

Chemical Biology 03
Oct 30, 2009

Cell Communication
and Signals

A cell's behavior is constantly regulated by extracellular signals:

Signals:
from environment
or from other cells

proteins
peptides
amino acids
nucleotides
steroids
fatty acid derivatives
dissolved gases

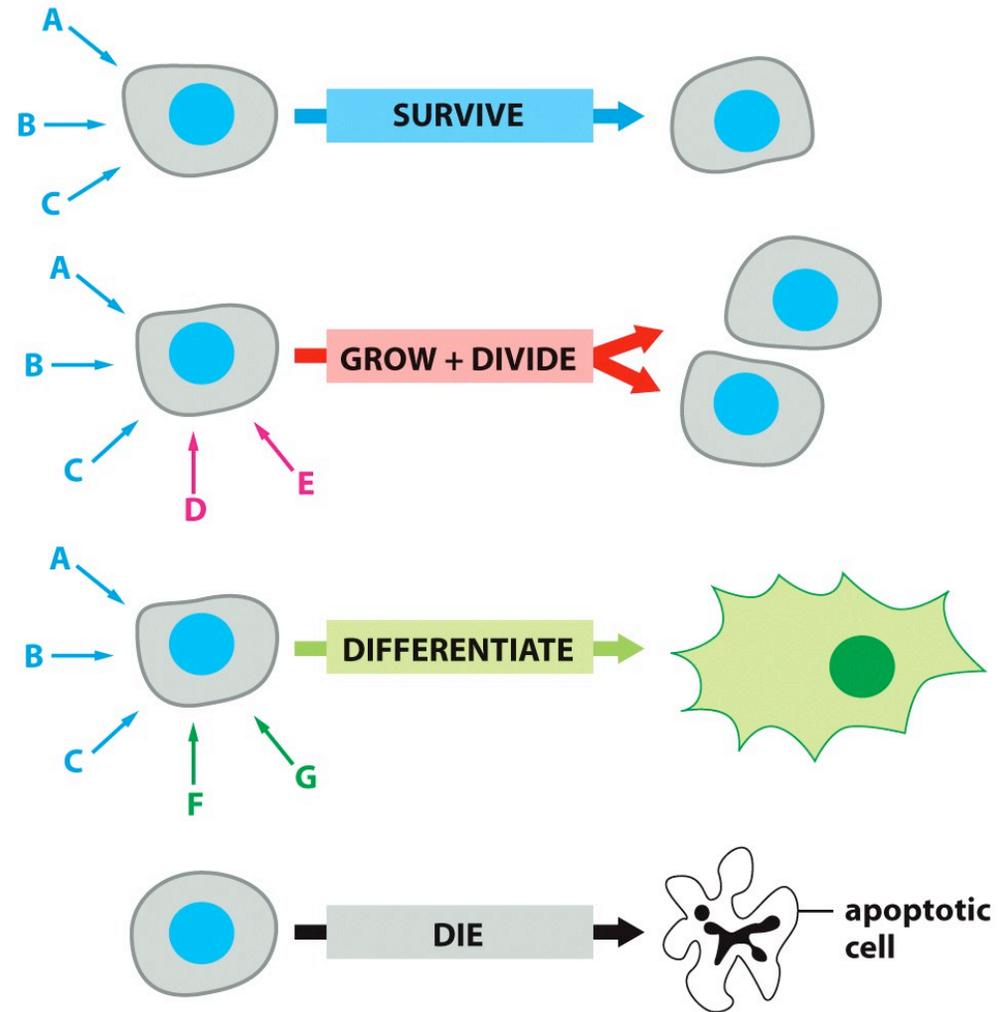
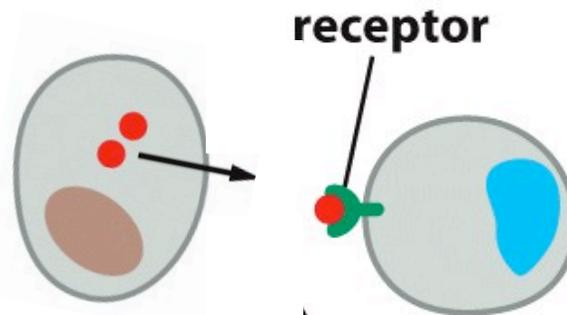


Figure 16-6 Essential Cell Biology 3/e (© Garland Science 2010)

Signaling from cell to cell = Cell Communication

Signaling Cell delivers signal
Receiving Cell responds to signal

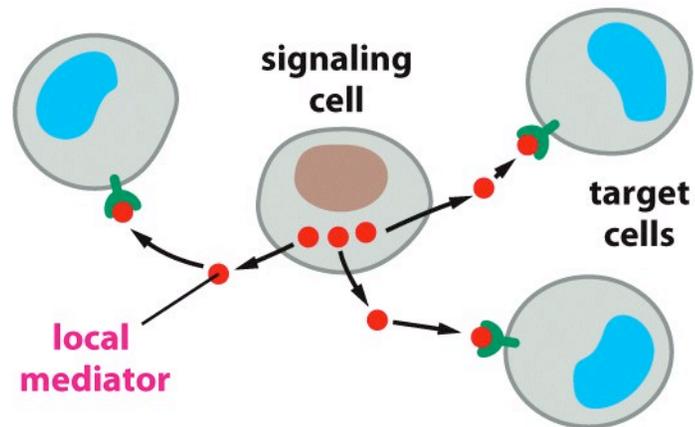


Receptor protein specifically
recognizes signal

4 different ways in which cell signals can be delivered:

1) Paracrine Signaling

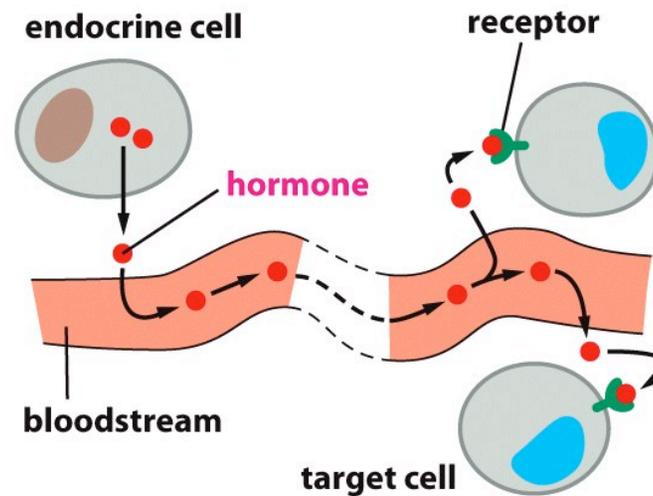
signal diffuses through extracellular fluid/matrix



4 different ways in which cell signals can be delivered:

2) Endocrine Signaling

signal travels through blood system to reach distant target cells



examples:

pancreatic endocrine cells secrete **insulin**

travels through blood: affects muscle cells, liver cells, etc.

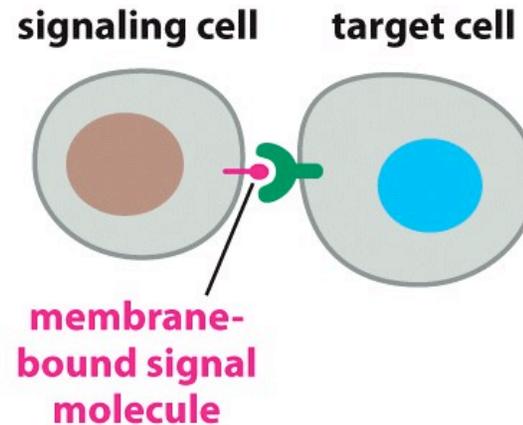
kidney cells secrete **erythropoietin**: affects bone marrow

testes and ovaries secrete **steroid hormones**: affect many different cells throughout the body

4 different ways in which cell signals can be delivered:

3) Contact-Dependent Signaling

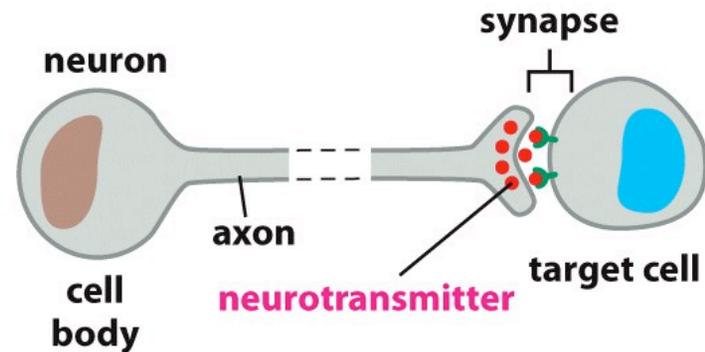
signal is not secreted; presented on surface of signaling cell, anchored in membrane



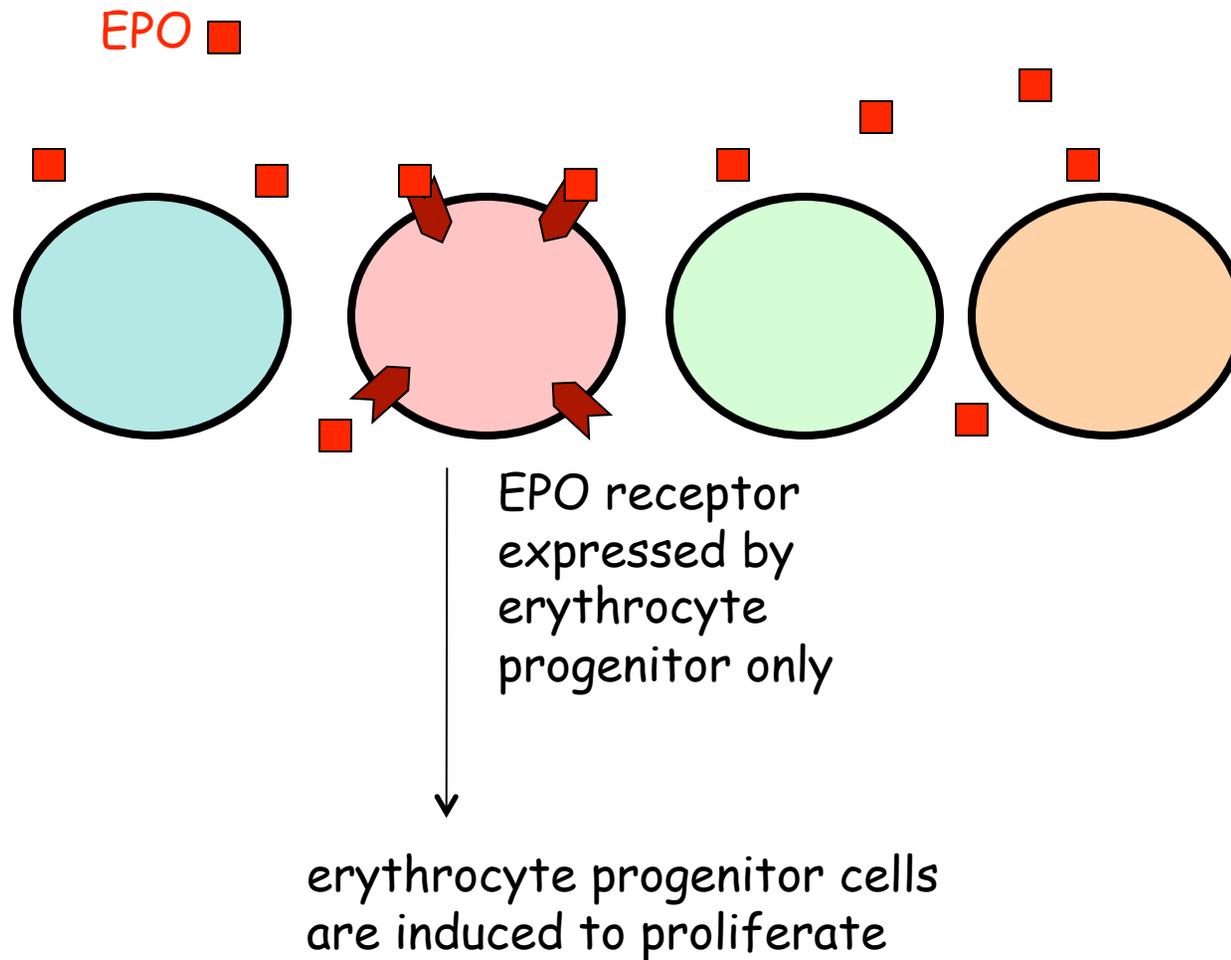
4 different ways in which cell signals can be delivered:

4) Neuronal Signaling

electrical pulse travels very quickly down long axons to stimulate release of extracellular signal

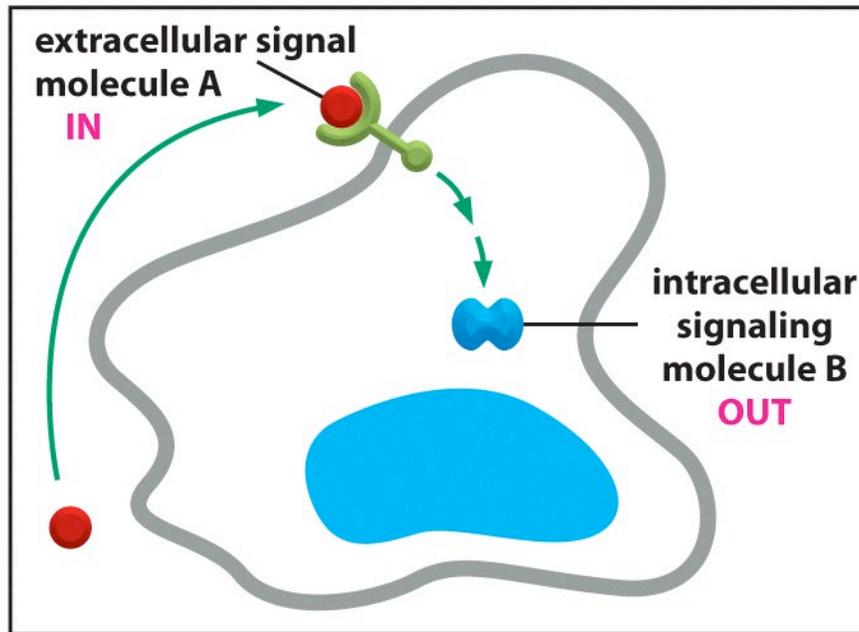


Cell-surface receptor proteins play a critical role in identifying target cells



Signal Transduction:

extracellular signal is converted into an intracellular signal
= cell's response to the signal

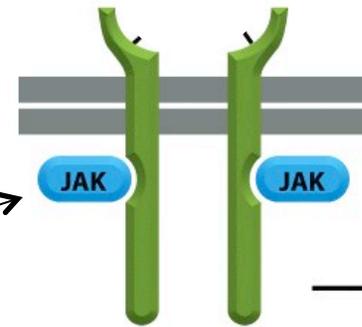


Signal Transduction example: EPO hormone

Players:

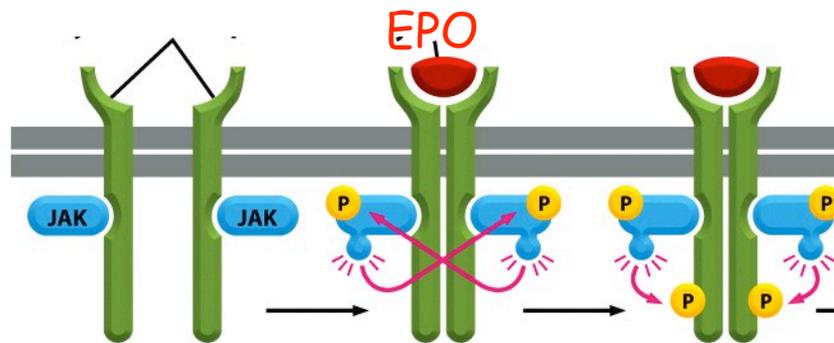
EPO (erythropoietin) protein hormone

EPO receptor (spans cell membrane)



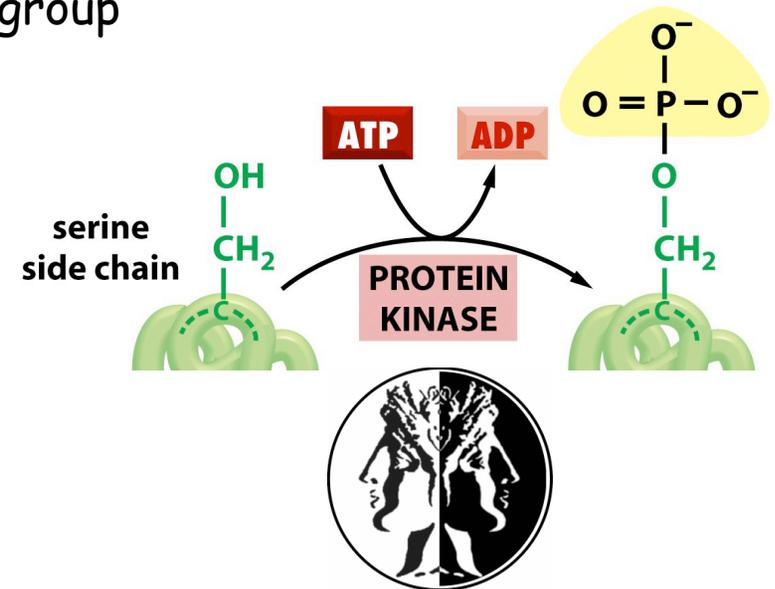
JAK protein (Janus Kinase)

("kinase" = enzyme that can add a phosphate group to amino acids tyr, ser, or thr)



BINDING OF CYTOKINE
CROSS-LINKS ADJACENT
RECEPTORS, AND JAKs
CROSS-PHOSPHORYLATE
EACH OTHER ON TYROSINES

ACTIVATED JAKs
PHOSPHORYLATE
RECEPTORS ON
TYROSINES

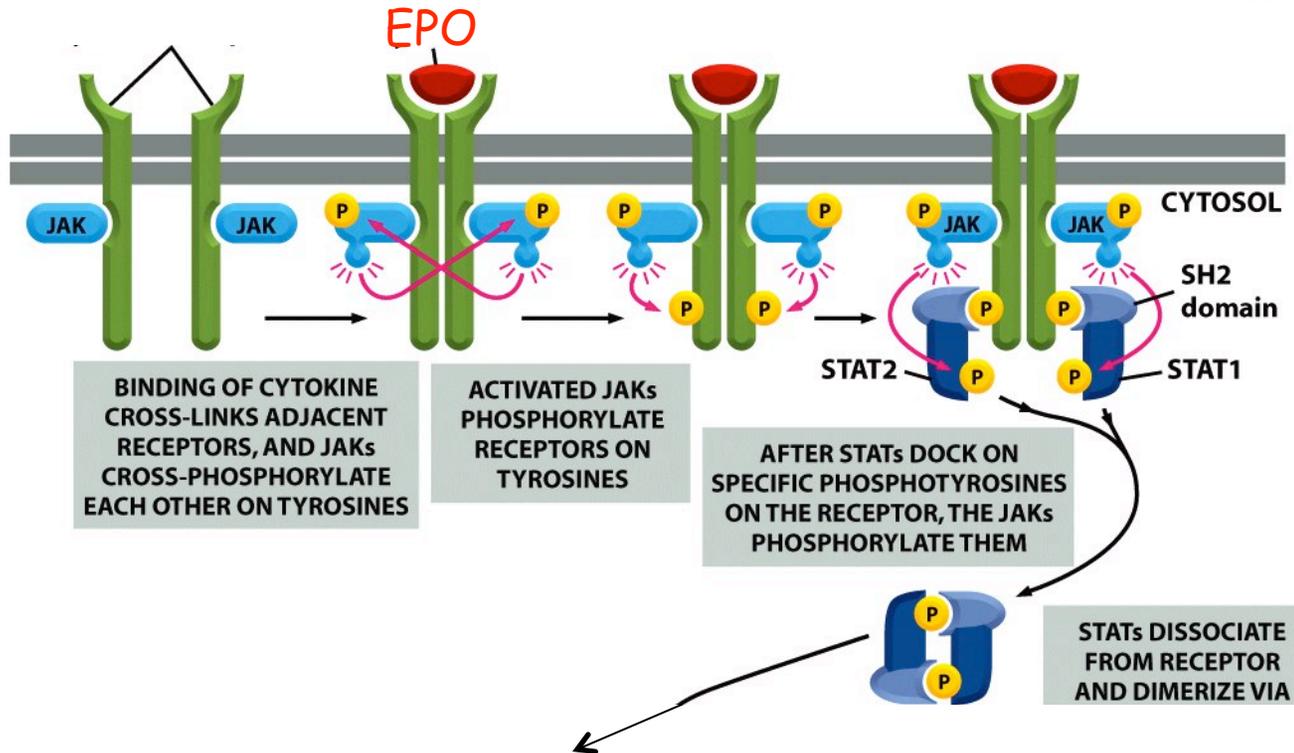


Signal Transduction example: EPO hormone

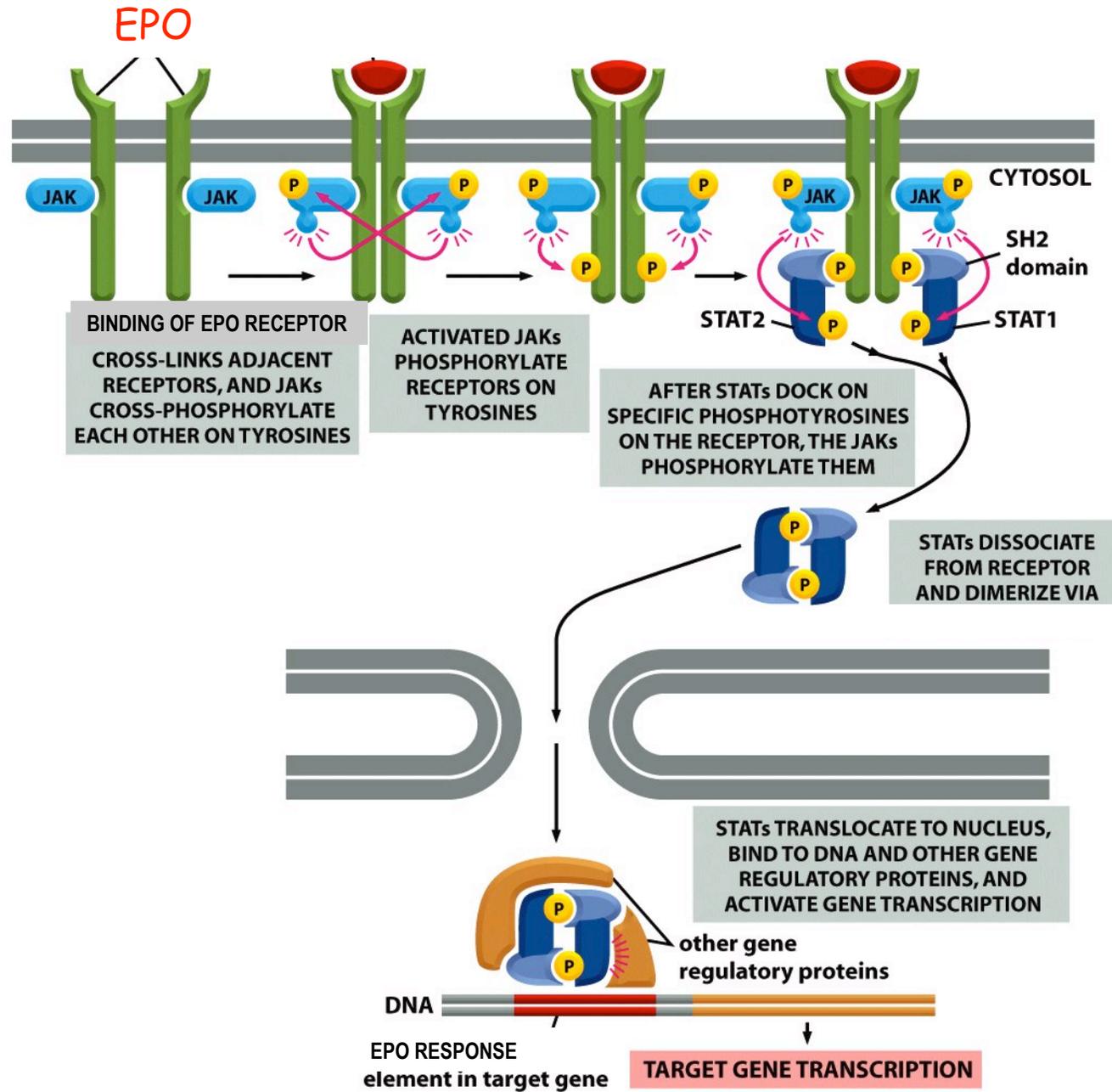
Another Player:
Transcriptional Regulator called "STAT"
(Signal Transducer and Activator of Transcription)



- inactive until:
- 1)phosphorylated
 - 2)dimerizes
 - 3)moves to nucleus



free to enter nucleus, and...



Jak-Stat signal transduction pathways are used in many different incidences

always starts with an extracellular signal
and ends with transcriptional activation of specific group of target genes

SIGNAL PROTEIN	RECEPTOR-ASSOCIATED JAKs	STATS ACTIVATED	SOME RESPONSES
γ -interferon	JAK1 and JAK2	STAT1	activates macrophages
α -interferon	Tyk2 and JAK2	STAT1 and STAT2	increases cell resistance to viral infection
Erythropoietin	JAK2	STAT5	stimulates production of erythrocytes
Prolactin	JAK1 and JAK2	STAT5	stimulates milk production
Growth hormone	JAK2	STAT1 and STAT5	stimulates growth by inducing IGF1 production
GM-CSF	JAK2	STAT5	stimulates production of granulocytes and macrophages

Table 15-6 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Variety of cell responses; some fast, some slow

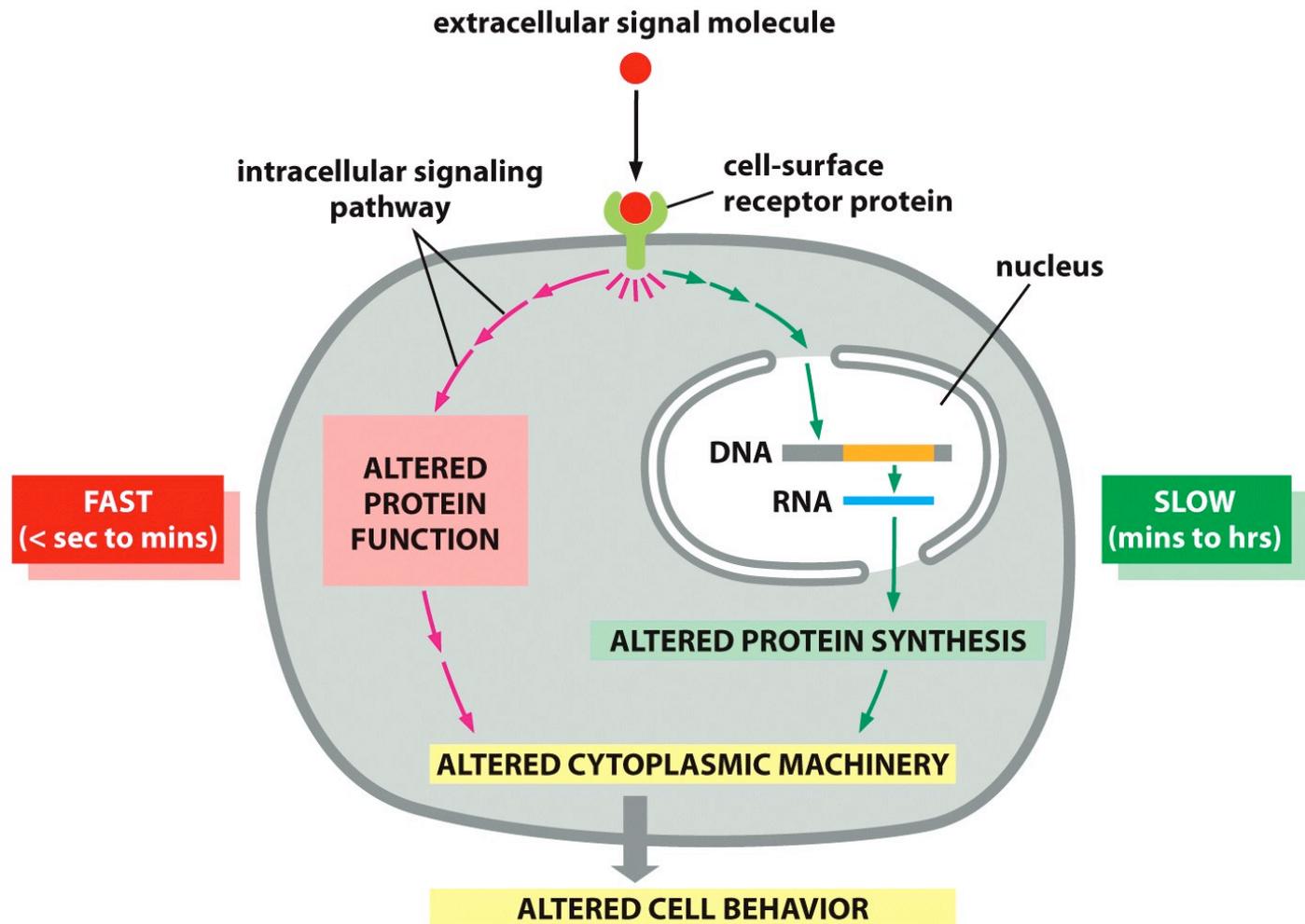


Figure 16-7 Essential Cell Biology 3/e (© Garland Science 2010)