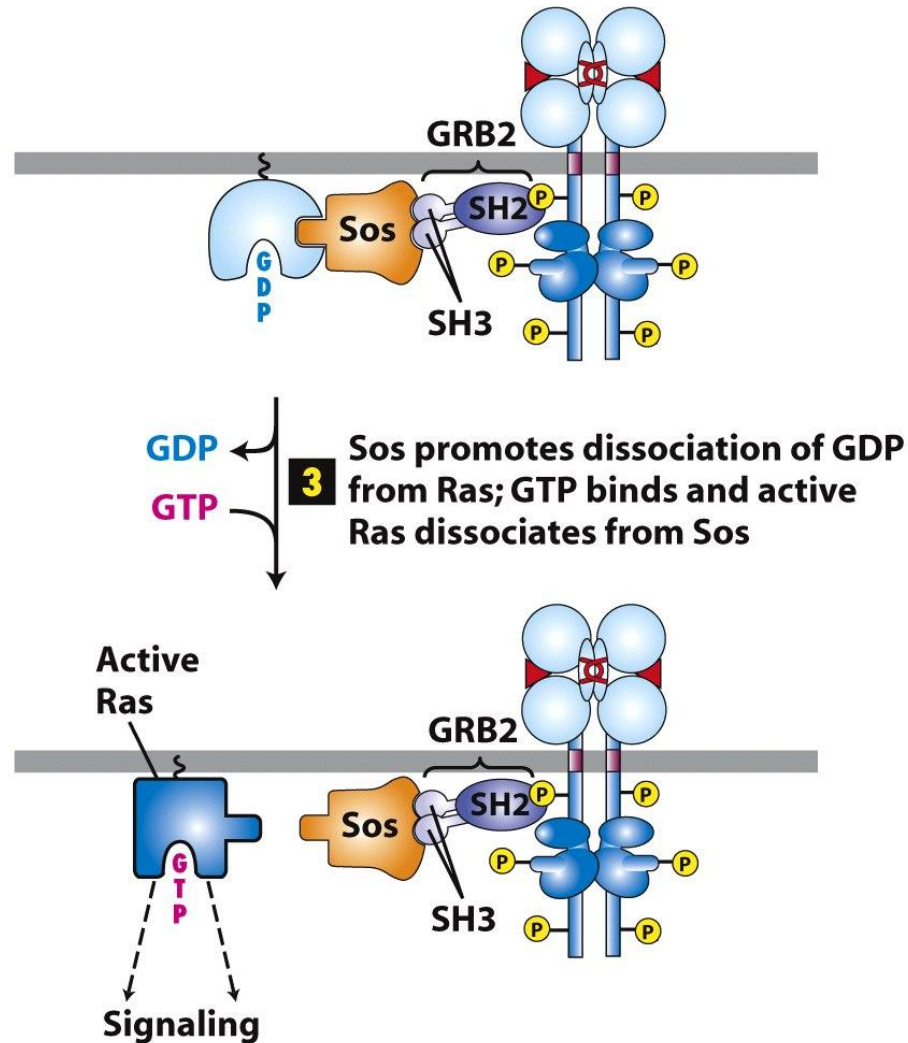
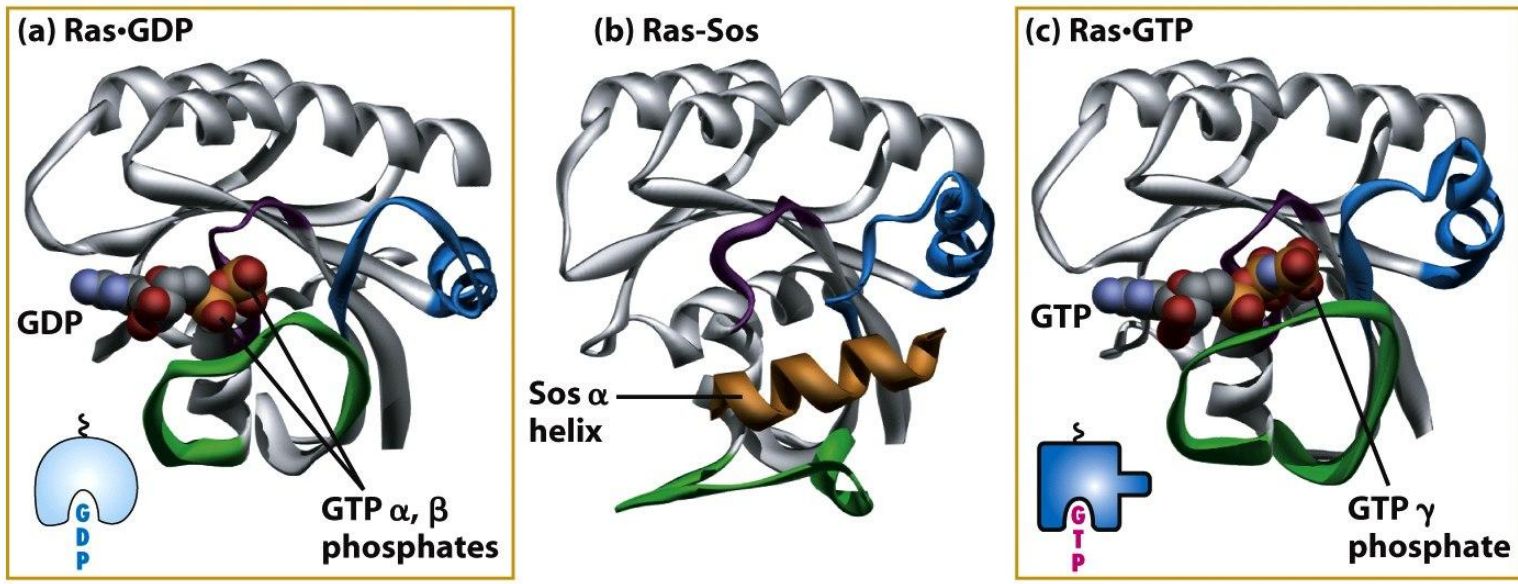


Figure 16-20 part 3
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How does Sos Work?



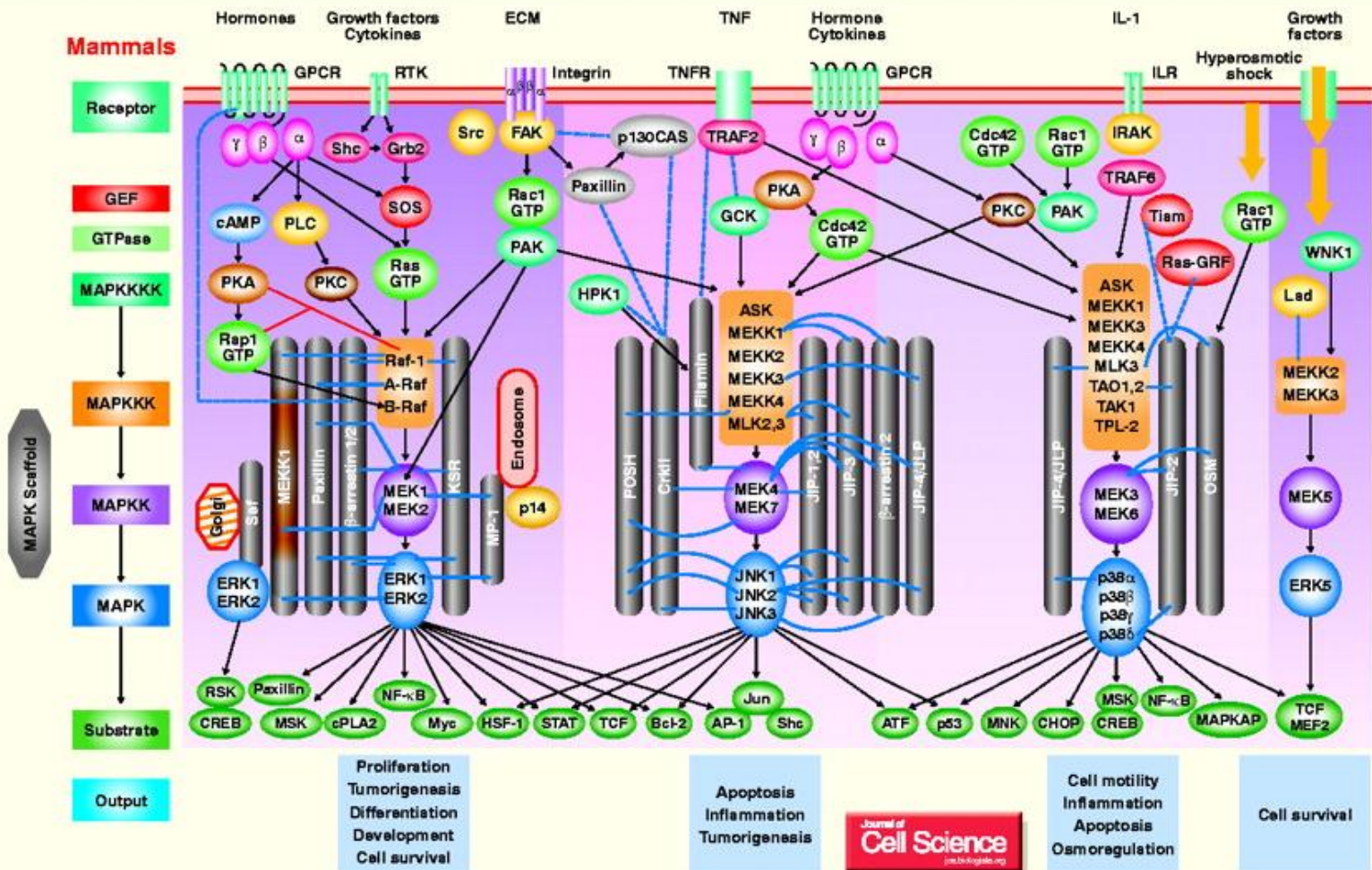
Switch I
Switch II

Figure 16-24
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Signaling Pathways

MAP Kinase Pathways

Maosong Qi and Elaine A. Elion



Questions?