Neurons: What They're Made Of and How They Function

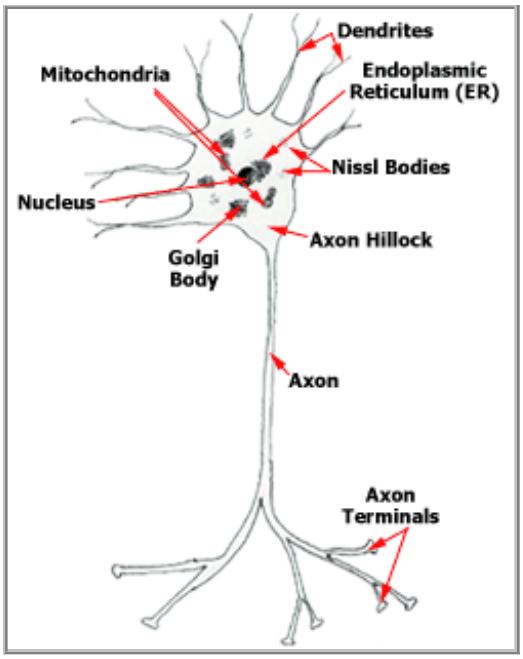
Drs. Foster & Smith Educational Staff

What is a neuron?

The nervous system is responsible for sending signals from one part of the body to another. It accomplishes this with a complex circuit of nerves. Nerves are bundles of cells called "neurons" that are arranged similar to the strands in a rope. The neurons are actually responsible for the conduction of communication signals. They are similar to other cells of the body, but they have some specialized modifications that allow them to communicate with each other.

What makes up a neuron?

Neurons have a unique shape. They have three distinct regions, the soma, the dendrites, and the axon.



The soma

The soma (or cell body) is the enlarged portion of the cell that contains the genetic material in the nucleus and the following other organelles which are all components of a normal body cell:

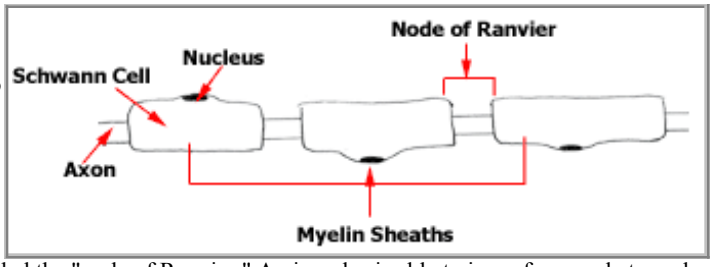
- Ribosomes: there are groups of ribosomes for protein synthesis called "nissl bodies"
- Endoplasmic reticulum (ER): for transporting the proteins
- Mitochondria: for energy production
- Golgi bodies: for packaging chemicals for transport to other cells

Dendrites

Dendrites are short, spiny processes that extend off of the soma. They are responsible for receiving input and transmitting signals to the soma. There are usually several dendrites per cell.

Axons

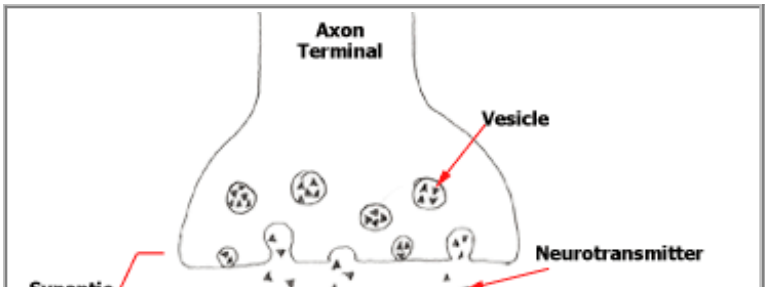
Generally, each cell has only one axon and it leaves the soma at an enlargement called the "axon hillock." The length of axons is greatly variable. They range from a fraction of an inch up to over 3 feet in length. The axon carries signals away from the soma.



Some axons are covered with a fatty, white sheath – the myelin sheath. The sheath serves to protect and electrically insulate the axons from others nearby, so the signal is not inadvertently sent the wrong way. Also, myelinated axons are able to send signals much faster than unmyelinated axons, because of the sheath. The sheath is made up of cells called "Schwann cells." The plasma membrane of these cells is enlarged and wraps around the axon many times. Between each Schwann cell, there is a gap called the "node of Ranvier." An impulse is able to jump from node to node, making the signal travel down the myelinated axon much faster.

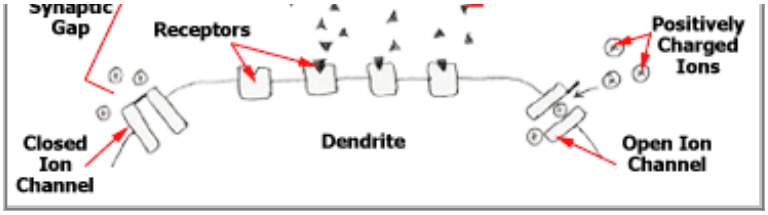
The junction of one neuron's axon with another neuron's dendrite is called the "synapse," and is where the cells are able to communicate with each other.

What happens at the synapse?

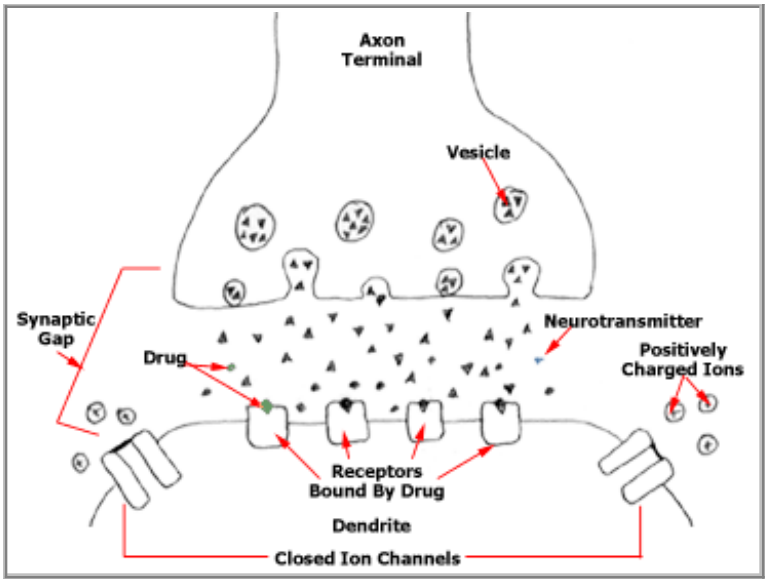


Axons have an enlargement at the end called the "axon terminal." The terminals are full of many small vesicles that contain complex chemicals called "neurotransmitters." When the electrical signal traveling down the axon reaches the terminal, the neurotransmitters are released into the space between the axon of the cell and nearby dendrites of another cell. This space is known as the "synaptic cleft." Once the chemicals cross the synaptic cleft,

they bind to special receptors on the dendrites. When bound, these receptors open channels in the cell membrane that allow positively charged particles (called ions) to enter the cell, changing the internal chemistry. This change, if great enough, will cause an electrical impulse to start at the axon hillock of the receiving neuron and travel down its axon to the next neuron.



Drug research focused on the blocking of neurotransmitter binding sites has been very successful. For example, imagine that pain signals are being sent to the brain along a certain neural pathway. A drug is administered that binds irreversibly to the neurotransmitter receptors in this pathway. The impulse is started along the path, but when the neurotransmitters are released into the synaptic cleft, there is no place for them to bind, because the receptors are already bound by the drug. Therefore, the signal is stopped, and the animal cannot perceive pain.



Conclusion

Neurons are some of the most delicate cells of the body, but they are also some of the most essential. They are the functional unit of the nervous system. Without them, the perceptions of pain, touch, emotion, and even memory would not be possible.

Interesting facts

- The human brain has more than 100 billion neurons.
- In almost all cases, neurons cannot be replaced after they die.
- Neurons are some of the oldest cells in the body. You may have some of the same cells your whole life.
- Neurons can be very long cells. Those that run from the spinal cord to the toes can be over 3 feet long.
- About one half of all neurons are myelinated.