

Cells communicate by a variety of chemical signals

Communication via **CELL-TO-CELL CONTACT** - here the signaling is direct:

- 1.
- 2.

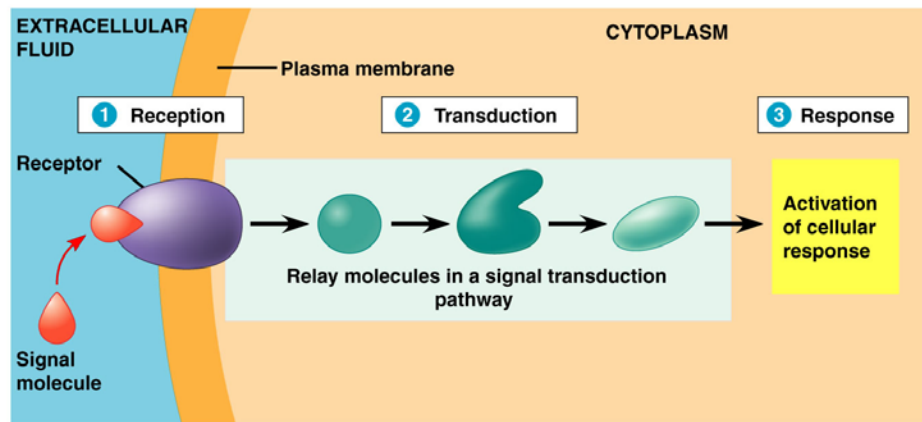
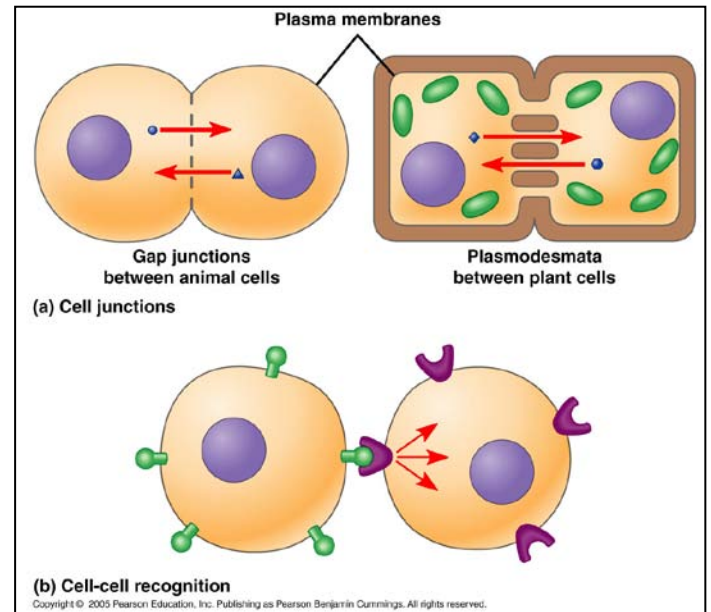
Cell-to-cell contact is critical for multi-cellular organisms.

- cell membranes contain

UNIVERSAL PRINCIPLES

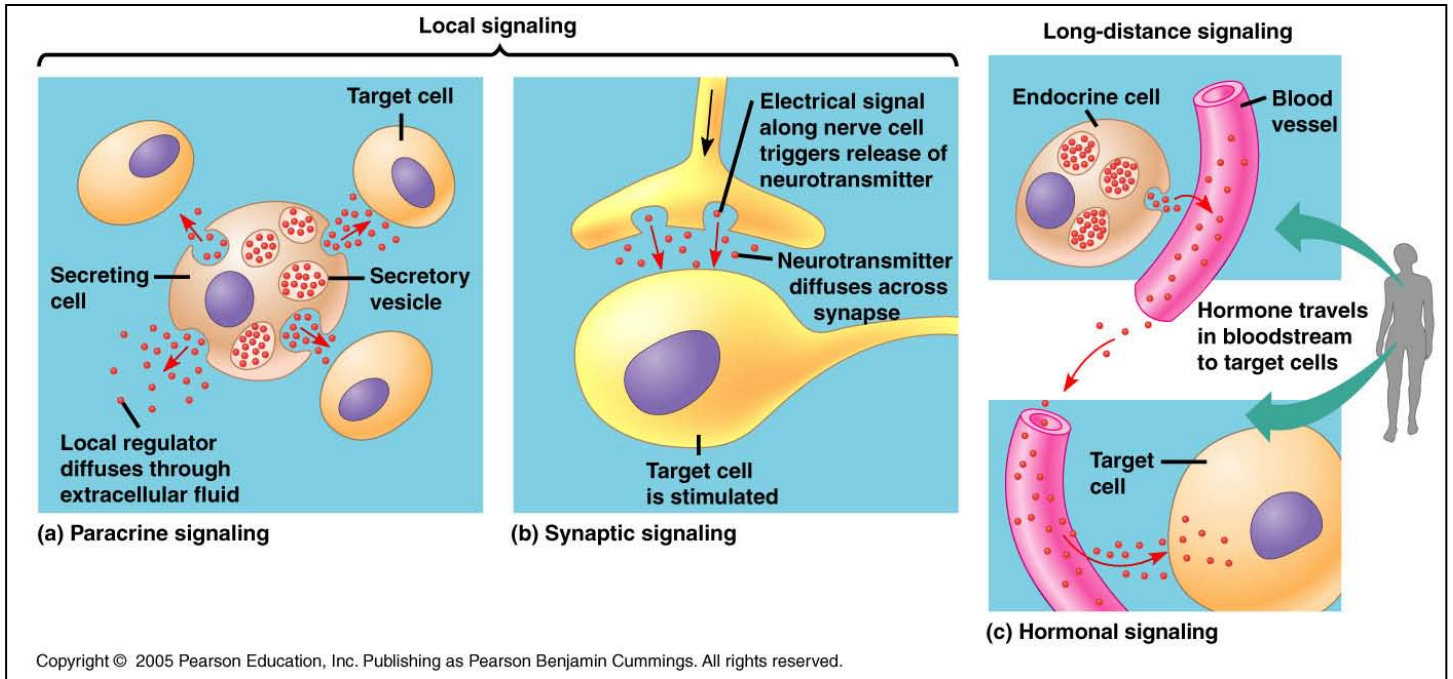
An analogy: auto industry → cars basically have same parts (engines, fenders, lights) but the variety of different patterns is boundless.

SIGNAL TRANSDUCTION

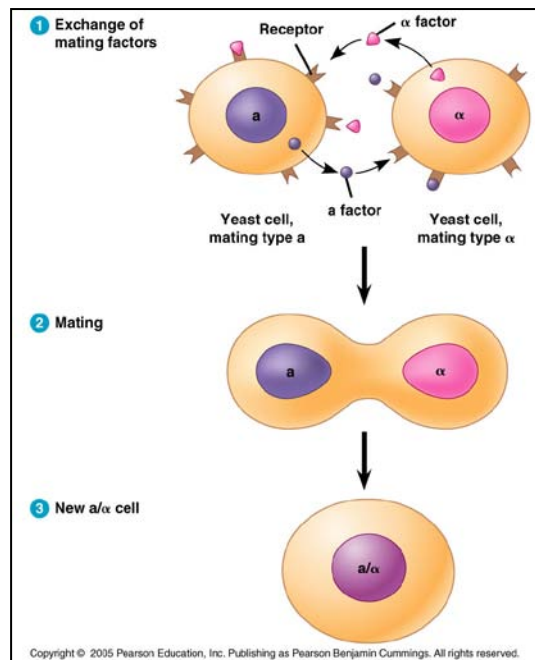


SIGNALING CAN BE LOCAL OR DISTANT

(local)



(distant) ↗



Single Cells COMMUNICATION... CELL to CELL SIGNALING SYSTEMS

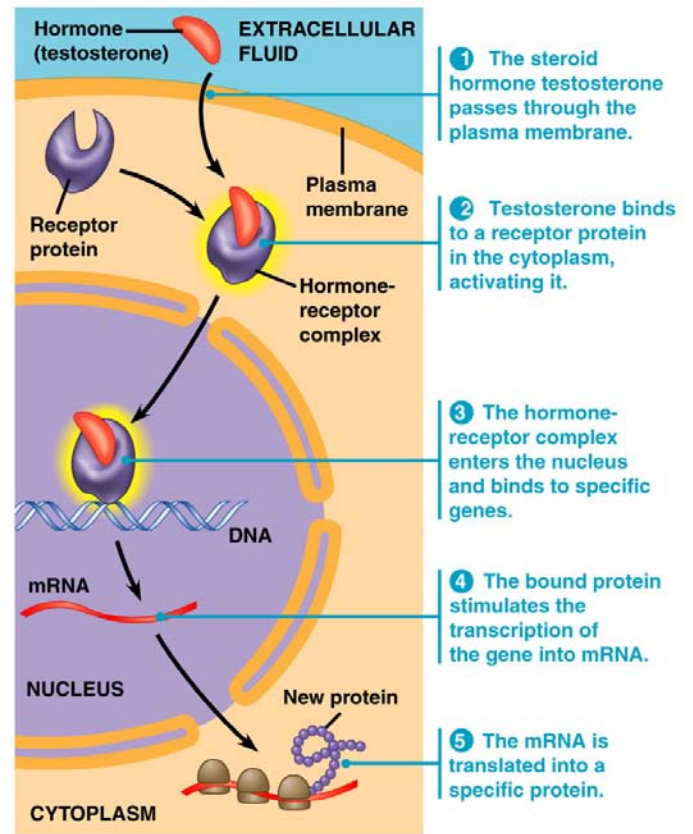
- 1.
- 2.
- 3.

Communication via **CELL SIGNALING** (aka
The 3 Stages of Cell Signaling Process...

1.

2.

3.



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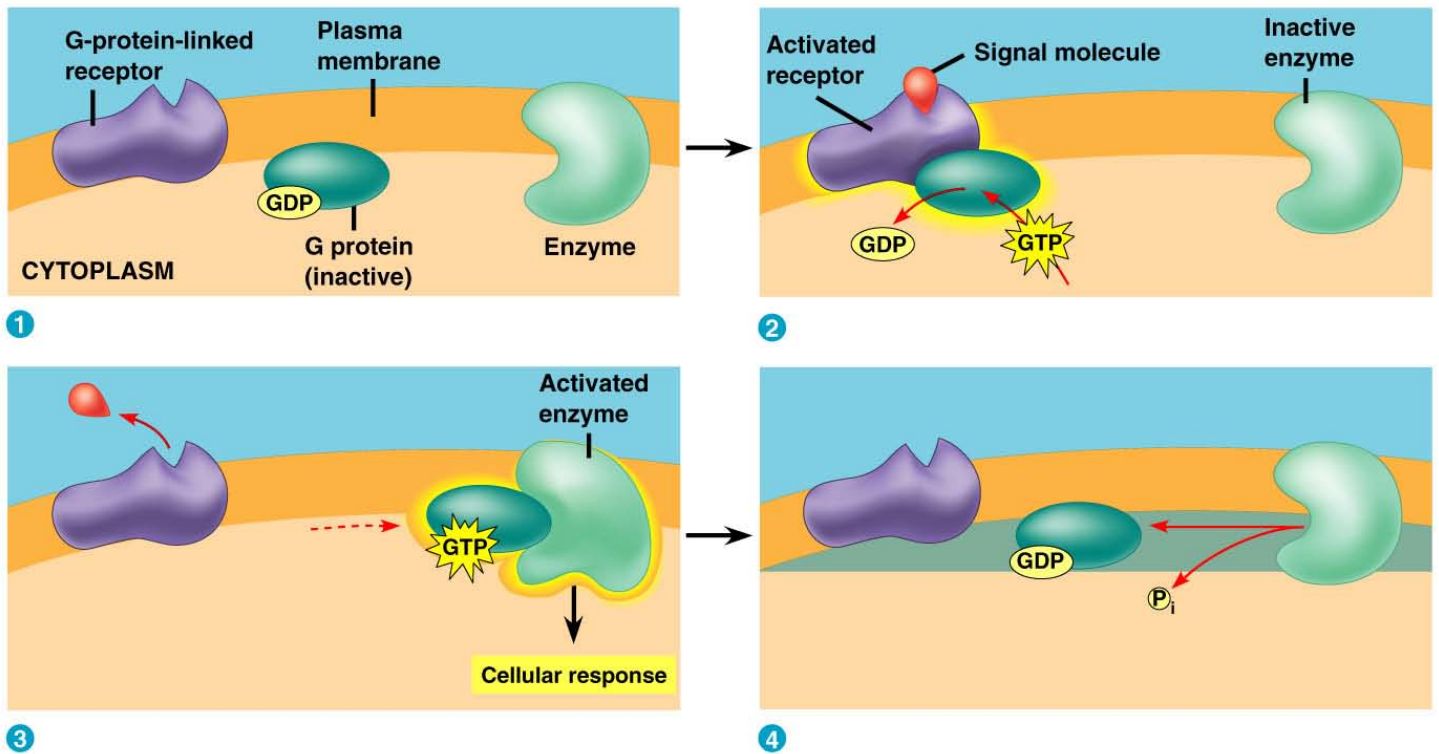
Example of a Receptor Protein & Signal Transduction System

1.

-
-
-

A specific example of **G-protein** cellular responses:

net result... 1 signal molecule gives multiple-enhanced response.



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The **specificity of cell signaling** is varied among cells and leads to a multiplicity of **RESPONSE MECHANISMS**

Other examples of signal transduction mechanisms:

- 1.
- 2.
- 3.
- 4.

all of these signaling mechanism model themselves after the basic **signal transduction mechanism**. example.

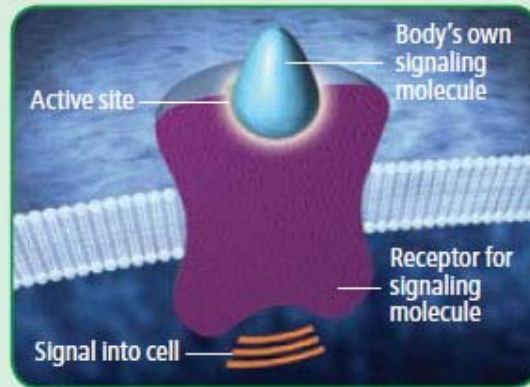
- 5.

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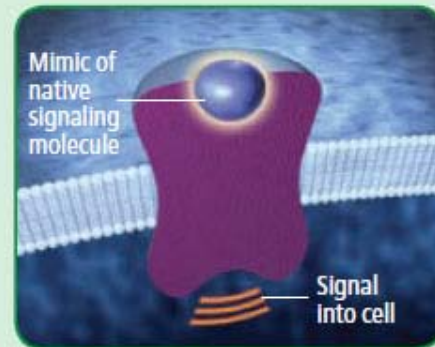
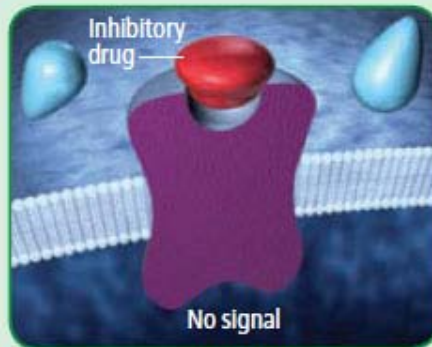
5.

When one of the body's own molecules, such as a neurotransmitter, attaches to the so-called active site of its receptor on a cell (*right*)—something like a key fitting into a lock—the receptor sets off an intracellular signaling cascade that ultimately causes the cell to change its activity. Many drugs inhibit or enhance such signaling.

NORMAL CELLULAR ACTIVITY

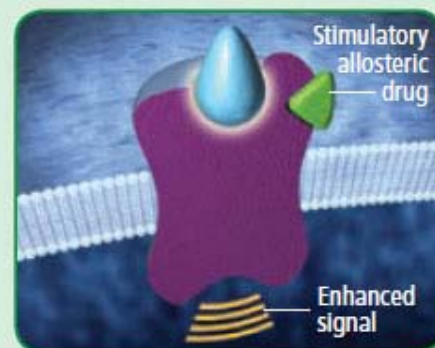
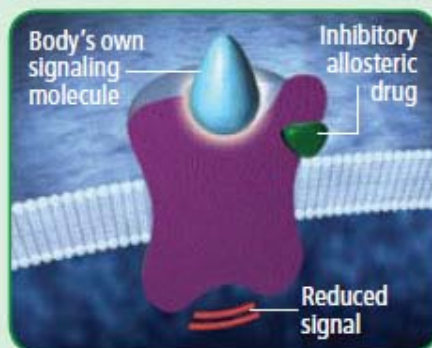


HOW CLASSIC DRUGS ACT



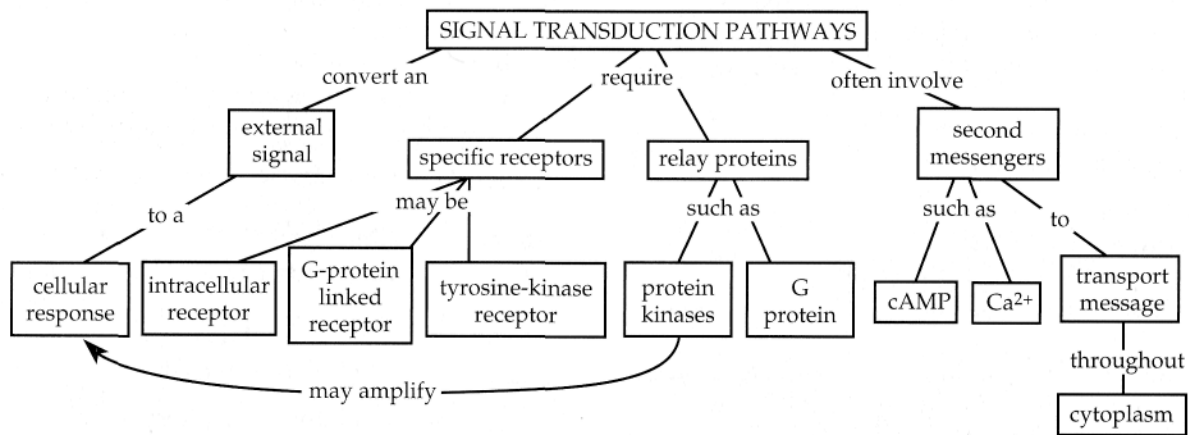
Typical pharmaceuticals bind to the active site in place of the native substance and either block the endogenous molecule's signaling (*left*) or mimic its effects (*right*).

HOW ALLOSTERIC DRUGS ACT



Allosteric drugs do not go to the active site. Instead they bind to other areas, altering the receptor's shape in a way that decreases (*left*) or increases (*right*) the receptor's response to the native substance. Allosteric agents might, for instance, cause the active site to grasp a neurotransmitter less or more effectively than usual.

Questions: use your textbook and the following diagrams to answer study questions.



1a. Do plant cells communicate using hormones?

1b. If so, how do those hormones travel between secreting cells and target cells?

2. Explain why G-protein-regulated pathways shut down rapidly in the absence of a signal molecule.

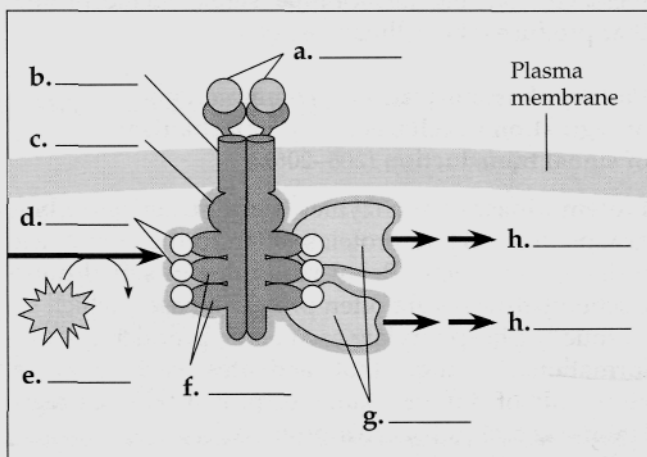


Fig. 11.7

| |
|----|
| a. |
| b. |
| c. |
| d. |
| e. |
| f. |
| g. |
| h. |

4a. What determines whether a cell is a target cell for a particular signal molecule?

4b. What determines whether a signal molecule binds to a membrane-surface receptor or an intracellular receptor?

5a. What does a protein kinase do?

5b. What does a protein phosphatase do?

5c. What is a phosphorylation cascade?

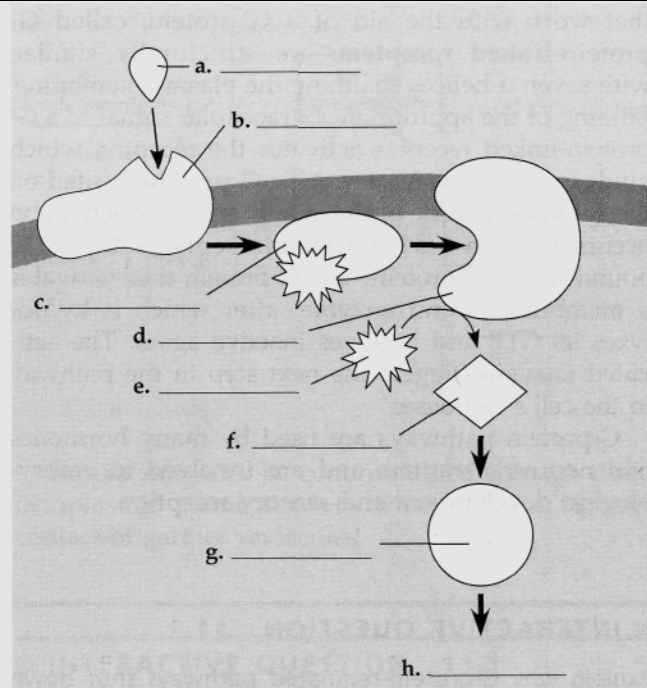


Fig. 11.10

| |
|----|
| a. |
| b. |
| c. |
| d. |
| e. |
| f. |
| g. |
| h. |

6. Fill in the blanks to review the steps in a signal transduction pathway involving a tyrosine-kinase receptor and Ca^{2+} as a second messenger.

A ___(a)___ binds to a tyrosine-kinase receptor. Two such activated receptor aggregate to form a ___(b)___ . The ___(c)___ on the cytoplasmic side of the receptor activate the enzyme ___(d)___, which cleaves a membrane phospholipid into DAG and ___(e)___ . ___(e)___ opens a ligand-gated channel, releasing ___(f)___ from the ___(g)___ . Ca^{2+} usually binds to ___(h)___, which regulates other proteins in the pathway to cellular responses.

| |
|----|
| a. |
| b. |
| c. |
| d. |
| e. |
| f. |
| g. |
| h. |

7. How do the following mechanisms or molecules maintain a cell's ability to respond to fresh signals?

a. reversible binding of signal molecules:

b. GTPase activity of *G* protein:

c. phosphodiesterase:

d. protein phosphatases:

8. Why is cell signaling such an important component of a cell's life?

9. Briefly describe the three stages of cell signaling.

10. Some signal pathways alter a protein's activity; others may result in the production of new proteins. Explain the mechanisms for these two different responses.

11. How does an enzyme cascade produce an amplified response to a signal molecule?