http://www.youtube.com/watch?v=i-NgGKSNiNw&safety_mode=true&persist_safety_mode=1&safe=active

Neural Communication

Our Nervous System is basically made up of billions of nerve cells called **neurons**. Each neuron is composed of the following:

1. **Dendrites**: bushy ends that receive messages.
2. **Cell Body:** the cell's control center.

3. **Axon:** a branching fiber that sends messages away from the cell body to the next neuron, muscle, or gland.

4. **Myelin Sheath:** layer of fatty *tissue* also known as Schwann cells that help speed up impulses by insulating the axon and providing *Nodes of Ranvier* (gaps between the cells) that allow for quick node to node hopping.

Glial cells guide neural connections and provide nutrients to nerve cells in the brain. Myelinated axons form the *white* matter of the nervous system while the non-myelinated axons, dendrites and cell bodies form the *gray* matter.

**MS attacks the myelin sheath

The human brain holds about 100 billion nerve cells.

http://www.ted.com/talks/ed_boyden.html

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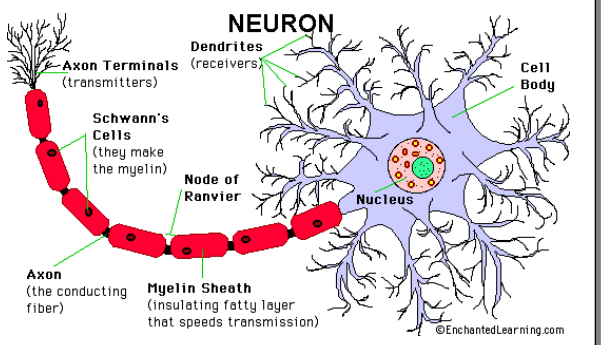

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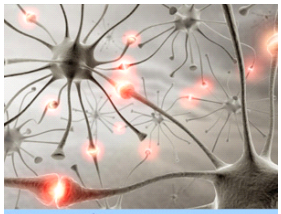
Action Potential

An impulse or an **action potential** is a brief electrical charge that is received by the dendrites, simulates the cell body and travels the length of the axon by *depolarizing the normally polarized axon.*

A neuron at rest has a positive-outside/negative-inside charge differential. This is called the cell's **resting potential**. Because the cell's membrane is selectively permeable, a neuron is stimulated and positive ions are able to rush in and depolarize the axon.

During the refractory period, the neuron will pump the positive ions back outside to restore the cell's resting potential. Then it can fire again.



Brain neurons firing

http://www.youtube.com/watch?v=ifD1YG07fB8&feature=related&safety_mode=true&persist_safety_mode=1&safe=active

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***Note:** neural messages usually travel in one direction only, from the dendrites to the cell body and down the length of the axon.

The intensity of a stimulus is called the **threshold**. A stimulus must exceed the threshold in order for a transmission to occur . *(Dominoes)* This is called the *all-or-none-response*. To differentiate between a really strong stimulus and a weak one, only the *number of neurons* firing will increase and not their speed.

http://epsych.msstate.edu/biological/neuron/Part2/index.html

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How Neurons Communicate - The Synapse

The axon terminal of the sending neuron is separated from the receiving neuron by a tiny gap called the **synapse** (or **synaptic cleft**).

Once the action potential reaches the synapse, **neurotransmitters**, or *chemical messengers*, are released into the gap where they will bind onto *specific* receptor sites on the receiving neuron. These chemicals can either induce or inhibit neural firing by either allowing ions in or not. Excess neurotransmitters are reabsorbed - reuptake.

When excitory - inhibitory > threshold ...the neuron fires!

http://www.youtube.com/watch?v=LT3VKAr4roo&feature=related&safety_mode=true&persist_safety_mode=1&safe=active

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Scientists have isolated more than sixty neurotransmitters:

Acetylcholine (ACh): This is the most well know neurotransmitter and causes muscles to contract in movement. Also involved in learning and memory. (Alzheimers)
{botulin/black widow spider}

Endorphins: neurotransmitters that are similar to morphine and are a natural opiate. They are released in response to pain and heavy exercise and induce pleasure (explaining runner's high)

Dopamine: movement, learning, attention and emotion. (Excess - schizophrenia, deficiency - Parkinsons)

Serotonin: mood, hunger, sleep and arousal. (Too little - depression, Prozac and other antidepressants raise serotonin levels.)

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The following types of drugs can alter neurotransmission:

1. **Agonists:** molecules that *mimic* the shape of natural neurotransmitters and thereby mimic its effects. An example would be morphine binding to the same receptor sites to which endorphins bind.

2. **Antagonists:** molecules that *block* neurotransmitters from binding to receptor sites. It mimics a natural neurotransmitter but is not similar enough to stimulate the receptor and mimic the effect. An example would be curare, a poison used by South American hunters, mimic and block Ach sites thereby paralyzing prey.

3. **Others:** There are a variety of drugs that inhibit the natural breakdown or re-absorption of the neurotransmitter. An example would be Prozac, an anti-depressant drug that prevents the re-absorption of serotonin from the synapse allowing it to linger longer in the synapse thereby enhancing serotonin's mood-lifting effect.

The brain has a ***Blood-brain barrier*** *that filters out unwanted chemicals in blood stream.*

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