

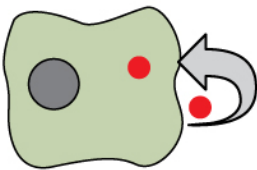
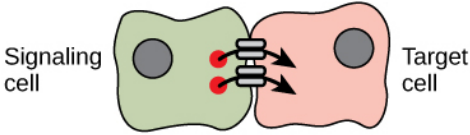
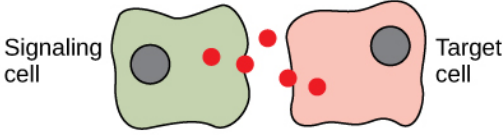

Cell Communication

Cell-to-Cell communication is essential for multicellular organisms. The billions of cells of a human or a maple tree must communicate in order to develop from a fertilized egg through adulthood. Communication among cells is also important for many unicellular organisms that must locate food and find mates for sexually reproduction.

The signals received by cells, whether originating from another cell or from some change in the organism's physical surroundings, take various forms. Cells can sense and respond to electromagnetic signals, such as light, and to mechanical signals, such as touch. However, cells most often communicate with each other using chemical signals.

There are three ways cells communicate with one another.

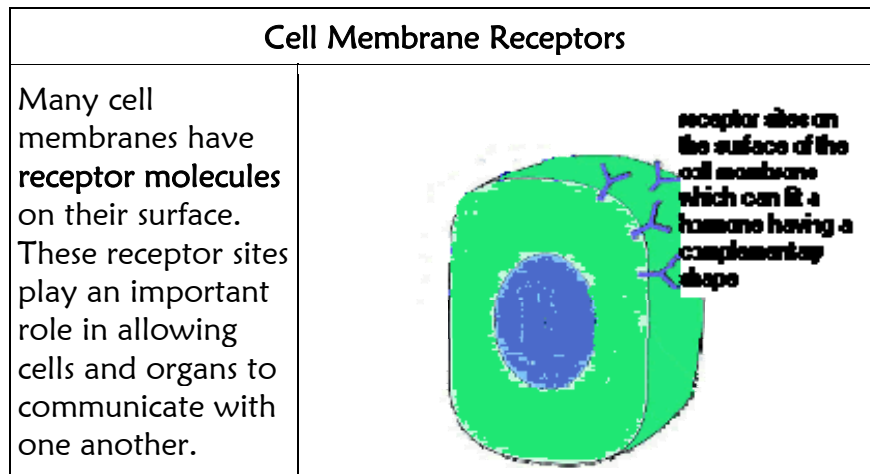
- ◆ **Autocrine Signaling:** the chemical works on the same cell that produces it
- ◆ **Paracrine Signaling:** the signaling cell is nearby the target cell. Neuron to neuron communication is an example of paracrine signaling.
- ◆ **Hormone Signaling:** the hormone is secreted by cells of a gland in one part of the body into the bloodstream and travel to the target cells in another part of the body.

Forms of Chemical Signaling	
Autocrine	A cell targets itself.
	
Signaling across gap junctions	A cell targets a cell connected by gap junctions.
	
Paracrine	A cell targets a nearby cell.
	
Endocrine	A cell targets a distant cell through the bloodstream.
	

In all three types of signaling, the target cells must have receptors on the cell membrane that will fit with the chemical signal. If the chemical signal does not fit with receptors on the cell membrane, the

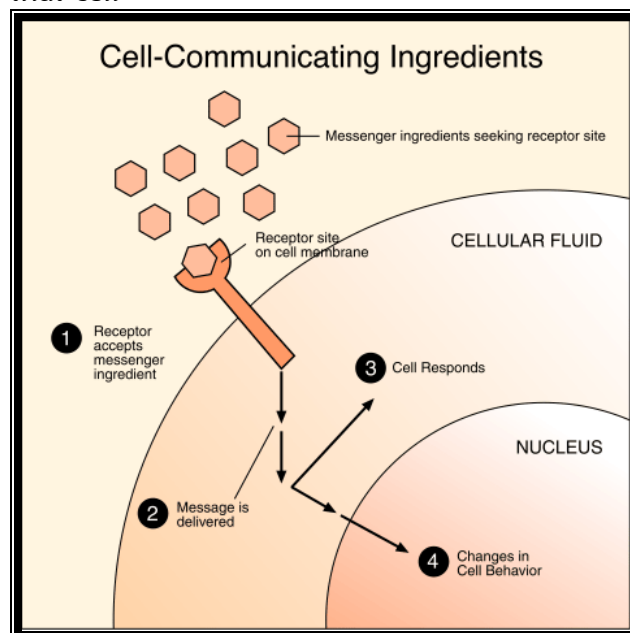
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cell will not be affected. The binding of a chemical to a receptor cell triggers a series of reactions within the cell that affects the function of that cell.



Hormones are generally protein chemical messengers that are secreted by the **glands** of the **endocrine system**.

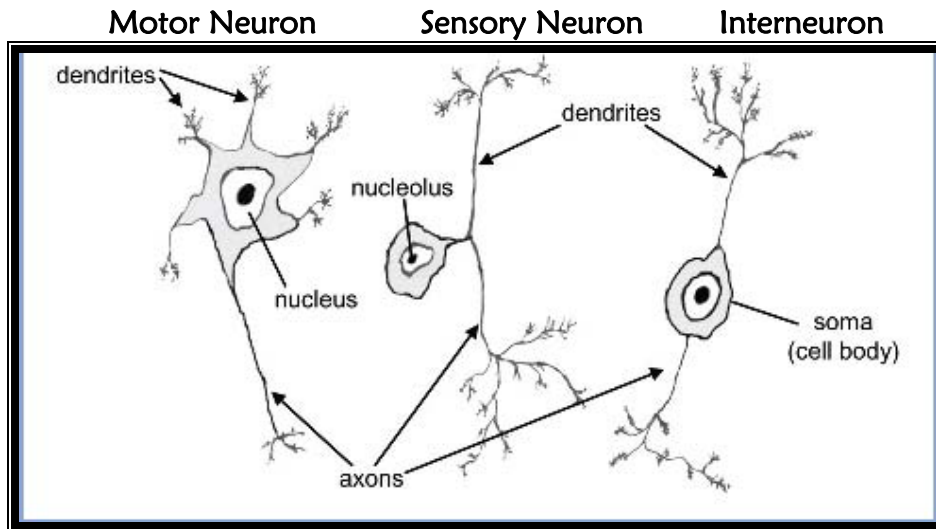
- ◆ Generally, glands in one part of the body, but target cells in another part of the body secrete hormones.
- ◆ In vertebrates, **hormones travel in the circulatory system** to get to their target cells.
- ◆ However, in some cases, hormones may be paracrine signalers, acting on cells within their local area. (see cell G in diagram below).
- ◆ Hormone receptors are found either exposed on the surface of the cell or within the cell, depending on the type of hormone that is involved in the signaling process.
- ◆ If the hormone fits in the receptor cell, then the cell will respond and effect a change in behavior or function of that cell



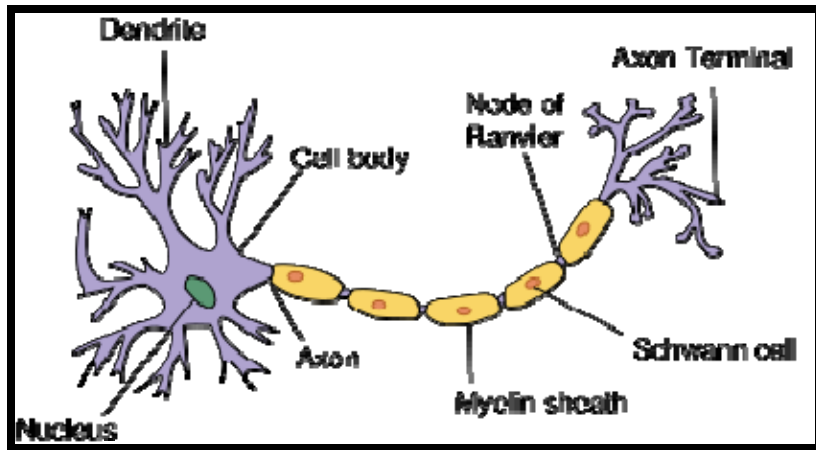
Neurons: are specialized cells that make up the nerves of the nervous system. They carry sensory information from the environment to the spinal cord and brain for interpretation and then carry the response of the brain and spinal cord to the muscles and endocrine glands.

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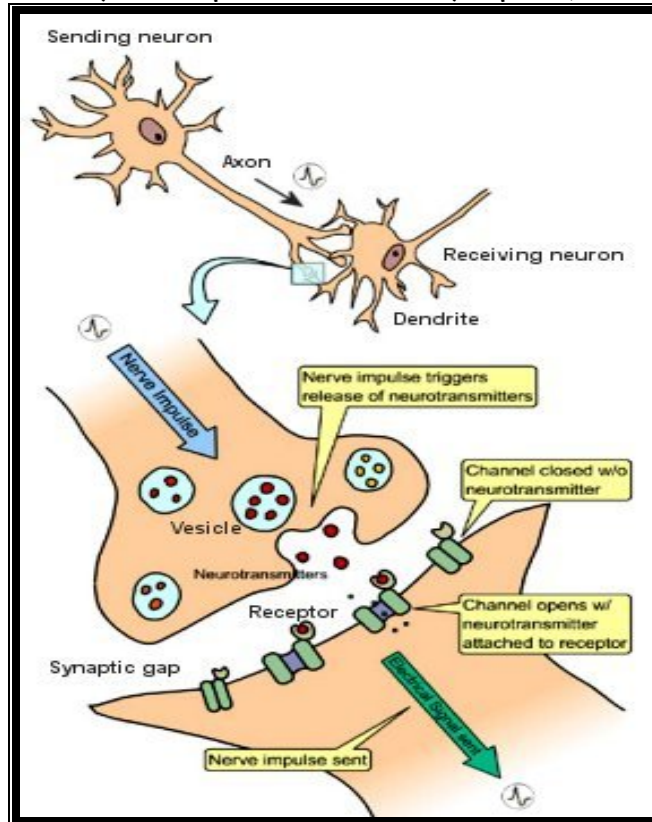
- ◆ There are 3 types of neurons
 - sensory neurons**: carry the stimuli from the sensory organs to the spinal cord and brain for interpretation.
 - interneurons** (associative neurons): **found in the spinal cord, and brain**, between the sensory and motor neurons
 - motor neurons**: carry the interpretation of sensory input to the muscles and/or endocrine glands, which respond to the stimulus.
- ◆ A diagram illustrating sensory, motor and interneurons is pictured below:



- ◆ Sensory information is picked up by receptors embedded in our receptor cells of our sense organs.
- ◆ Sensory information is converted to an **electrochemical signal** or **IMPULSE** which travels in **ONE** direction from sensory neurons to interneurons of the spine and brain (where it is interpreted) and then sent back down the interneurons of the spine to the motor neurons to glands or muscles (**effectors**) which carry out the response to the stimulus.
- ◆ Nerves are made up of individual neurons that are separated by one another by spaces called **synapses**.
- ◆ A typical neuron that is generally depicted is that of a nerve cell as pictured below:



- ◆ **Dendrites:** hair-like structures that branch off the **cell body (cyton)** of the neuron – pick up and conduct incoming sensory signals.
- ◆ **Axon:** conducts signal from cyton to the terminal branches. The axon is covered in a **myelin sheath**, a fatty covering made by the **Schwann cells**, which acts as an insulator and, along with the **Nodes of Ranvier**, help to speed up transmission of the signal.
- ◆ **Terminal Branches:** at the end of the terminal branches are **synaptic buttons**, which produce **neurotransmitters** that carry the impulse across the synapse. (see diagram below)



--Examples of neurotransmitters include:

- ✓ **Acetylcholine: (ACh)** involved in muscle action
- ✓ **Dopamine:** brain neurotransmitter, involved in regulating movement and emotion, Loss of dopamine has been implicated in the development of Parkinson's disease.
- ✓ **Serotonin:** involved in sleep, depression, and memory

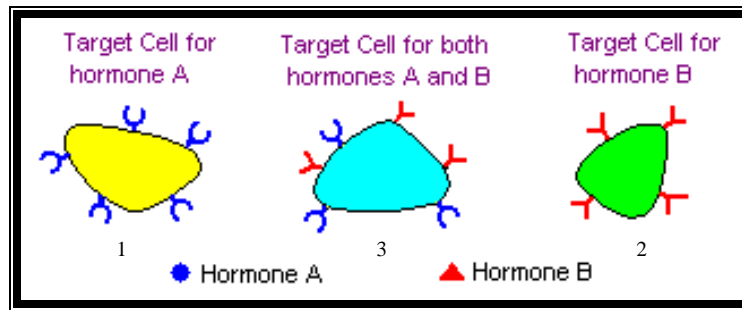
If chemical signaling is blocked in any way, cells communication may be interrupted and organism homeostasis may be negatively affected.

Check for Understanding:

1. Why is cell communication necessary for multicellular organisms to survive?
2. Why are autocrine and paracrine signaling referred to as local signaling, while hormone signaling, is often called long distance signaling?
3. Define the term hormones.
4. If a hormone, such as follicle stimulating hormone (FSH) is produced in the pituitary gland (in your head, above your ear) how can FSH stimulate the ovaries to begin the maturation of an egg.

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5. Examine the following diagram. Explain why the cell 1 cannot be stimulated by hormone B,
6. Using the same diagram, explain why the Cell 3 can be affected by both hormones A and B.



7. Differentiate among sensory, motor, and interneurons.
8. Label the motor neuron on the next page and provide a brief description of each labeled part.
9. You are sitting in Living Environment class and begin to daydream. Your instructor notices your lack of attention and gives you one of her teacher looks. You don't notice; you are caught somewhere between drifting off to sleep and imagining you have just won your school's talent show. Your table partner elbows you. You jump to attention and, much to your embarrassment, a loud "Hey" comes out of your mouth, disrupting the entire class. Trace the impulse pathway from your skin registering the poke in your side to the time you yell out "Hey".
10. What is a neurotransmitter? Where is it made?
11. How does the impulse cross the synapse between two neurons?
12. Acetylcholine is a neurotransmitter that is involved in muscle action. Hypothesize as to what may happen if a neuron in a major motor nerve is cut and unable to function.

