

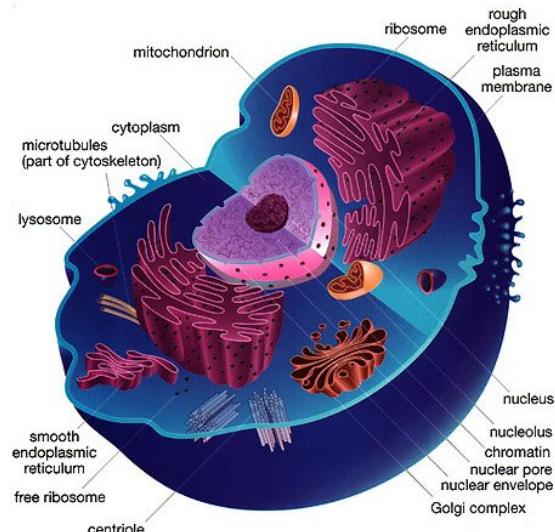
Cell Membrane & Principle of Cell Communication



Learning Objectives:

- Understand functions of the cell membrane
- Describe principles of membrane transport
- Understand electrical properties of the cell membrane and the role of ion channels and transporters
- Understand basic process of cell communication
- Understand how cell surface receptors relay signals
- Understand functional roles of intracellular signaling complex

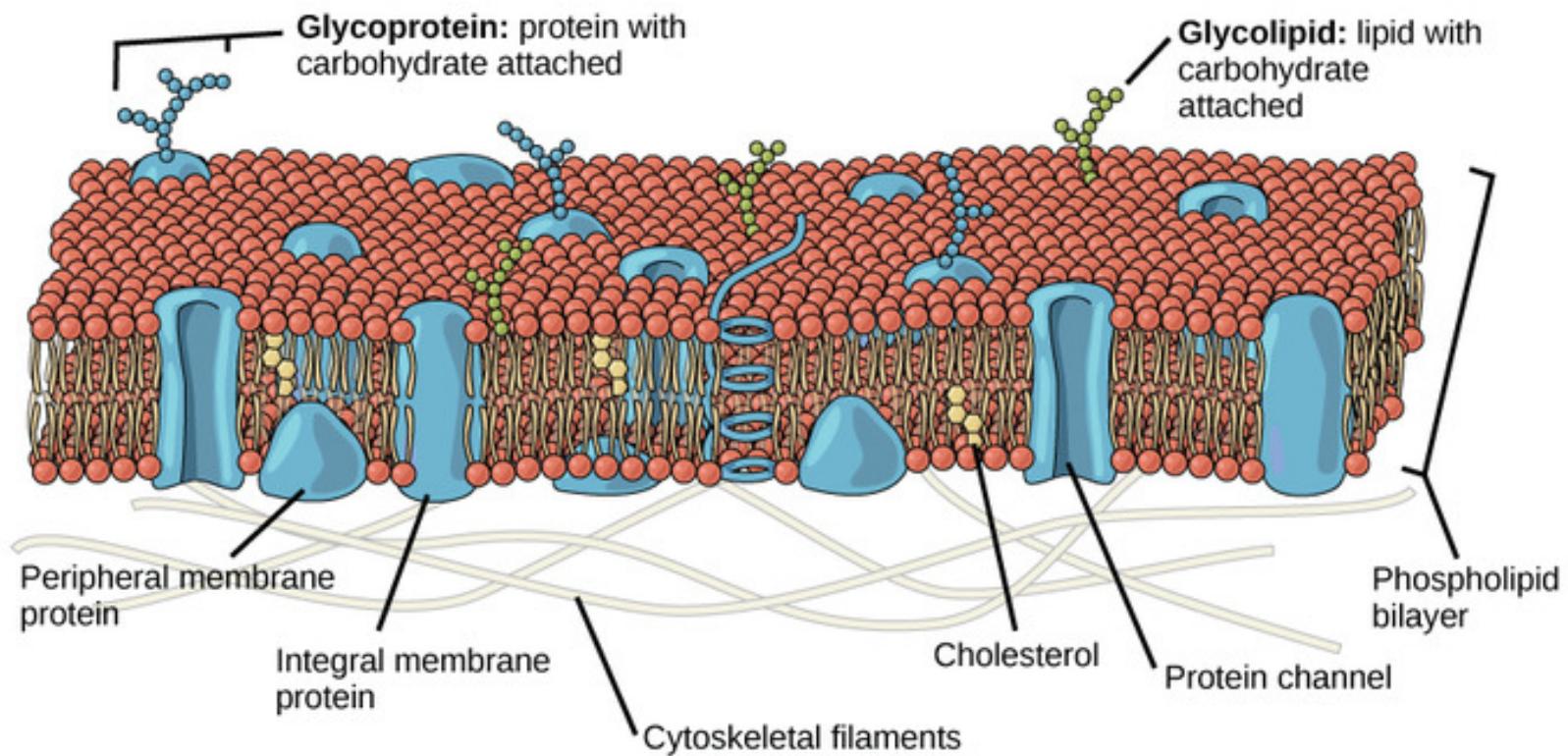
Cell Membrane: Compartmentalization



<https://amit1b.wordpress.com/the-molecules-of-life/10-the-living-cell-gallery/>

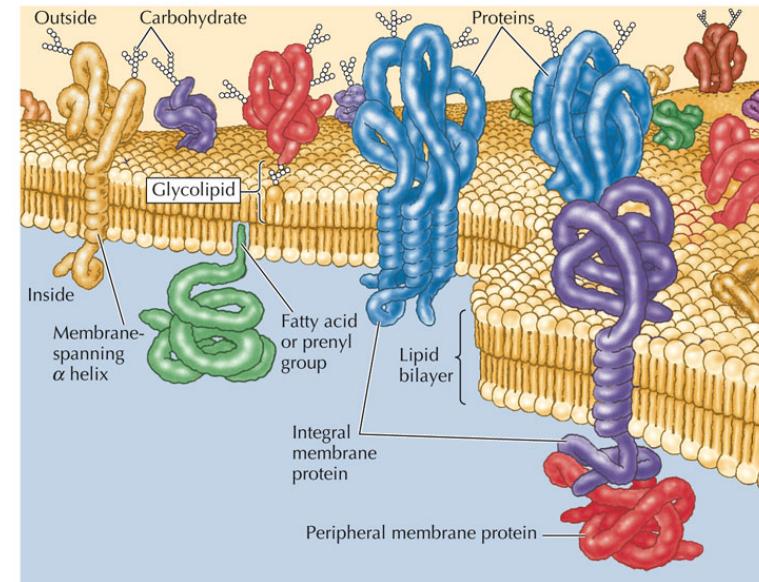
- Separates interior of cell from environment
- Defines the interior compartments of eukaryotic cells: organizes into functional districts, membrane-enclosed compartments, organelles.
- Provides membrane area for biochemical reactions and creates specialized liquid spaces within the cell

Structure of cell membrane



Membrane proteins

- Most integral membrane proteins are transmembrane proteins: Transmembrane domain
- Perform most of the membrane's specific tasks.
- Function as large complexes
- Functions: receptors, membrane transport, electron transport and oxidative phosphorylation, control the interaction between cells.



THE CELL, Fourth Edition, Figure 2.25 © 2006 ASM Press and Sinauer Associates, Inc.

Membrane proteins can be restricted to specific domains

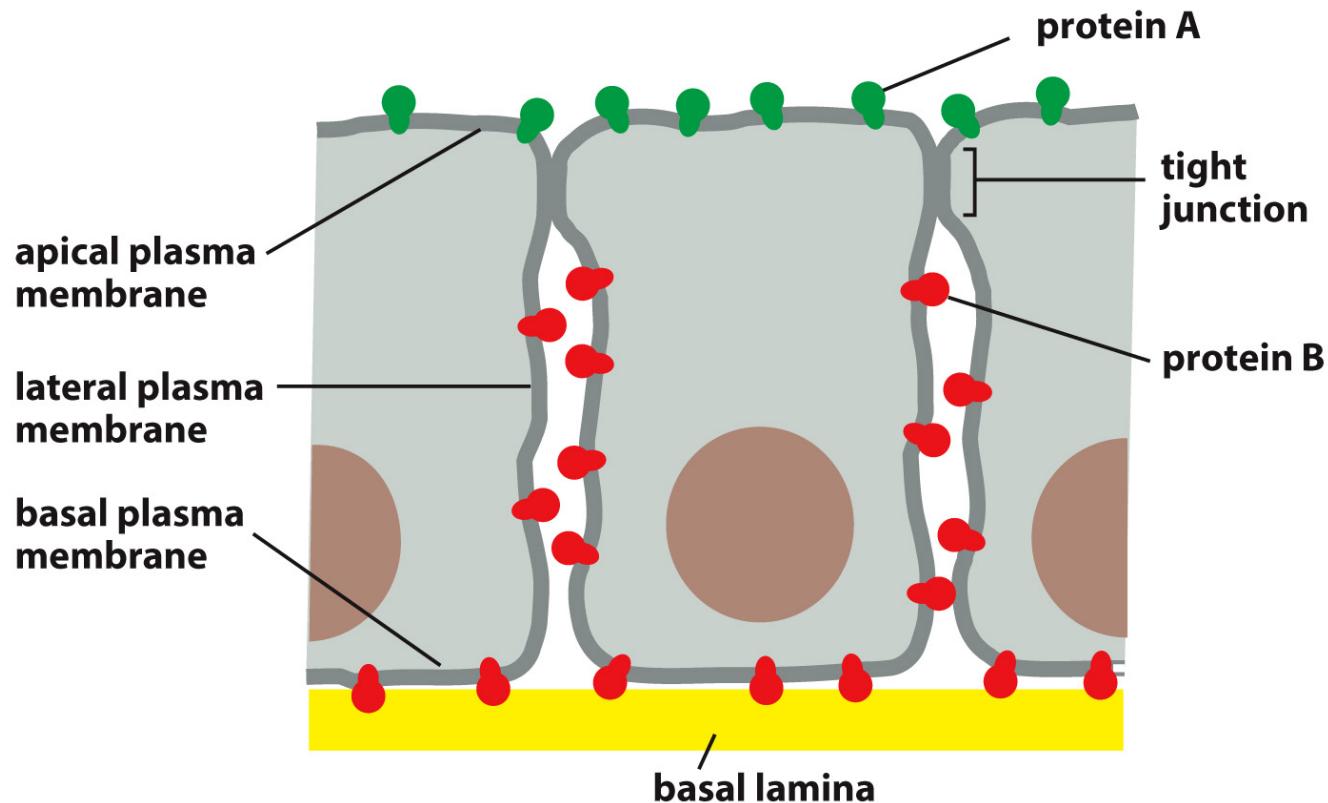
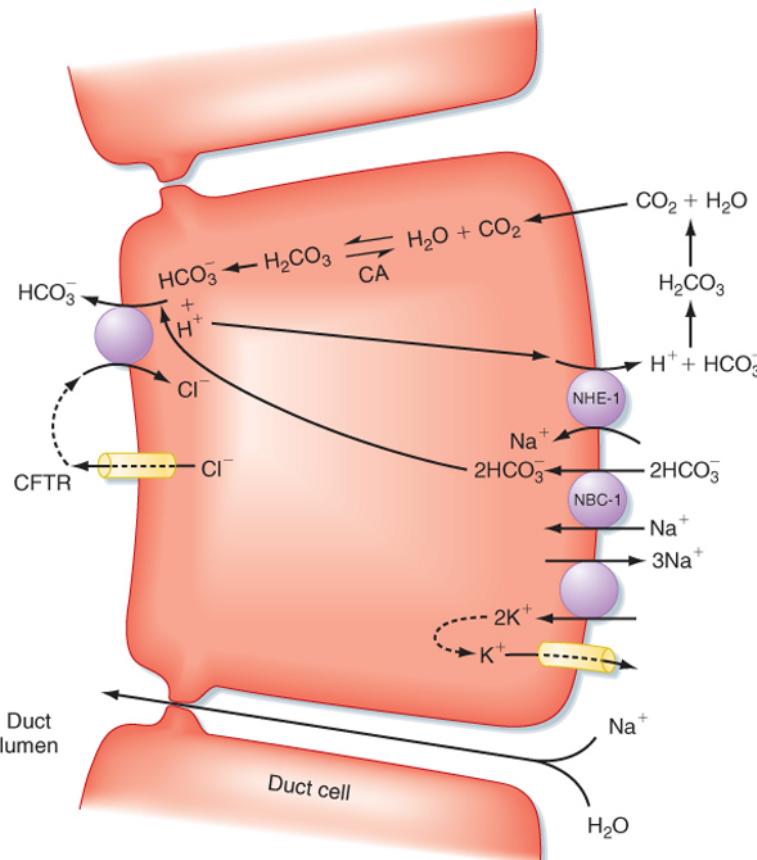


Figure 10-34 Molecular Biology of the Cell 6e (© Garland Science 2015)

Transporters in epithelial cells are asymmetrically distributed



Koeppen & Stanton: Berne and Levy Physiology, 6th Edition.
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Principle of membrane transport

- ◆ Some molecules can move across the lipid bilayer: small, non-charged and non-polar
- ◆ Most small molecules move across the cell membrane via transporters i.e., carriers and ion channels: passive transport or active transport
- ◆ Larger molecules move across the cell membrane by endocytosis and exocytosis

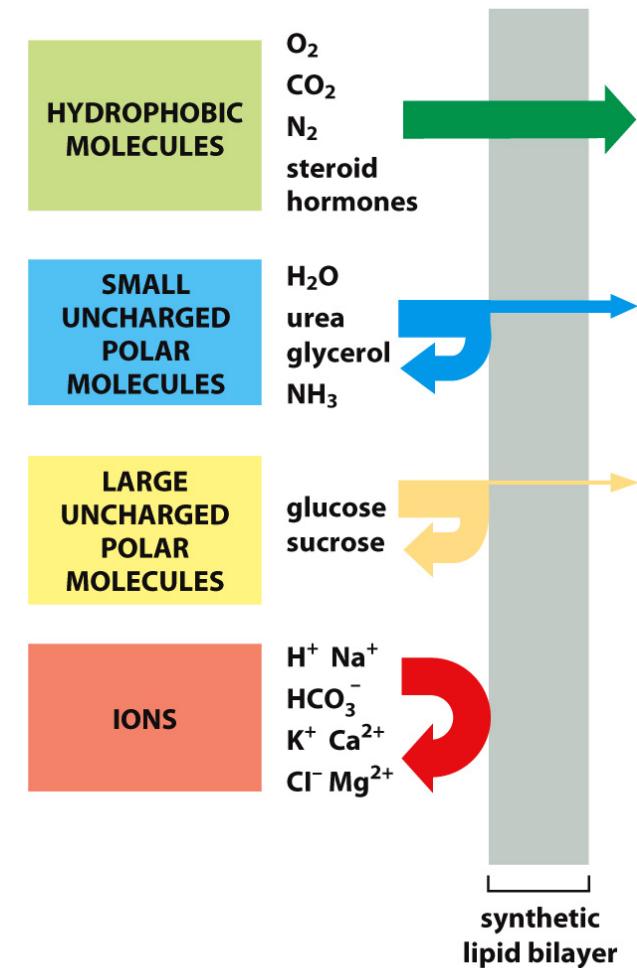


Figure 11-1 Molecular Biology of the Cell 6e (© Garland Science 2015)

Active VS Passive Transport

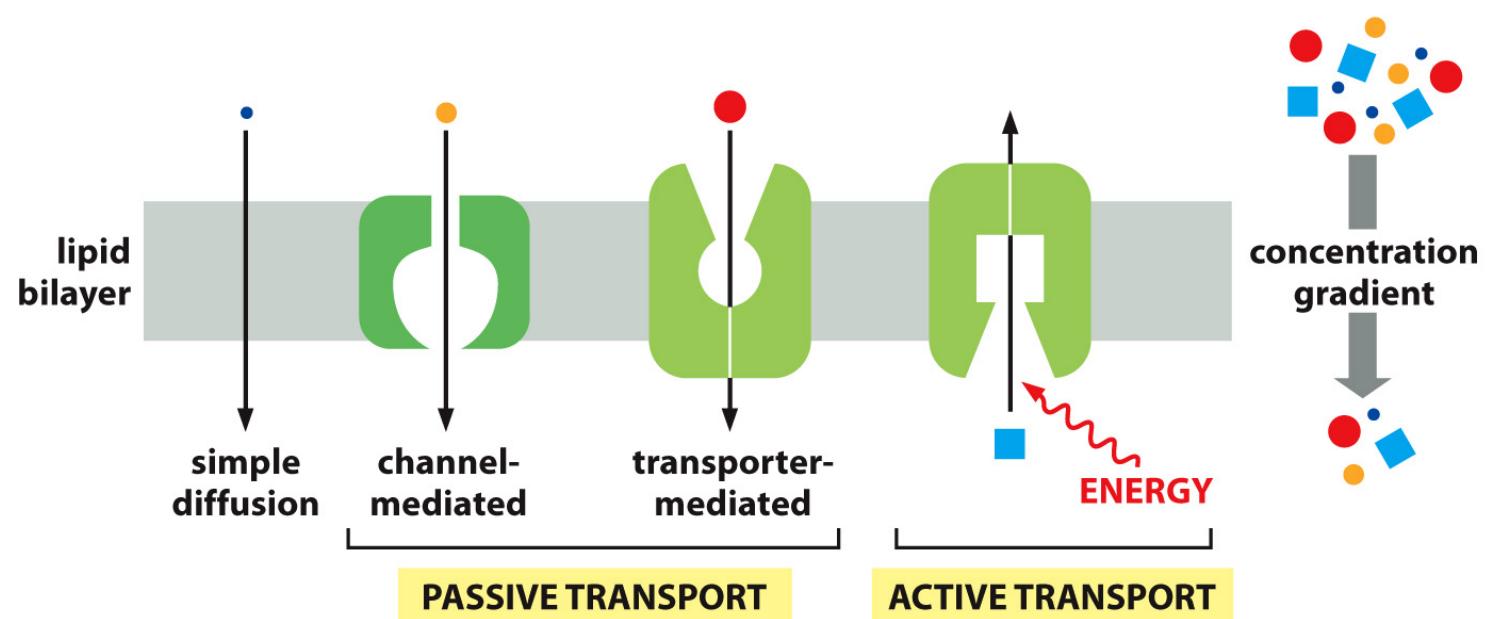
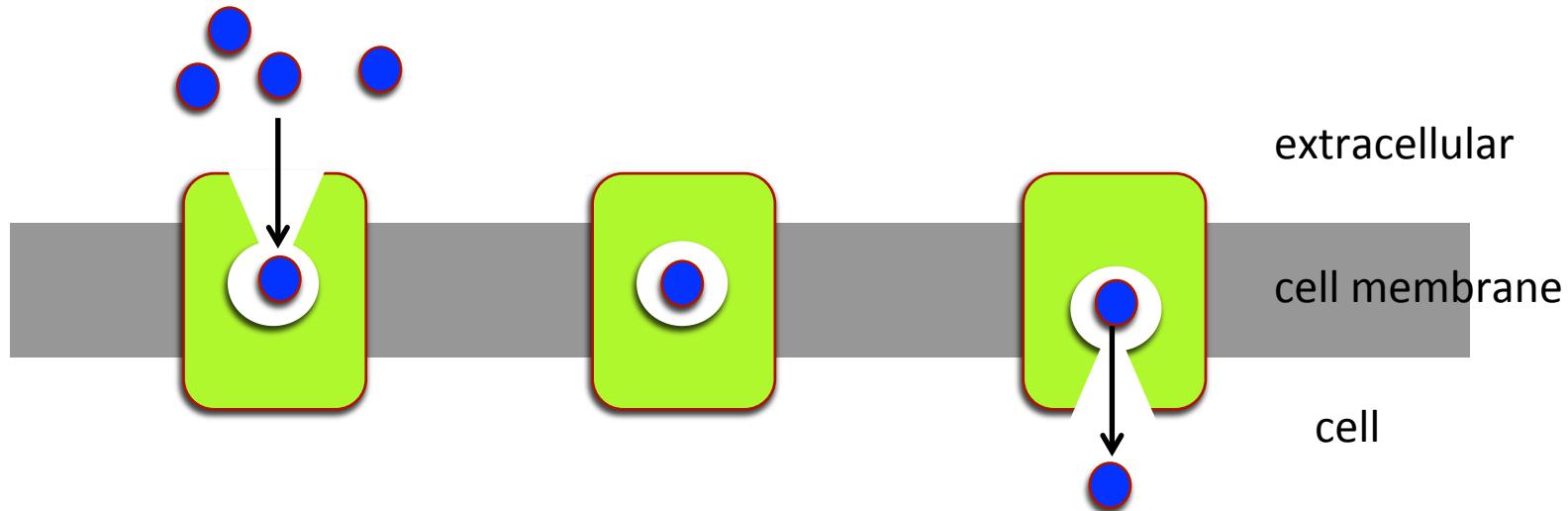


Figure 11-4a Molecular Biology of the Cell 6e (© Garland Science 2015)

Transporters



- Binding of solute
- Conformational changes (reversible)
- Expose solute to another side of the membrane
- Active/passive transport

Na^+ /glucose co-transporter (SGLT)

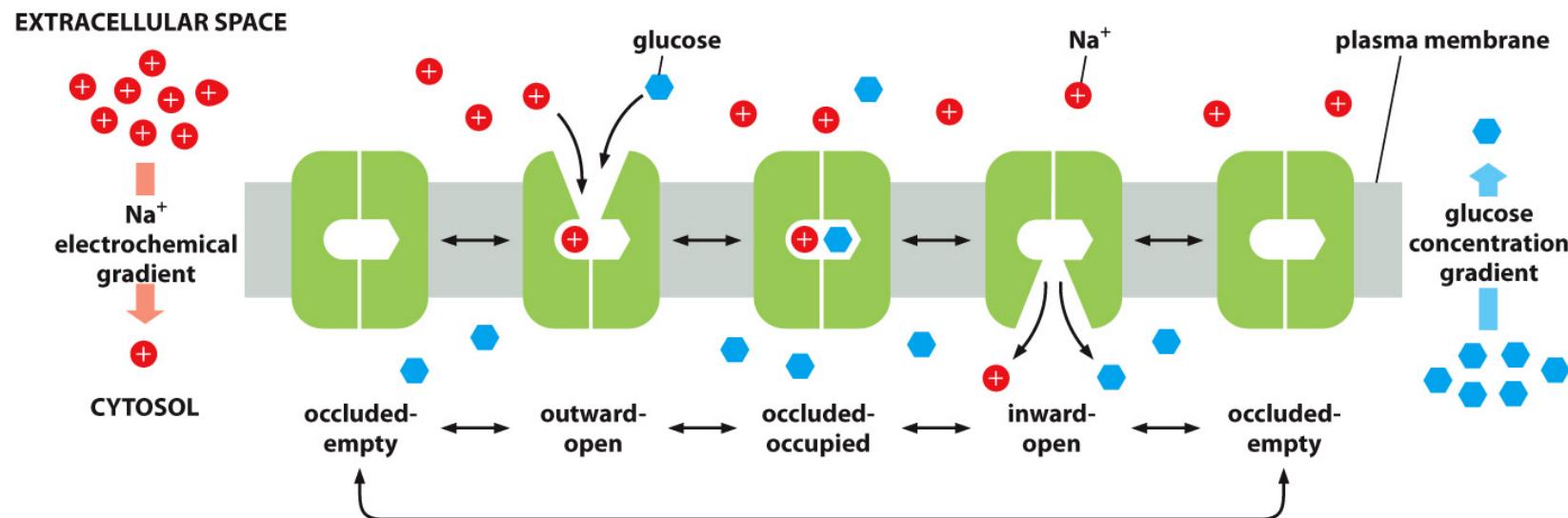


Figure 11-9 Molecular Biology of the Cell 6e (© Garland Science 2015)

Asymmetric distribution of transporters allows transcellular glucose transport

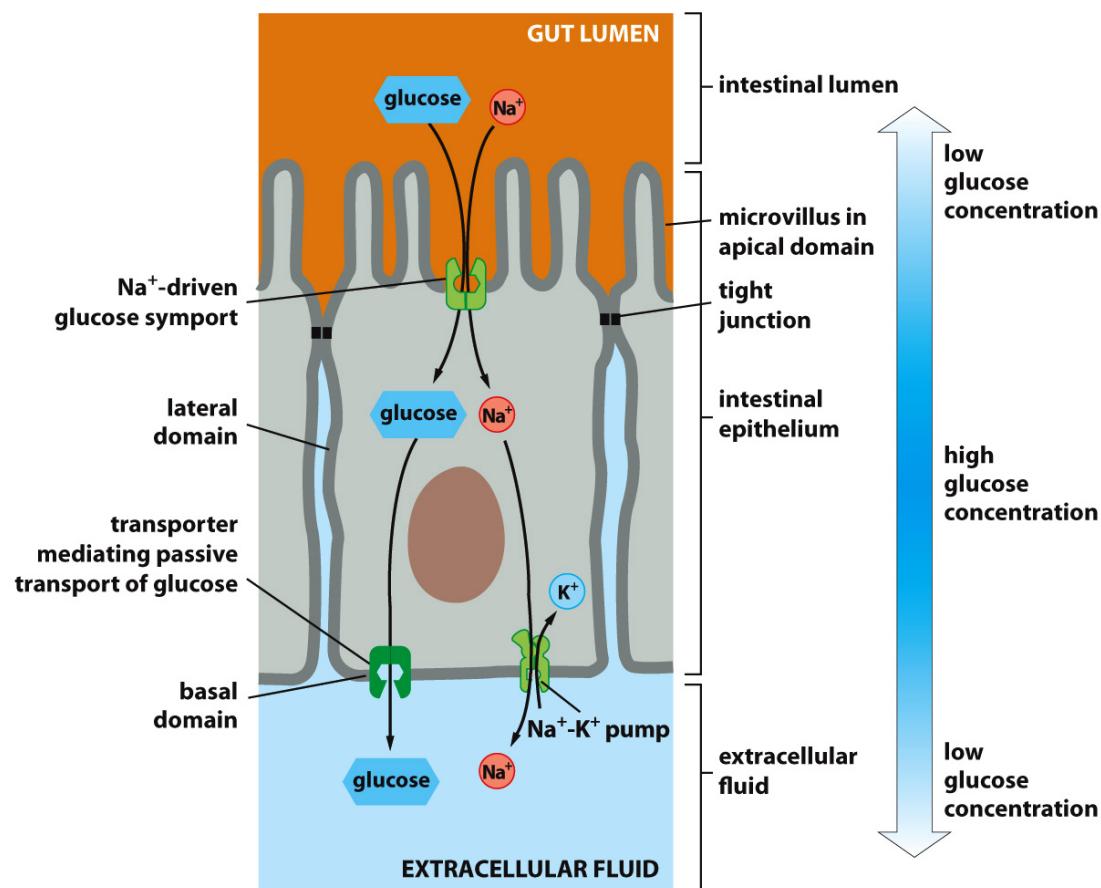
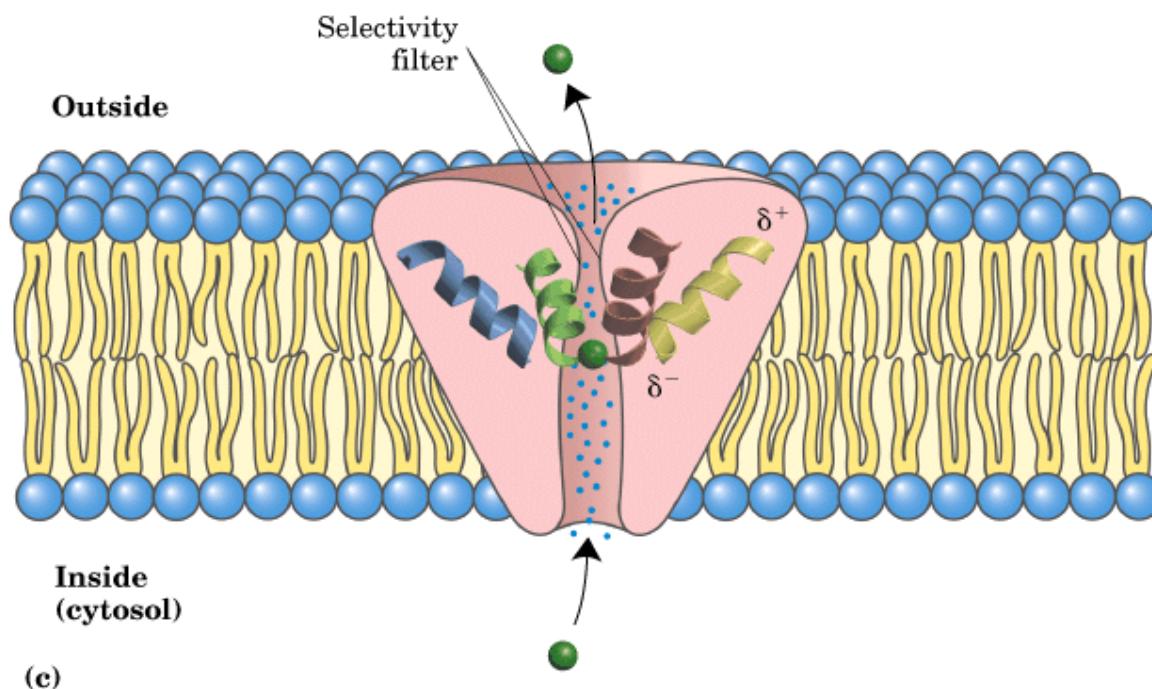


Figure 11-11 Molecular Biology of the Cell 6e (© Garland Science 2015)

Ion channels: selective filter



Function of cell membrane

- Compartmentalization: defining the cell & boundaries of the subcellular organelles
- Gate-keeper: selective permeability
- Cell-to-cell communication
- Provide space for biochemical reactions

Cell communication

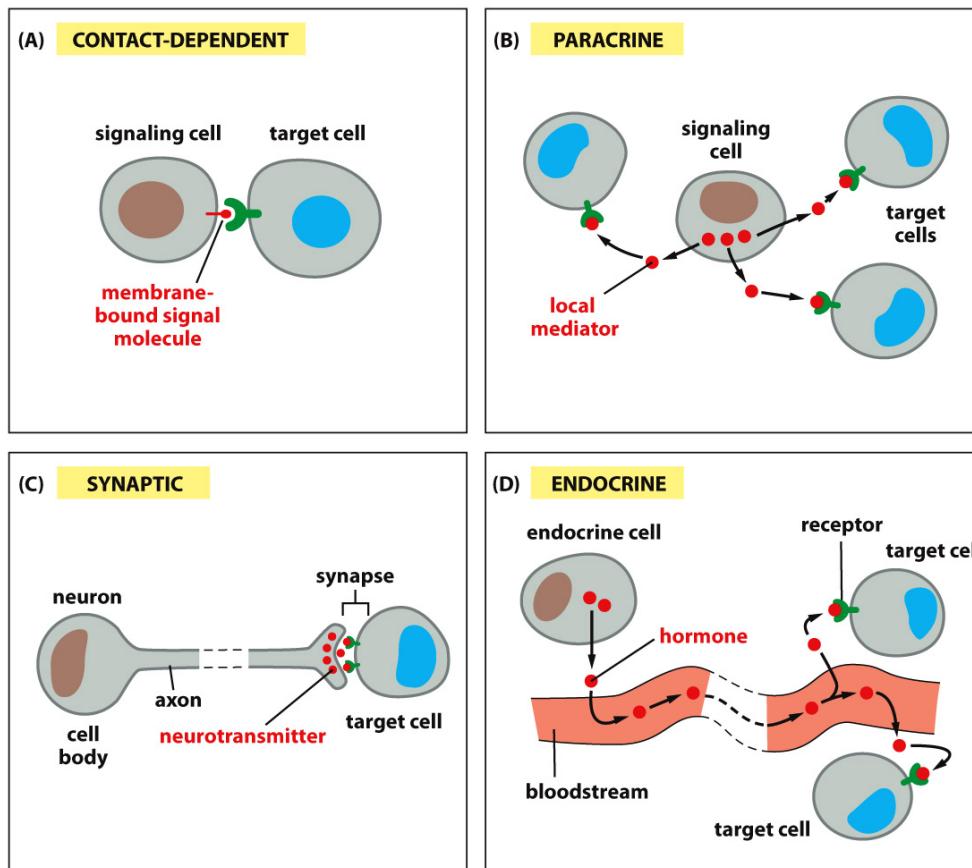
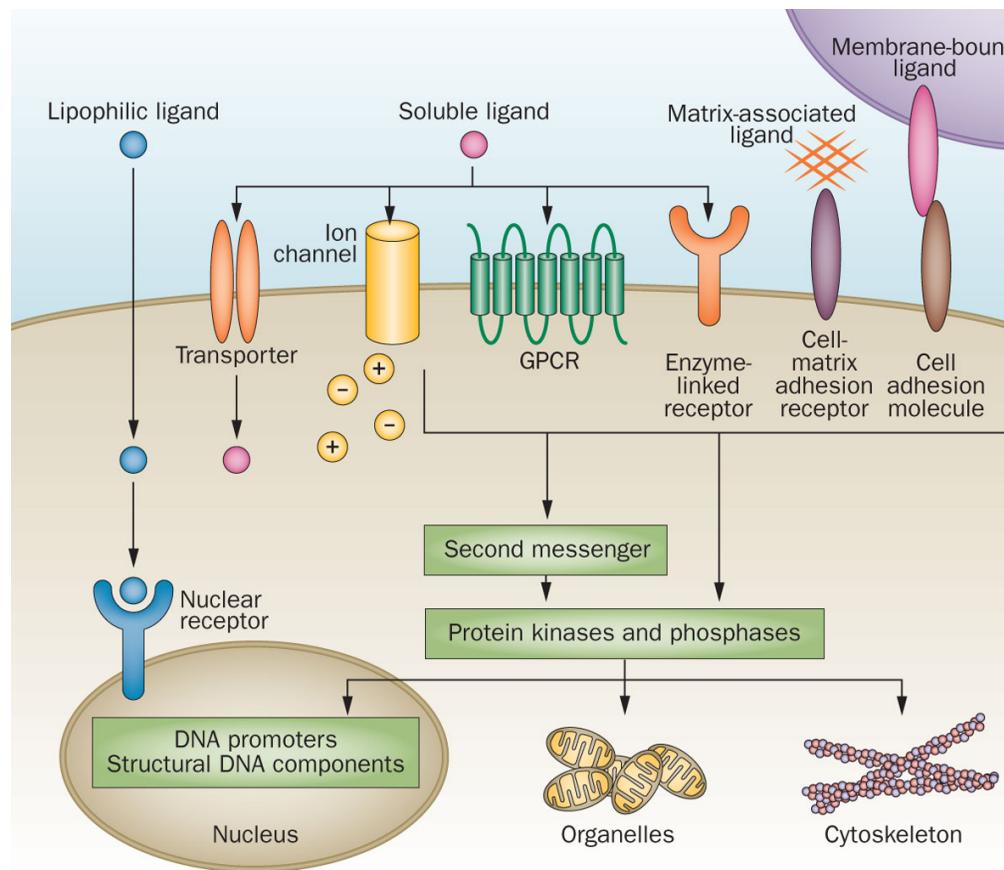


Figure 15-2 Molecular Biology of the Cell 6e (© Garland Science 2015)

Cell Signaling



Intracellular signaling

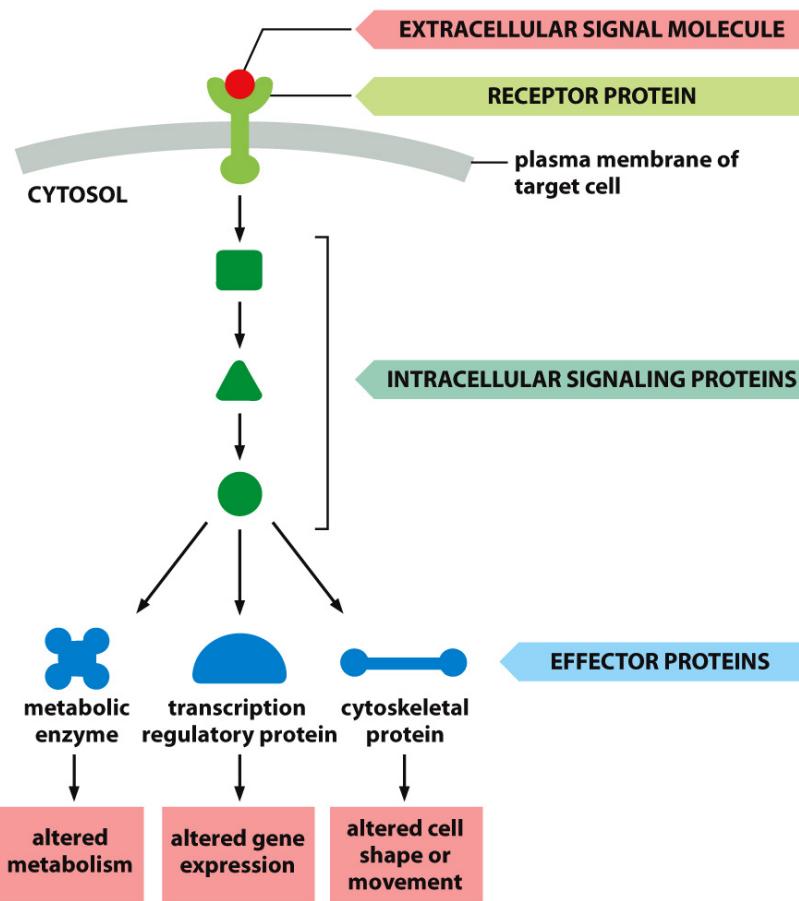


Figure 15-1 Molecular Biology of the Cell 6e (© Garland Science 2015)

Cells respond to combinations of signals

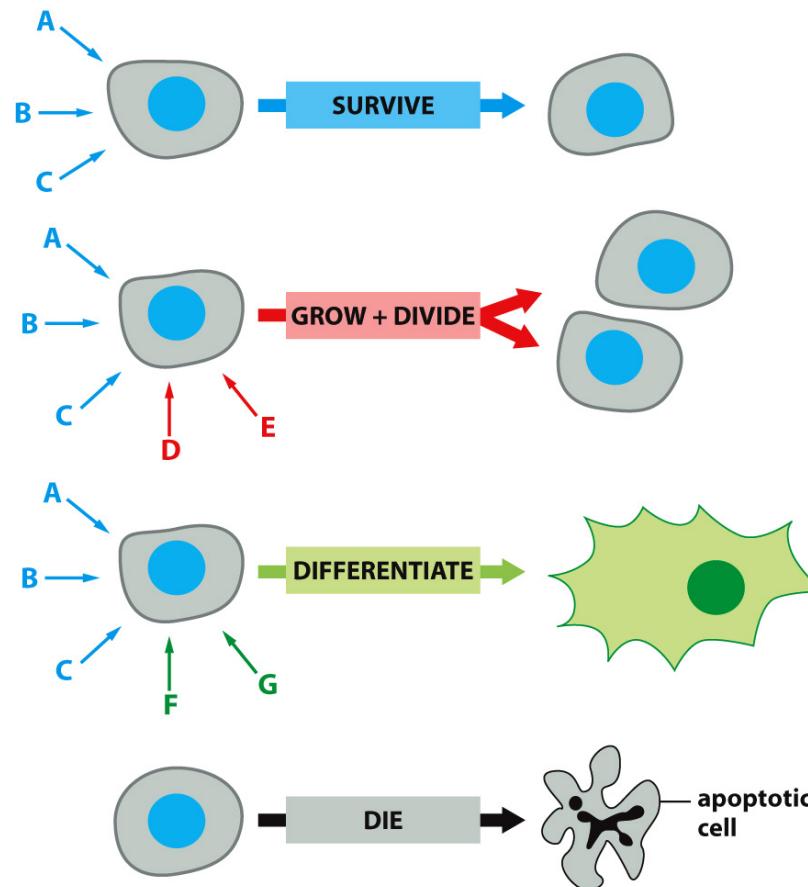


Figure 15-4 Molecular Biology of the Cell 6e (© Garland Science 2015)

Signaling molecule has different effects of different cell types

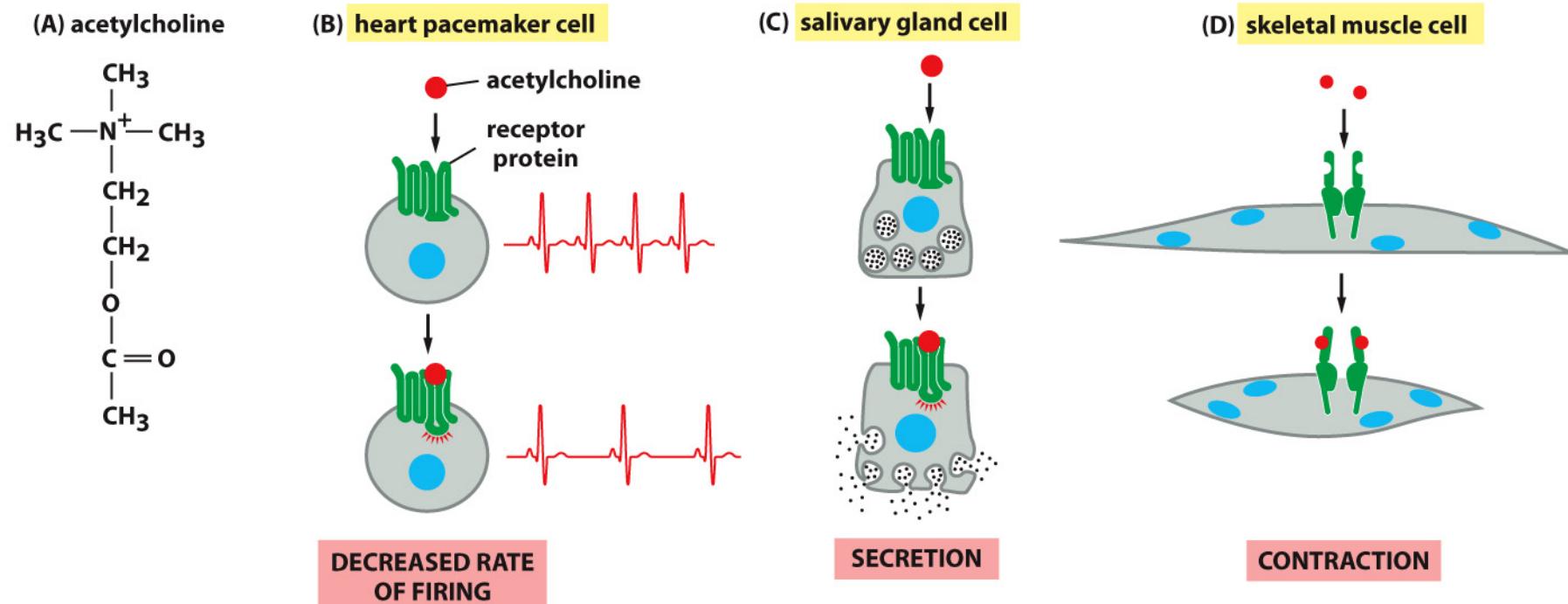


Figure 15-5 Molecular Biology of the Cell 6e (© Garland Science 2015)

Three major classes of membrane receptors

- Ligand-gated ion channels
- G protein-coupled receptors
- Enzyme-linked receptors

Receptor I: Ligand-gated ion channels

ION-CHANNEL-COUPLED RECEPTORS

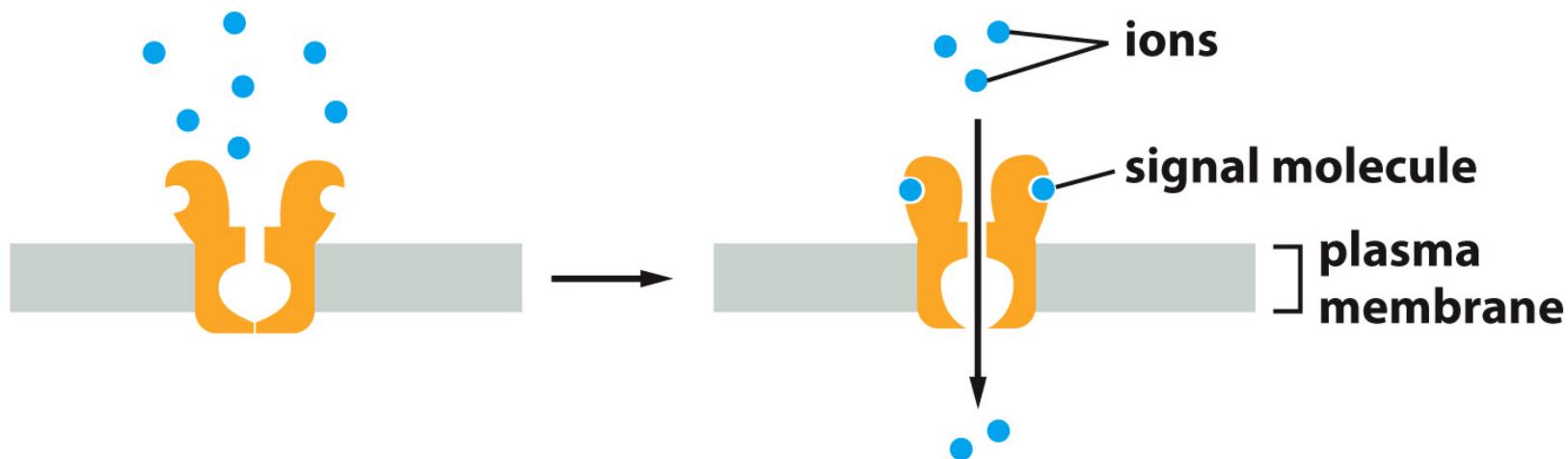


Figure 15-6a Molecular Biology of the Cell 6e (© Garland Science 2015)

Ligand-gated ion channels, Transmitter-gated ion channels, Ionotropic receptors

- GABA receptor: Cl^- channel
- Nicotinic Ach receptor: anion channel

Receptors II: G protein-coupled receptors

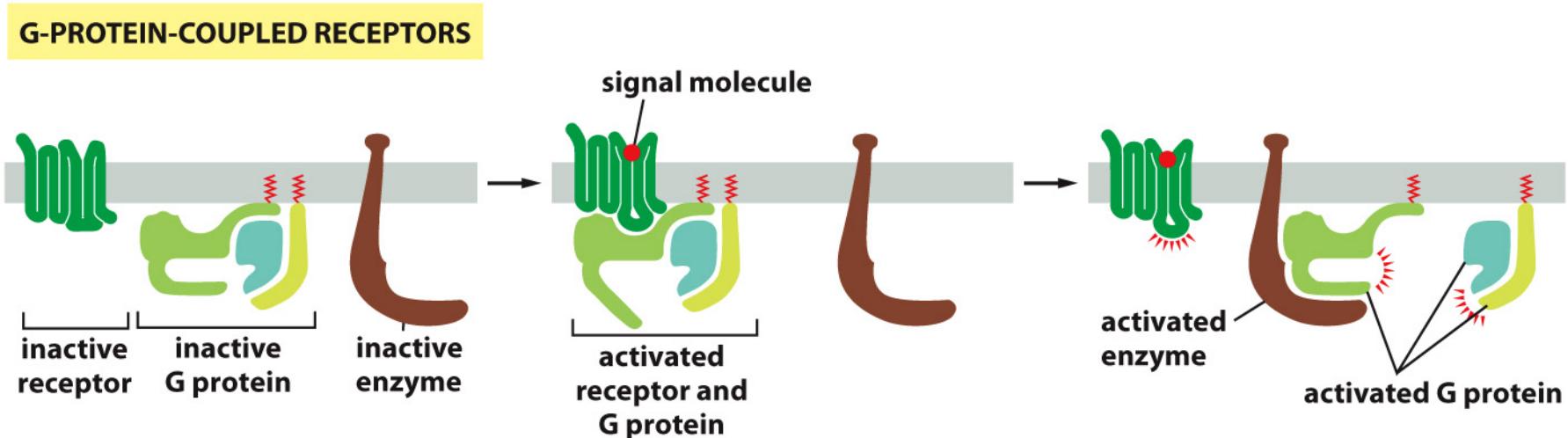


Figure 15-6b Molecular Biology of the Cell 6e (© Garland Science 2015)

G protein-coupled receptor (GPCRs), Trimeric GTP-binding protein
7 transmembrane (7TM) receptors

Receptor III: Enzyme-linked receptors

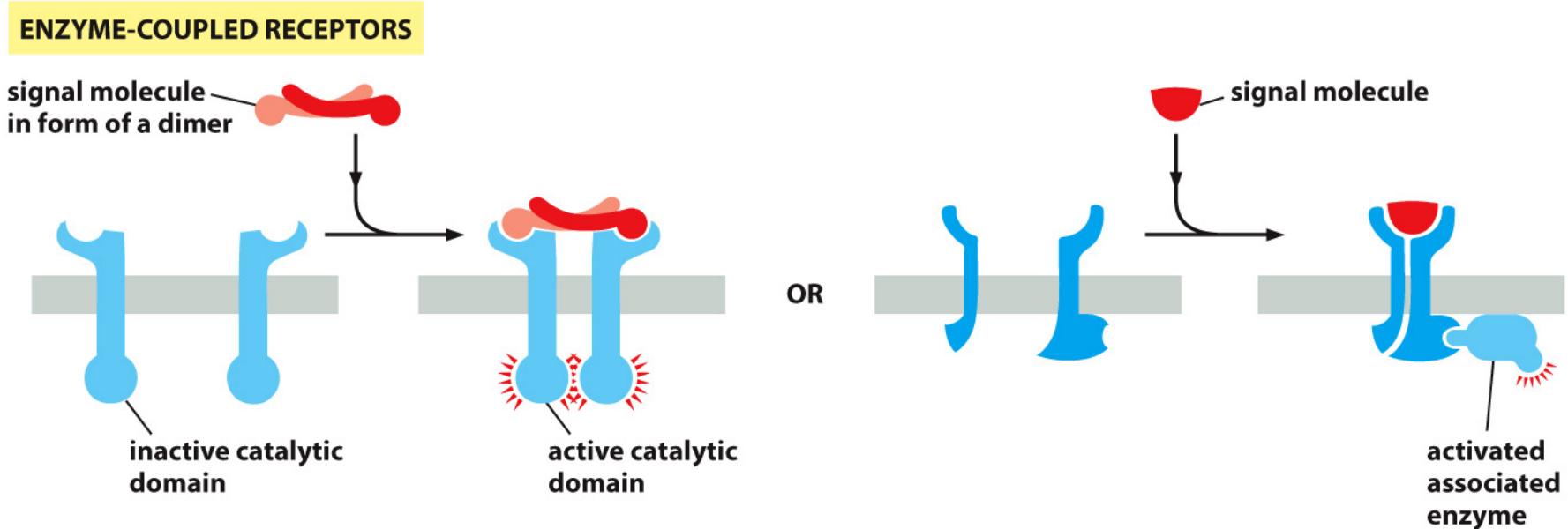


Figure 15-6c Molecular Biology of the Cell 6e (© Garland Science 2015)

Enzyme-linked receptors, Catalytic receptors

- EGFR, GFR, Toll-like-R (Receptor Tyrosine Kinases)
- NPRS (natriuretic peptide R) (guanylyl cyclase)

Intracellular signaling

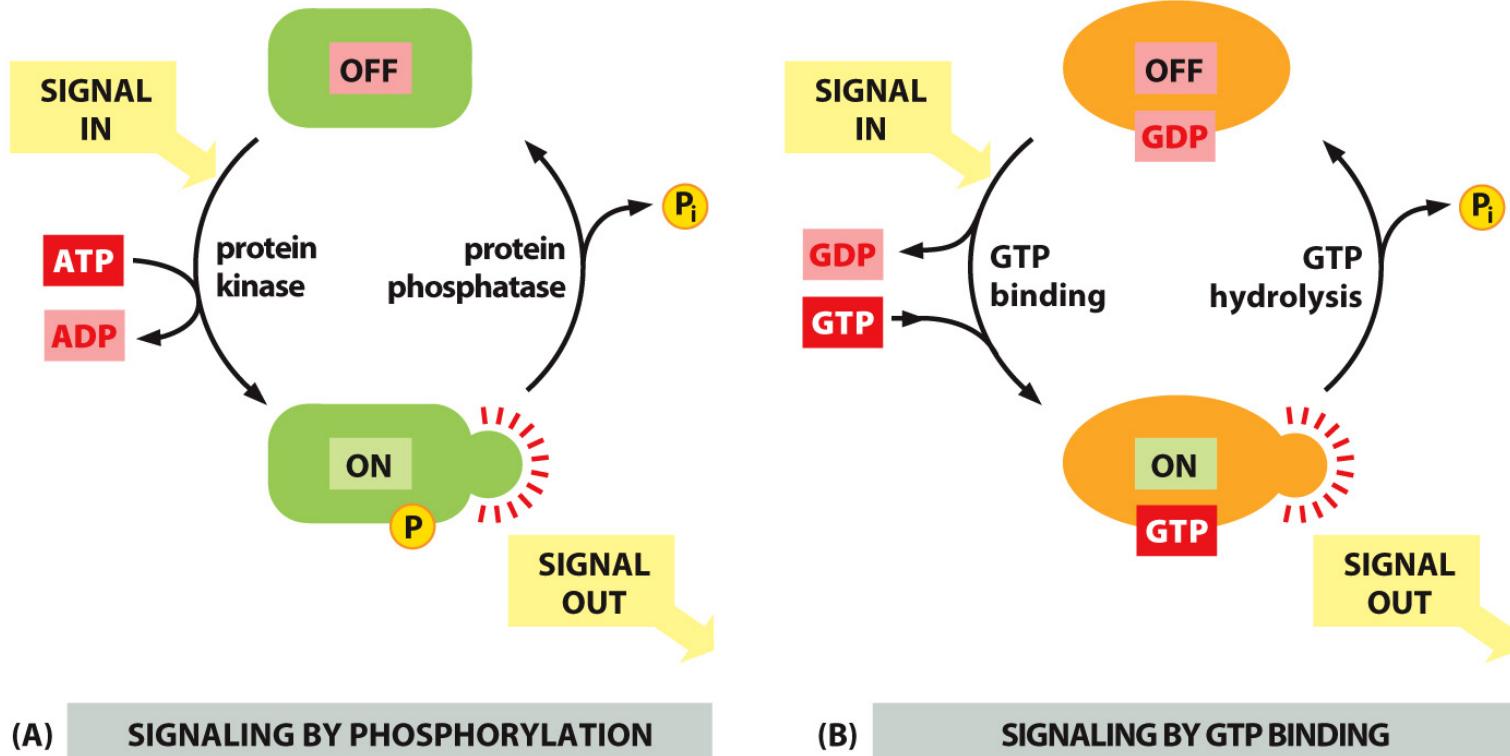


Figure 15-7 Molecular Biology of the Cell 6e (© Garland Science 2015)

Enhancing signal specificity: Signaling complex

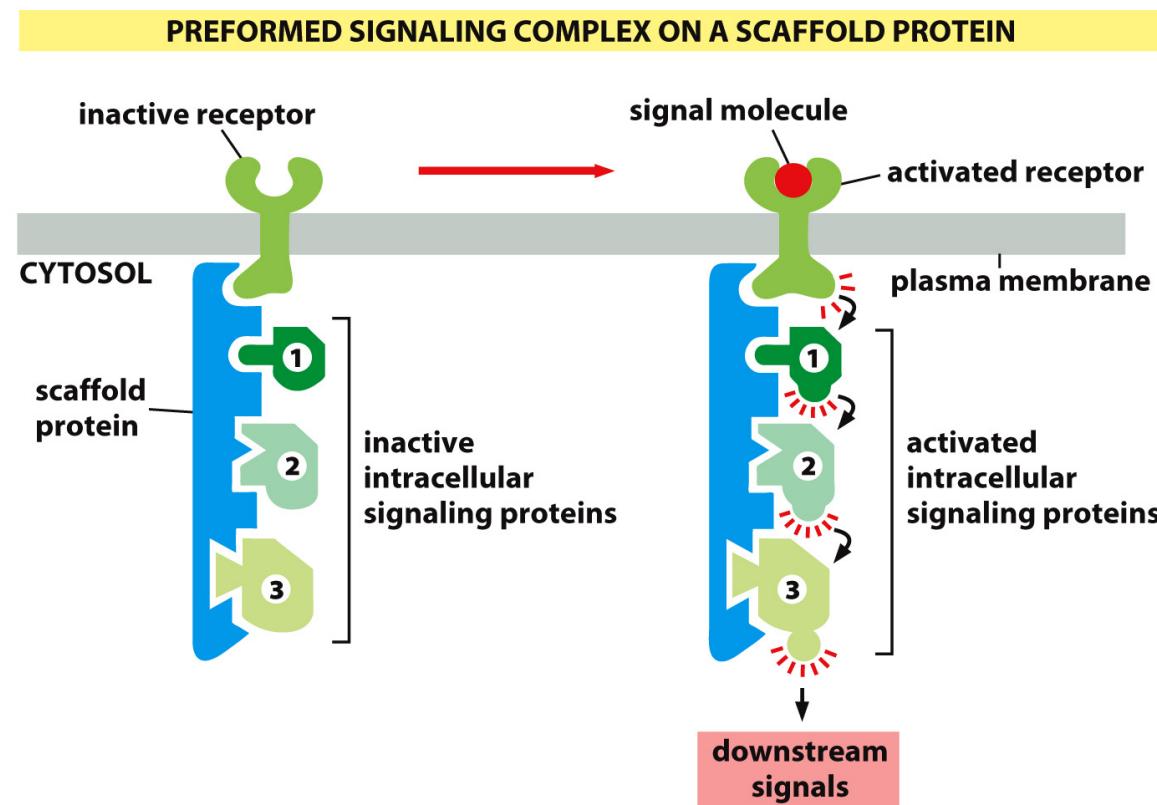


Figure 15-10a Molecular Biology of the Cell 6e (© Garland Science 2015)

Signaling complexes on an activated receptor

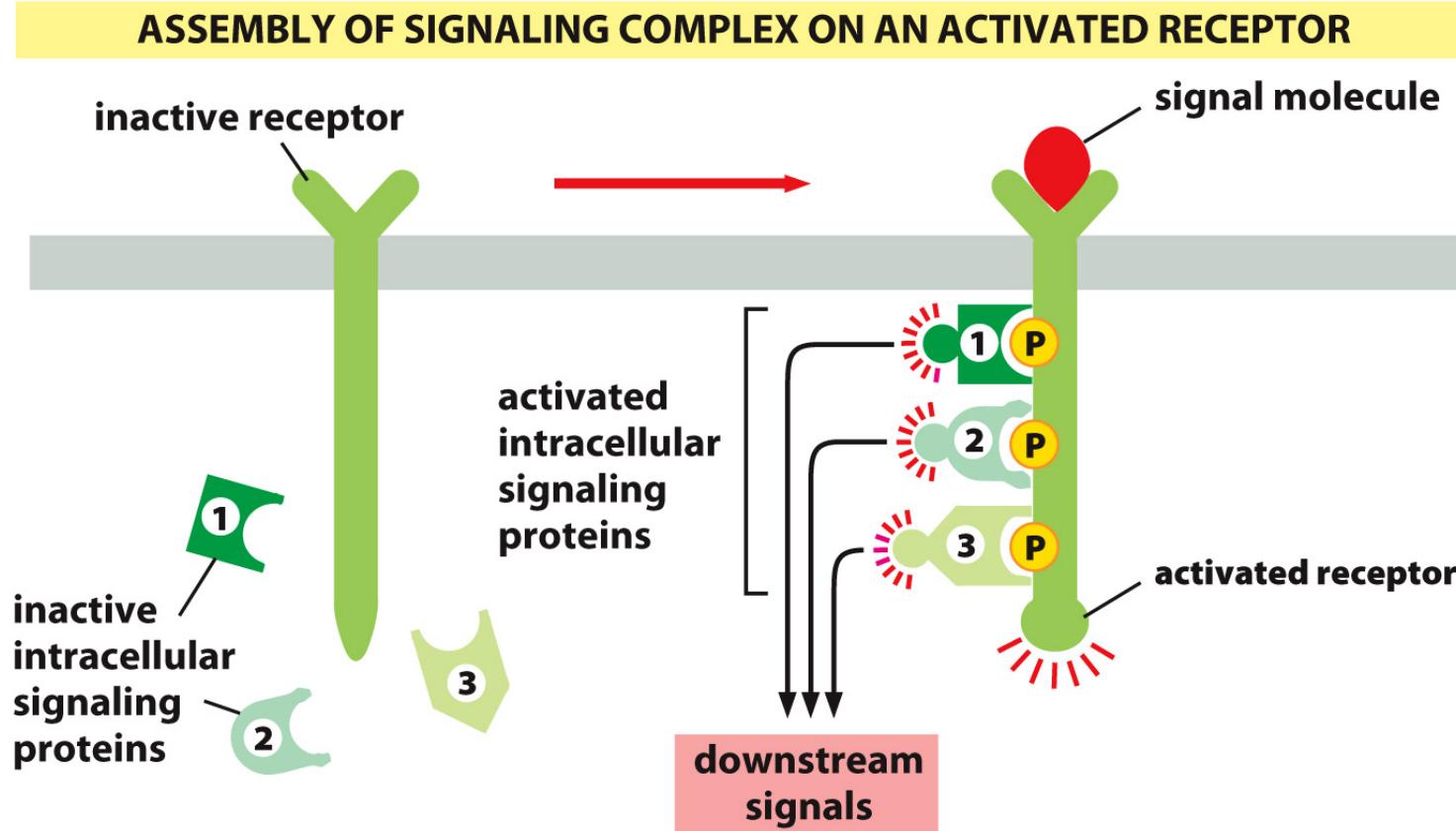


Figure 15-10b Molecular Biology of the Cell 6e (© Garland Science 2015)

Signaling complexes associated with membrane lipids

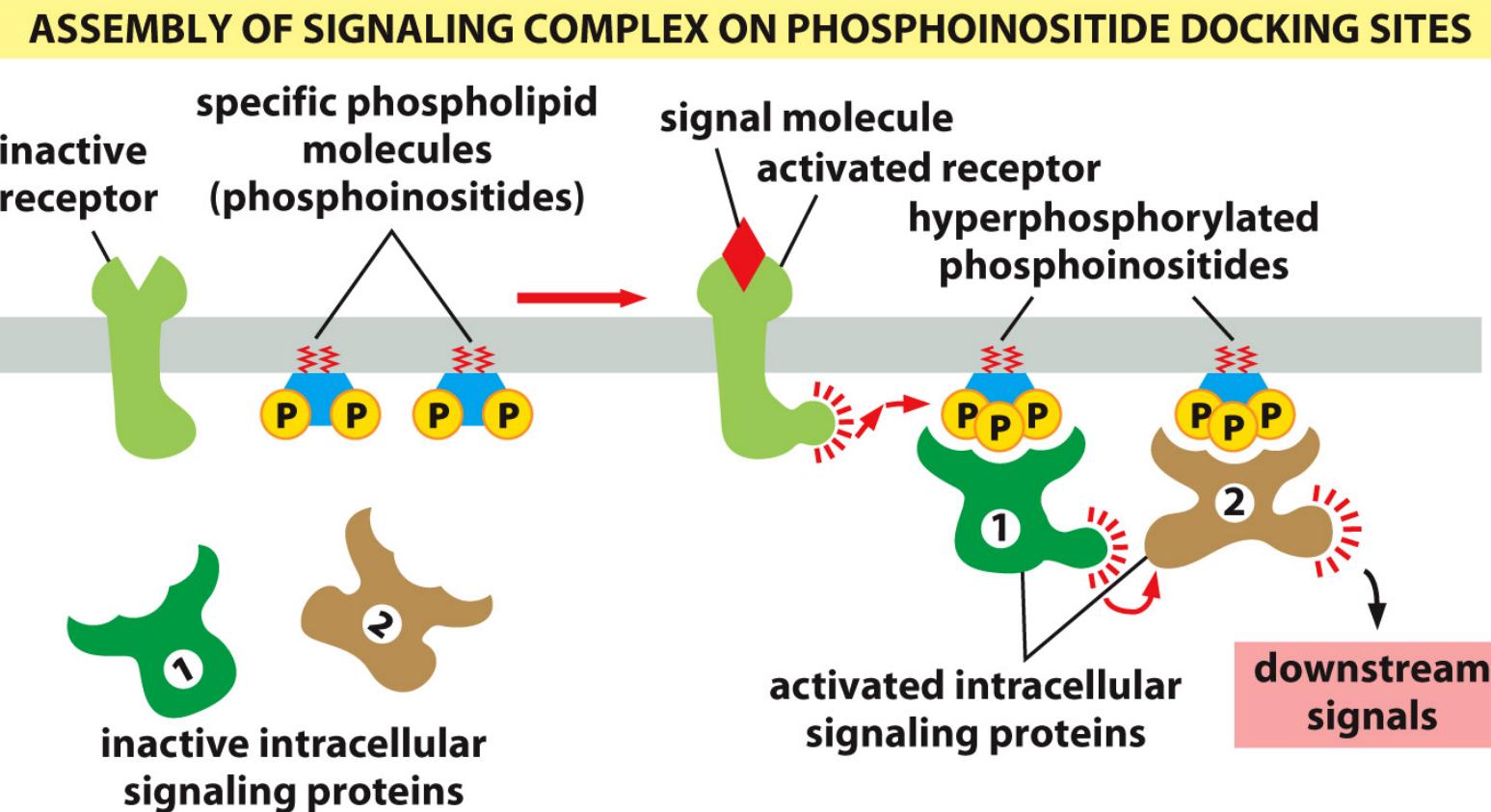


Figure 15-10c Molecular Biology of the Cell 6e (© Garland Science 2015)

Intracellular signaling complexes

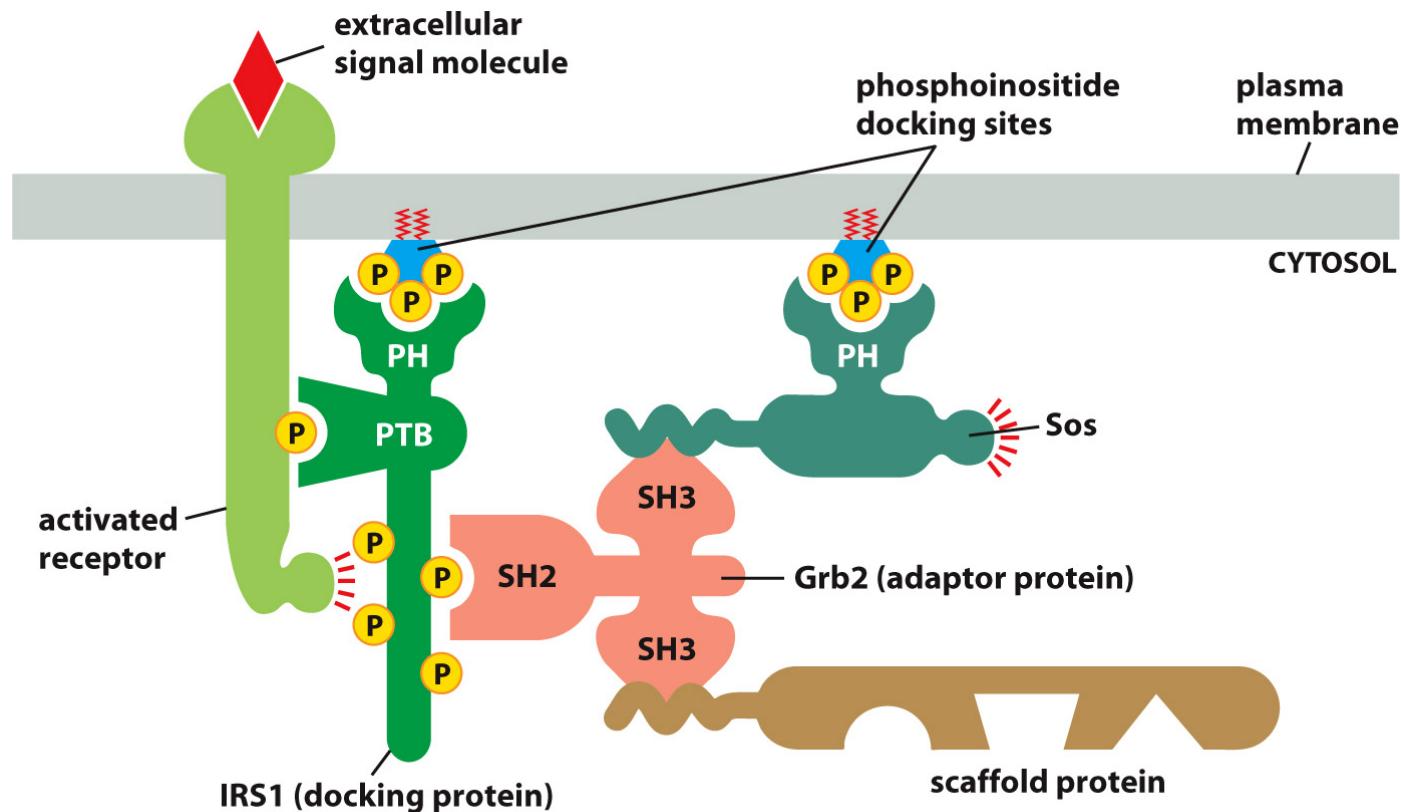


Figure 15-11 Molecular Biology of the Cell 6e (© Garland Science 2015)

Desensitization

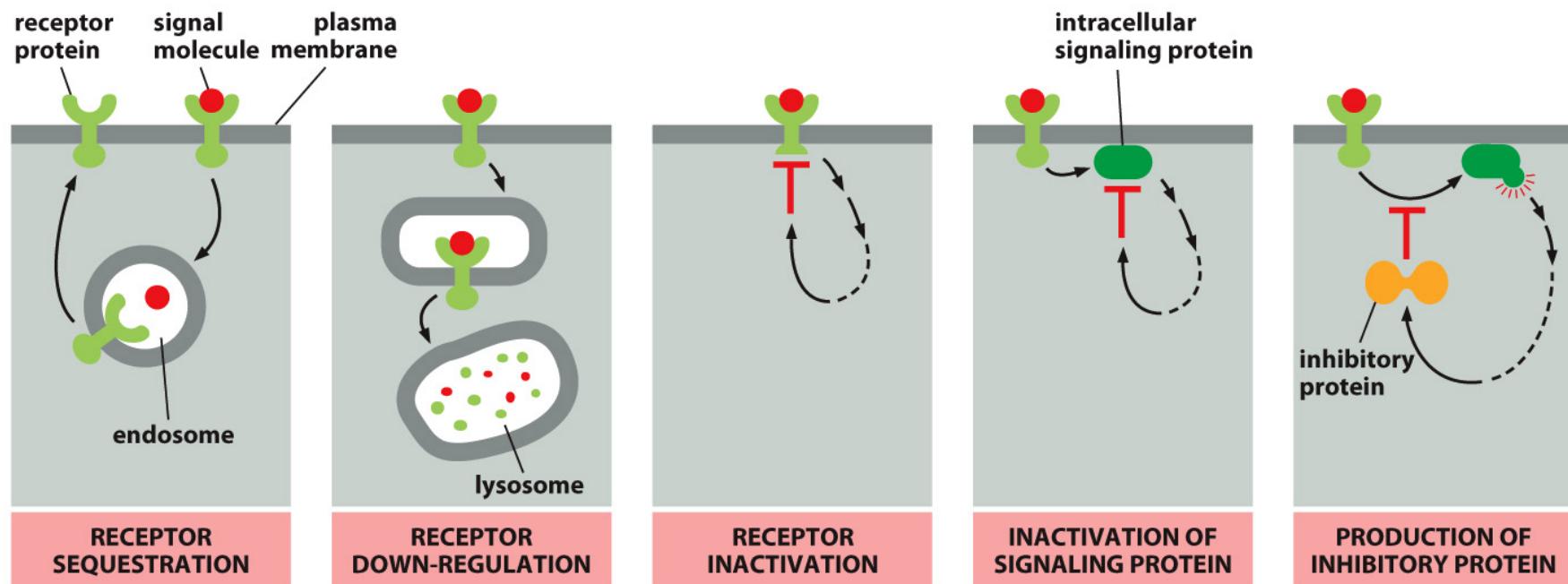


Figure 15-20 Molecular Biology of the Cell 6e (© Garland Science 2015)

Summary

- Structure and functions of cell membrane
- Principle of membrane transport
- Electrical properties of cell membrane: role of ion channels and transporters
- Basic process of cell communication
- Mechanisms by which membrane receptors are activated
- Signal transduction
- Intracellular signaling complex