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# Types of Cell signalling

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# Cell Signaling

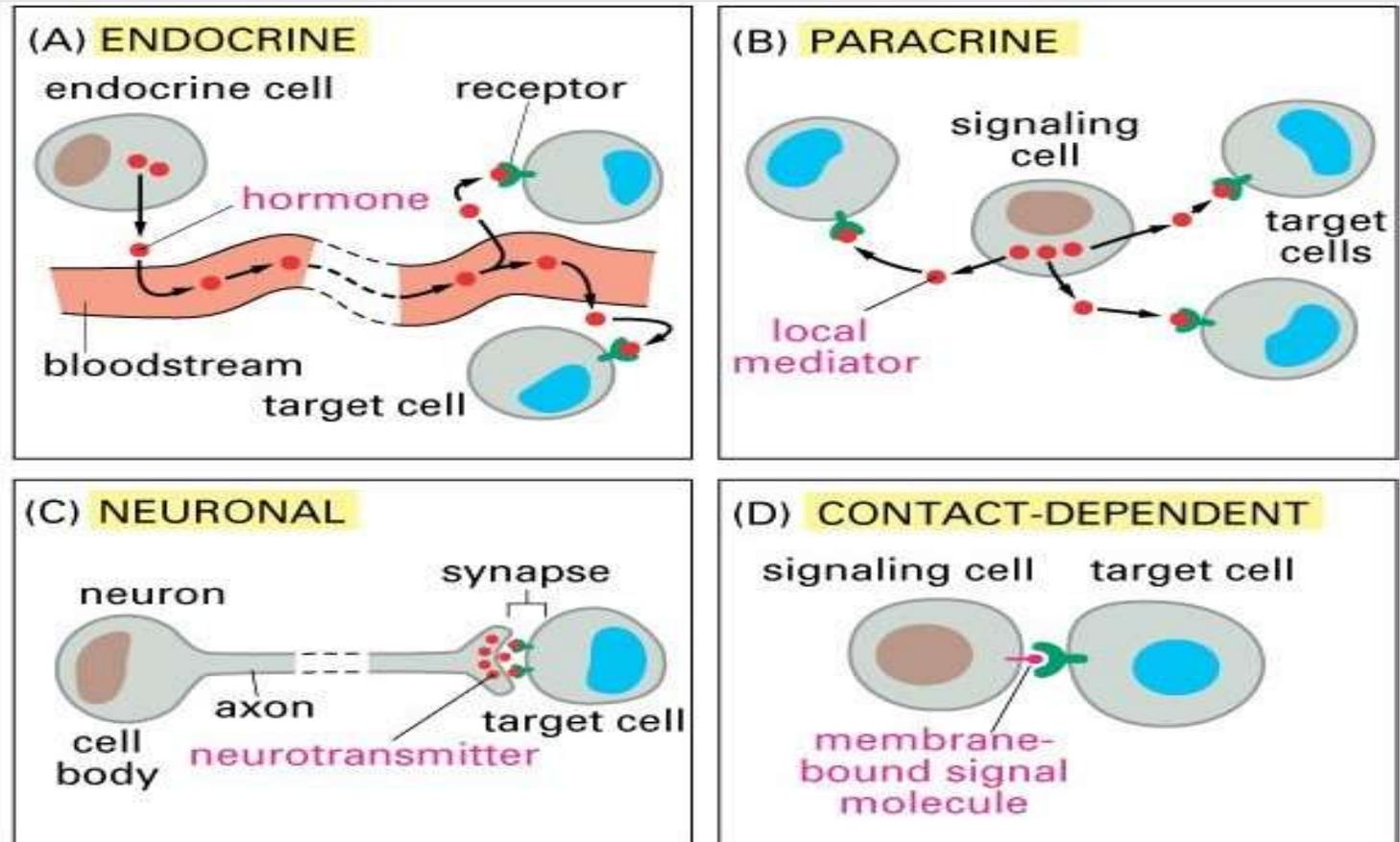


Figure 16-3 Essential Cell Biology, 2/e. (© 2004 Garland Science)



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- Cells typically communicate using chemical signals.
  - These chemical signals, which are proteins or other molecules produced by a **sending cell**, are often secreted from the cell and released into the extracellular space.
- There, they can float – like messages in a bottle – over to neighboring cells.



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# Forms of signalling

- There are four basic categories of chemical signaling found in multicellular organisms:
- paracrine signaling,
- autocrine signaling,
- endocrine signaling, and
- signaling by direct contact.



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# Paracrine

Often, cells that are near one another communicate through the release of chemical messengers (ligands that can diffuse through the space between the cells).

- This type of signaling, in which cells communicate over relatively short distances, is known as
- One unique example of paracrine signaling is **synaptic signaling**, in which nerve cells transmit signals. This process is named for the **synapse**, the junction between two nerve cells where signal transmission occurs. **paracrine signaling**.



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When the sending neuron fires, an electrical impulse moves rapidly through the cell, traveling down a long, fiber-like extension called an axon.

When the impulse reaches the synapse, it triggers the release of ligands called **neurotransmitters**, which quickly cross the small gap between the nerve cells.

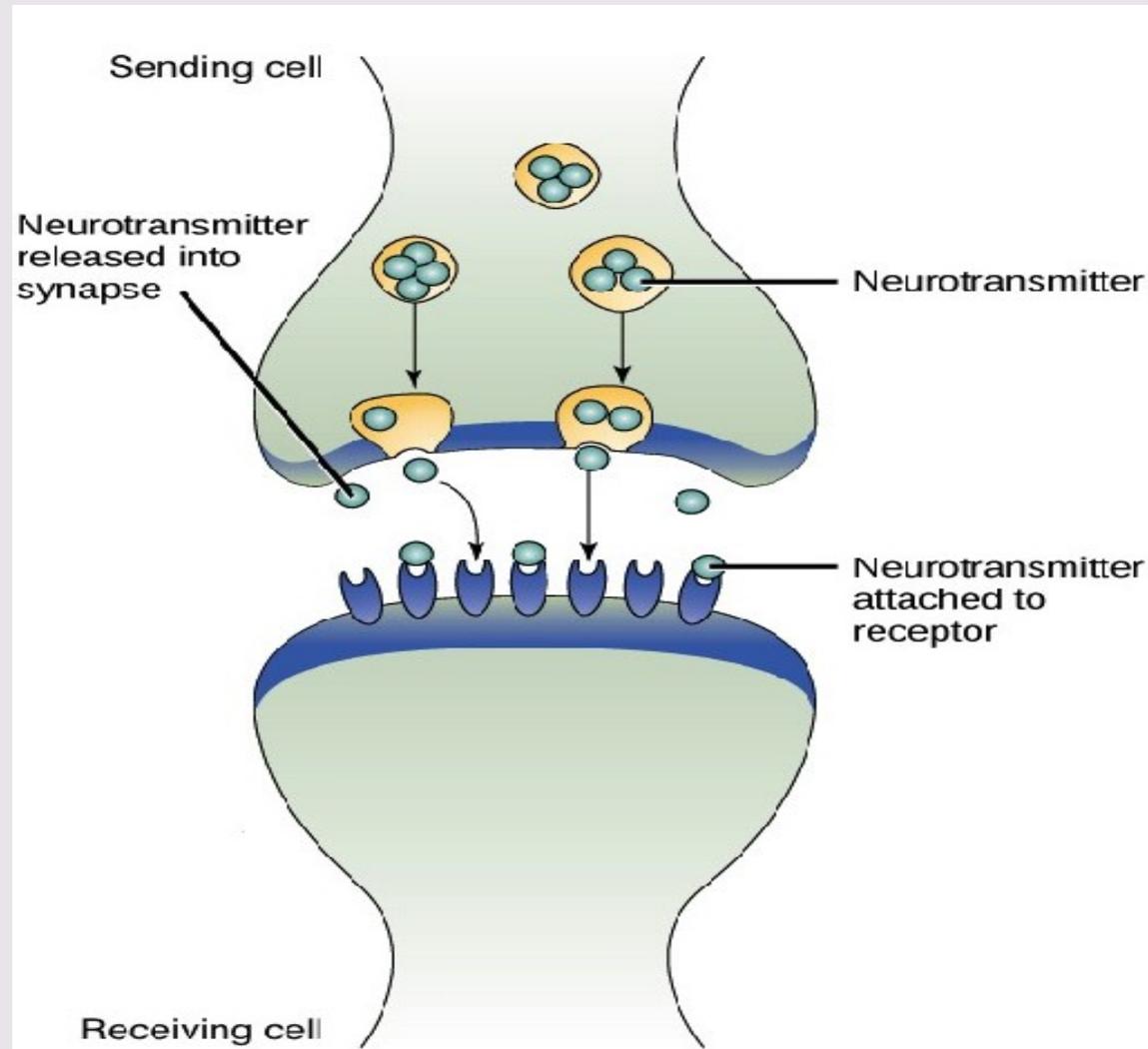
When the neurotransmitters arrive at the receiving cell, they bind to receptors and cause a chemical change inside of the cell (often, opening ion channels and changing the electrical potential across the membrane).

The neurotransmitters that are released into the chemical synapse are quickly degraded or taken back up by the sending cell. This "resets" the system so the synapse is prepared to respond quickly to the next signal.



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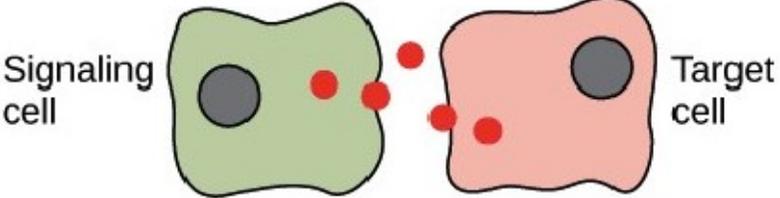
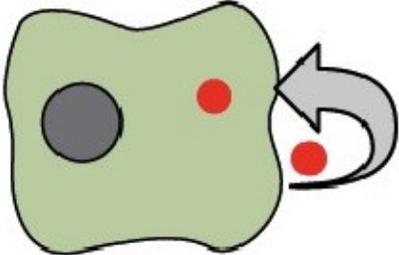
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Paracrine	A cell targets a nearby cell.
 <p>Signaling cell</p> <p>Target cell</p>	
Autocrine	A cell targets itself.
	



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# Autocrine signaling

In **autocrine signaling**, a cell signals to itself, releasing a ligand that binds to receptors on its own surface (or, depending on the type of signal, to receptors inside of the cell).

This may seem like an odd thing for a cell to do, but autocrine signaling plays an important role in many processes.

For instance, autocrine signaling is important during development, helping cells take on and reinforce their correct identities.

From a medical standpoint, autocrine signaling is important in cancer and is thought to play a key role in metastasis (the spread of cancer from its original site to other parts of the body).

In many cases, a signal may have both autocrine and paracrine effects, binding to the sending cell as well as other similar cells in the area.



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# Endocrine signaling

When cells need to transmit signals over long distances, they often use the circulatory system as a distribution network for the messages they send.

In long-distance **endocrine signaling**, signals are produced by specialized cells and released into the bloodstream, which carries them to target cells in distant parts of the body.

Signals that are produced in one part of the body and travel through the circulation to reach far-away targets are known as **hormones**.

In humans, endocrine glands that release hormones include the thyroid, the hypothalamus, and the pituitary, as well as the gonads (testes and ovaries) and the pancreas.

Each endocrine gland releases one or more types of hormones, many of which are master regulators of development and physiology.

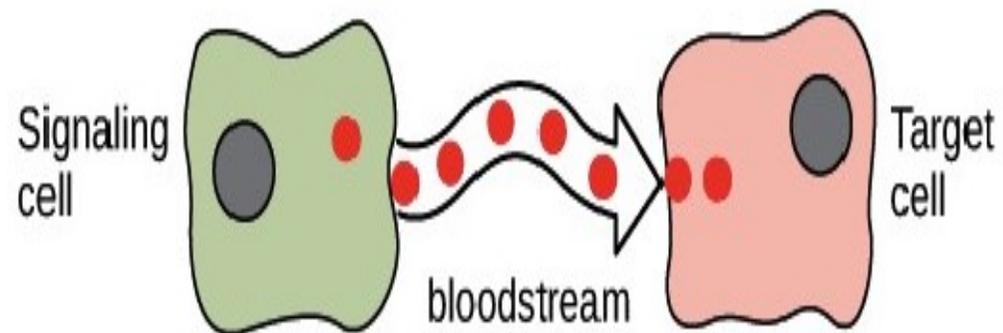


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Endocrine

A cell targets a distant cell through the bloodstream.





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# Signaling through cell-cell contact

Gap junctions in animals and plasmodesmata in plants are tiny channels that directly connect neighboring cells.

These water-filled channels allow small signaling molecules, called **intracellular mediators**, to diffuse between the two cells.

Small molecules, such as calcium ( $Ca^{2+}$ ), are able to move between cells, but large molecules like proteins and DNA cannot fit through the channels without special assistance.

The transfer of signaling molecules transmits the current state of one cell to its neighbor.

This allows a group of cells to coordinate their response to a signal that only one of them may have received. In plants, there are plasmodesmata between almost all cells, making the entire plant into one giant network.

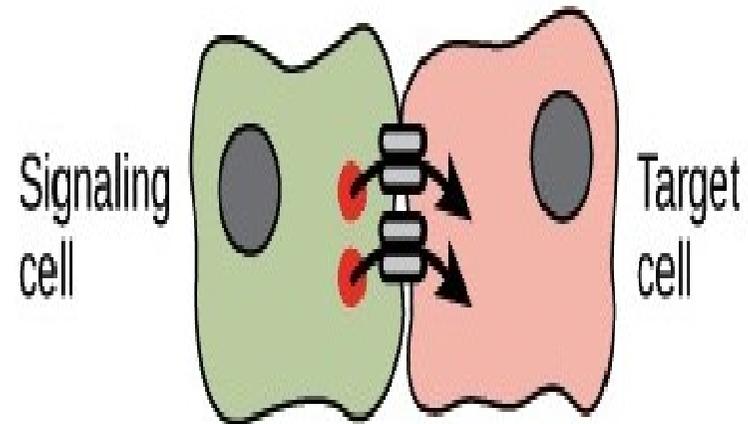


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Signaling across gap junctions

A cell targets a cell connected by gap junctions.





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In another form of direct signaling, two cells may bind to one another because they carry complementary proteins on their surfaces.

- When the proteins bind to one another, this interaction changes the shape of one or both proteins, transmitting a signal.

- This kind of signaling is especially important in the immune system, where immune cells use cell-surface markers to recognize “self” cells (the body's own cells) and cells infected by pathogens

A natural killer (NK) immune cell recognizes a healthy cell of the body by binding to a "self" marker on the cell's surface.

