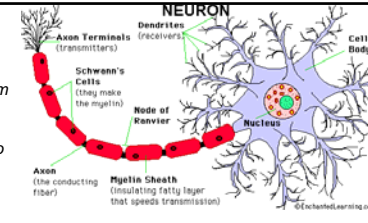
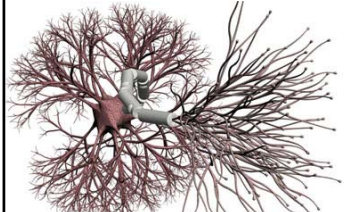


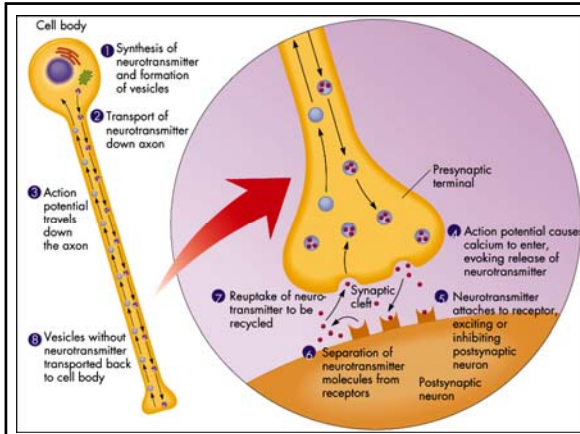
The human brain has about 100 billion neurons in it.

Neurons range in length from <1 millimeter to 1 meter.

Each neuron is connected to between 1,000 and 10,000 other neurons.

Octopus: 300 million neurons
Honey bee: 950 thousand
Leech: 350



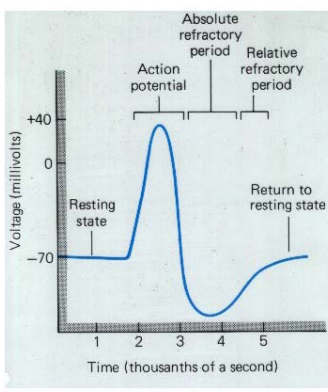
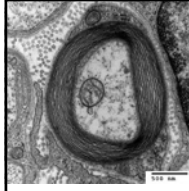
Resting state of neuron is about -70 mV.

Some neurotransmitters excite (depolarize) neurons (i.e., raise voltage), others inhibit (hyperpolarize) neurons (i.e., lower voltage).

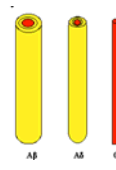
If voltage of neuron gets above -55 mV, we say that it has crossed the **threshold** for an action potential.

During **action potential**, voltage of neuron shoots up to $+40$ mV, then falls back down and the process begins anew.

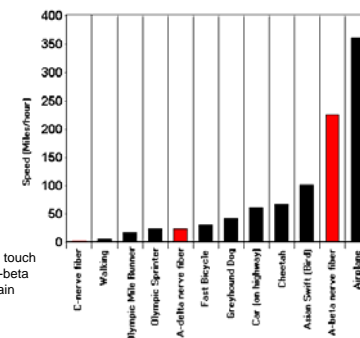
Action potentials cause release of neurotransmitters to postsynaptic neurons.

Microscopic image of myelin coating of an axon.



A-beta carries touch information. A-beta and C carry pain information.



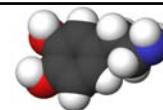
Category	Speed (Miles/hour)
C-nerve fiber	~1
Walking	~3
Olympic Mile Runner	~10
Olympic Sprinter	~20
A-delta nerve fiber	~30
Fast Bicycle	~40
Greyhound Dog	~50
Car (on highway)	~60
Cheetah	~70
Asian Swift (Bird)	~100
A-beta nerve fiber	~230
Airplane	~360

Agonist and Antagonist

- **Agonist**
 - Drug that binds to receptors and stimulates them (like a natural neurotransmitter would)
- **Antagonist**
 - Drug that binds to receptors, but doesn't stimulate them (blocks naturally occurring neurotransmitters from binding).

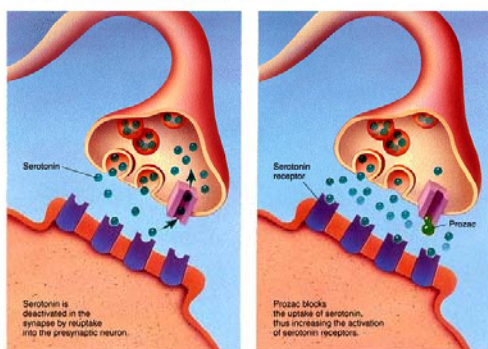


Dopamine



- Dopamine is neurotransmitter that plays roles in cognition, voluntary movement, motivation, sleep, mood, attention, etc.
 - Parkinson's disease patients have brains with almost no dopamine. Dopamine agonists can help Parkinson's patients regain function.
 - Schizophrenics have overactive dopamine systems. Dopamine antagonists can "turn down" the dopamine system, alleviating symptoms.

► Blockade of Serotonin Reuptake by Fluoxetine



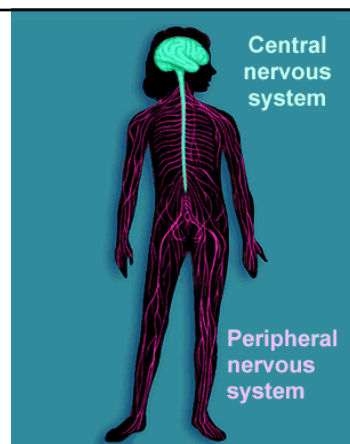
Central Nervous System (CNS): control center; brain and spinal cord

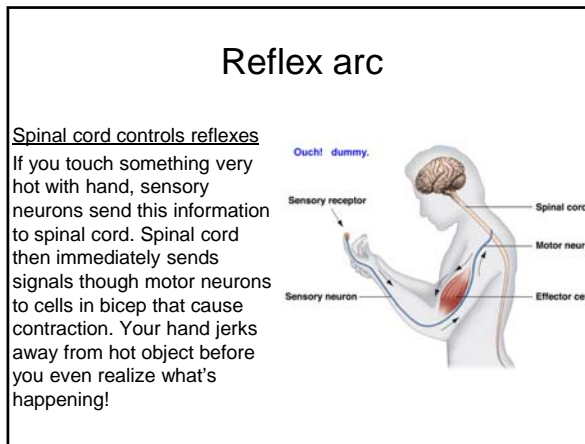
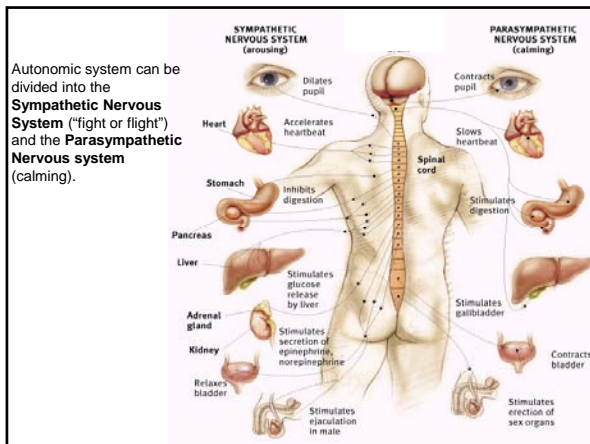
Peripheral Nervous System (PNS): highway system; sends signals back and forth between CNS and muscles, sense receptors, glands, etc.

PNS can be divided into nerve fibers that carry signals from brain (**somatic**) and those that carry signals from spinal cord and base of brain (**autonomic**)

Somatic: responsible for purposeful actions

Autonomic: responsible for mostly automatic functions (internal organs, glands, etc.)



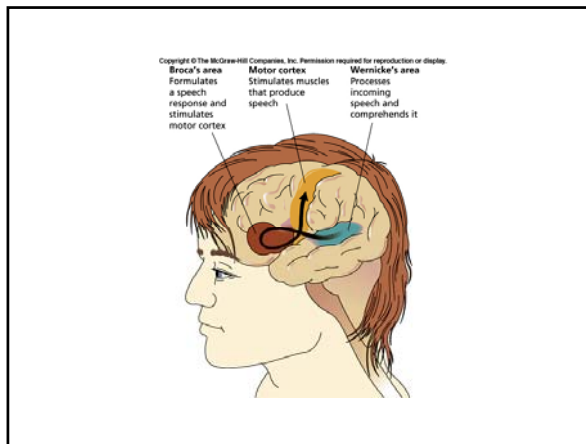
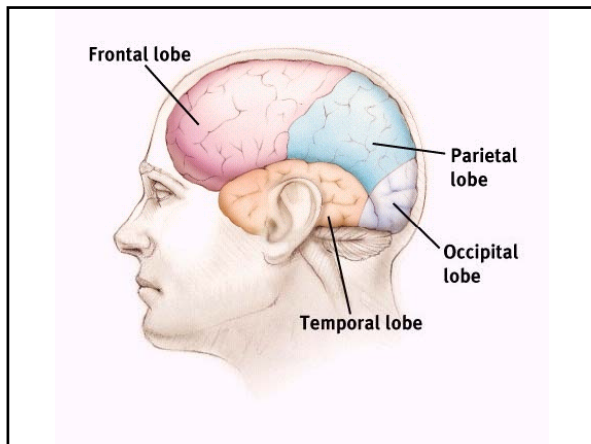


The brain

Average weight	2.7 pounds
% of body weight	2%
% of calories used	20%
% water / fat	78% / 11%
Surface area of cortex	2.5 feet
Total length of neurons	115,000 miles
# pain receptors	0

The Triune brain

- Simple (overly-simple) system used to describe the approximate evolution of the vertebrate brain.
- Reptilian brain: focuses on the four "F's:" feeding, fighting, fleeing, and...reproduction
 - Ancient (> 500 million years old), inner-most layer of brain
- Limbic system: produces emotions
 - More recent (200-300 million years old), middle layer of brain
- Neocortex: intellectual abilities, conscious awareness
 - Newest (100-150 million years ago), outer layer of brain



Wernicke's aphasia:

Receptive aphasia, meaning that you have trouble grasping the meaning of language (but you can speak sentences just fine).

Oftentimes, these patients will say sentences that are grammatically correct, but lack meaning.

"I called my mother on the television and did not understand the door. It was too breakfast, but they came from far to near. My mother is not too old for me to be young."

Some patients who recover report that things people were saying (including things they were saying themselves) didn't make any sense.



The autopsied brain of patient with Wernicke's aphasia. Note the large lesion where Wernicke's area should be.

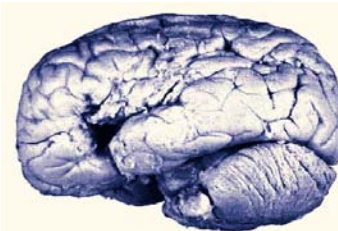
Broca's aphasia:

Expressive aphasia, meaning that you have trouble speaking (although you understand language).

Example of a man trying to describe how he got to the dentist:

"Yes... ah... Monday... er... Dad and Peter H... and Dad.... er... hospital... and ah... Wednesday.. Wednesday, nine o'clock... and oh... Thursday... ten o'clock, ah doctors... two... an' doctors... and er... teeth... yah."

Patients with Broca's aphasia who recover typically report that they knew what they wanted to say, but just couldn't get the words out properly.



The actual autopsied brain of Paul Broca's famous patient. Note the obvious lesion in what later became known as Broca's Area.

Split Brain Research

- Brain divided into 2 hemispheres (left and right).
 - Left controls speech.
 - Left hemisphere controls right sensory/motor system and vice-versa.
- Hemispheres connected by corpus callosum (~250 million neurons)
- Some epileptic patients have CC cut.
- Hemispheres cannot communicate.

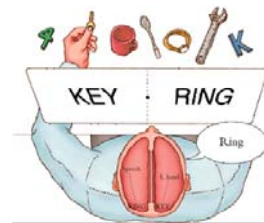
corpus callosum



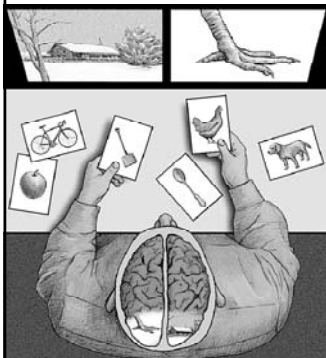
Split Brain Research

Split-brain patients will:

1. Verbally state that they see the word "ring." They will never mention the word "key."
2. Pick up a ring if asked to pick up what they see with their right hand.
3. Pick up a key if asked to pick up what they see with the left hand. They will not be able to verbally describe what they are holding, however, until they either look at it or put it in their right hand.



Split Brain Research



"I saw a claw and I picked the chicken, and you have to clean out the chicken shed with a shovel."

