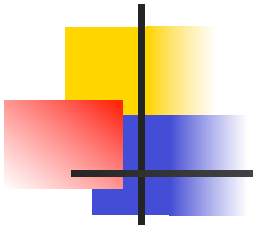
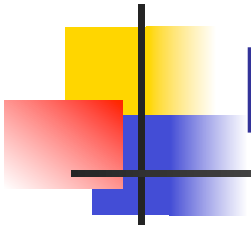
Biological Psychology



- branch of psychology concerned with the links between biology and behavior
- some biological psychologists call themselves *behavioral neuroscientists, neuropsychologists, behavior geneticists, physiological psychologists,* or *biopsychologists*

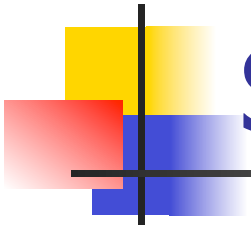
Principles of Biological Psychology

- Principles
  - Everything psychological is simultaneously biological.
  - The nervous system is complexity built from simplicity.
  - The brain is both specialized and integrated.
  - The nervous system is “plastic” especially at early ages of development.



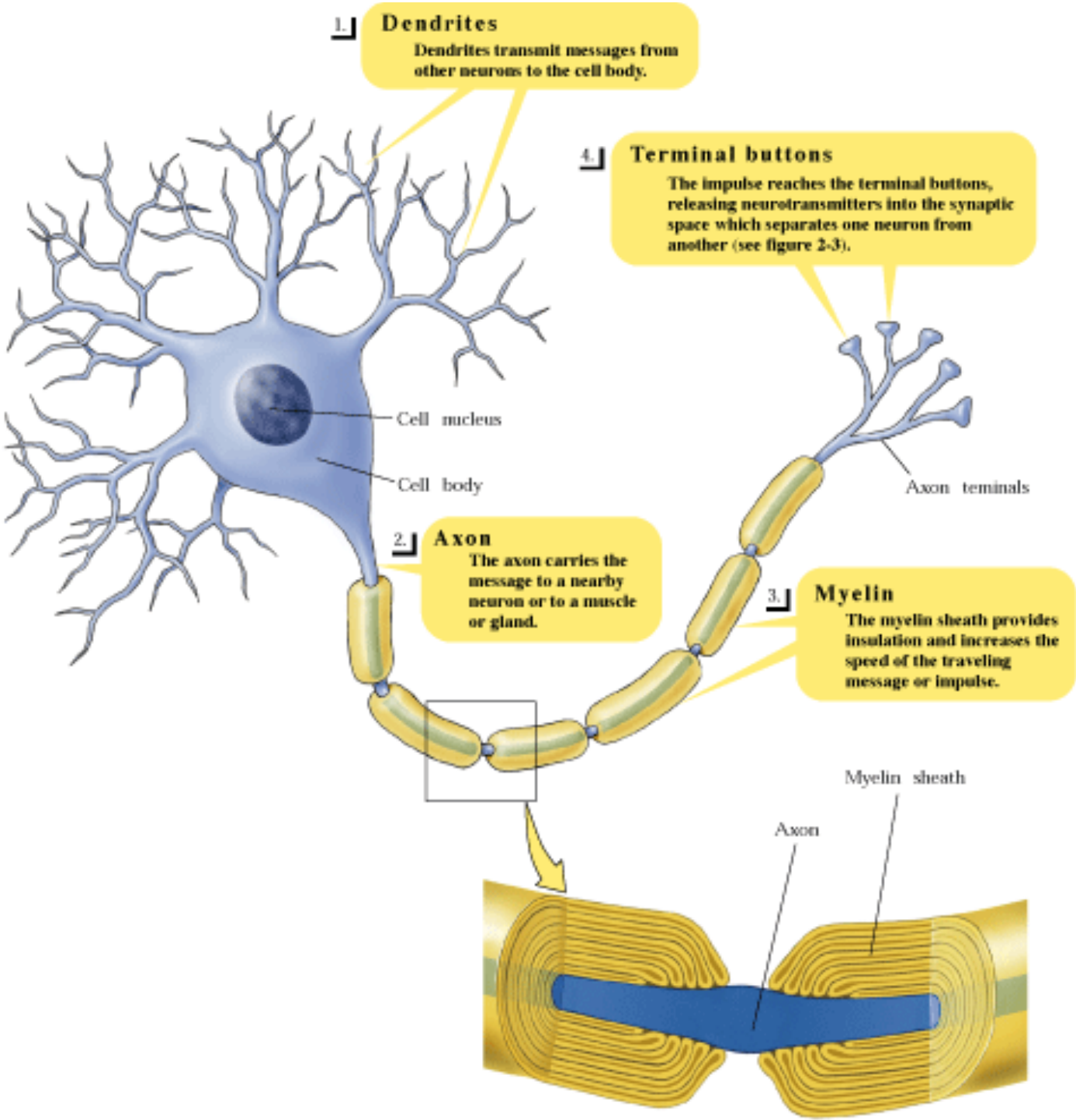
Neurons: The Messengers

- About 100 billion neurons (nerve cells) in the human brain
- Neurons have many of the same features as other cells
  - Nucleus
  - Cytoplasm
  - Cell membrane
- What makes neurons unique is their shape and function

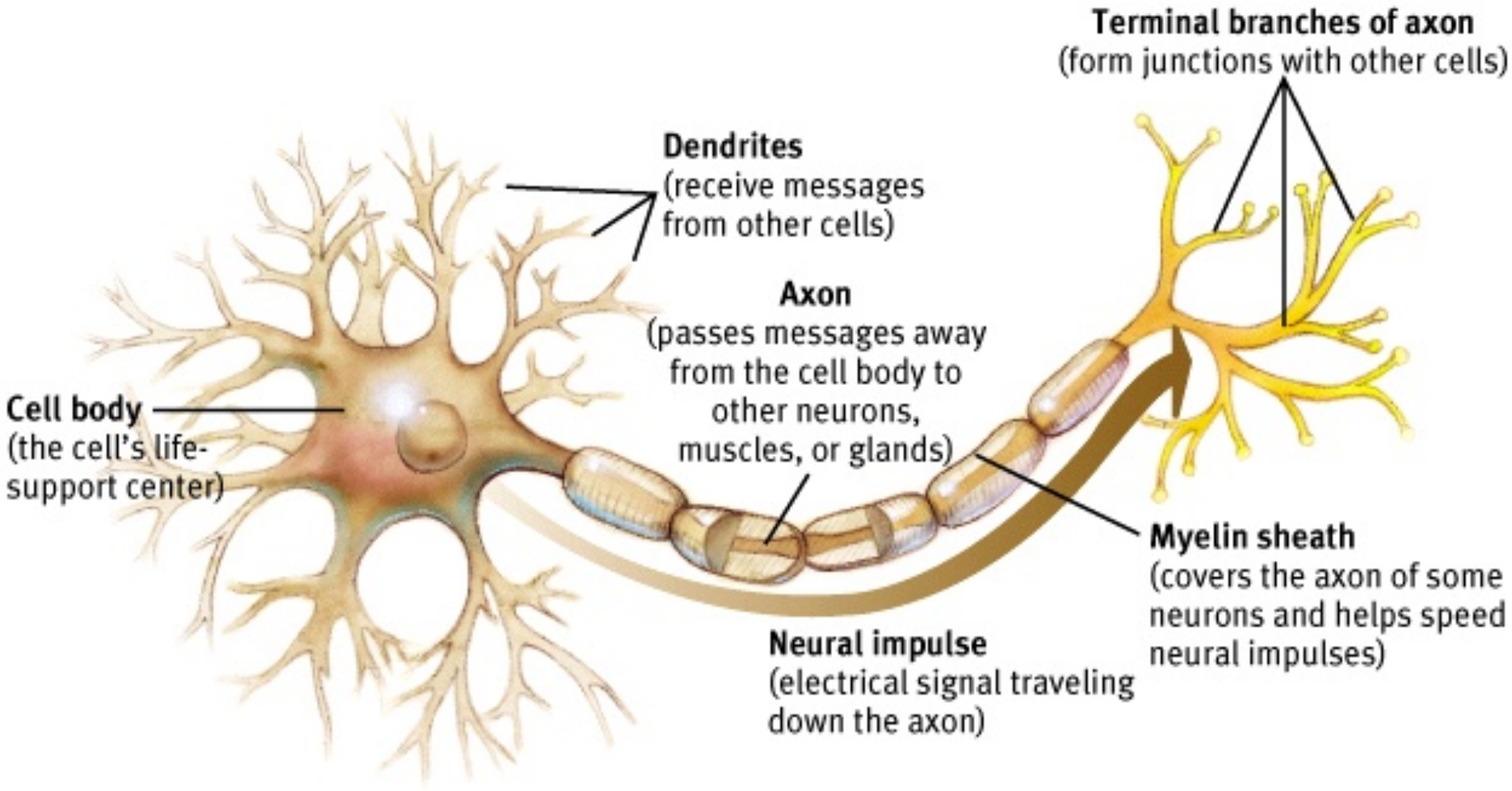


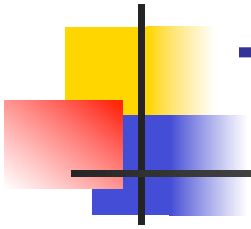
Structure of Neurons

- Dendrites
  - Carry information to the cell body from other neurons
- Cell Body (Soma)
  - Contains nucleus
- Axon
  - Carries information to the next cell
- Myelin Sheath
  - Insulates the axon and speeds up the neural impulse


1. Dendrites
Dendrites transmit messages from other neurons to the cell body.
4. Terminal buttons
The impulse reaches the terminal buttons, releasing neurotransmitters into the synaptic space which separates one neuron from another (see figure 2-3).
Cell nucleus
Cell body
Axon teminals
2. Axon
The axon carries the message to a nearby neuron or to a muscle or gland.
3. Myelin
The myelin sheath provides insulation and increases the speed of the traveling message or impulse.
Myelin sheath
Axon

Neural Communication



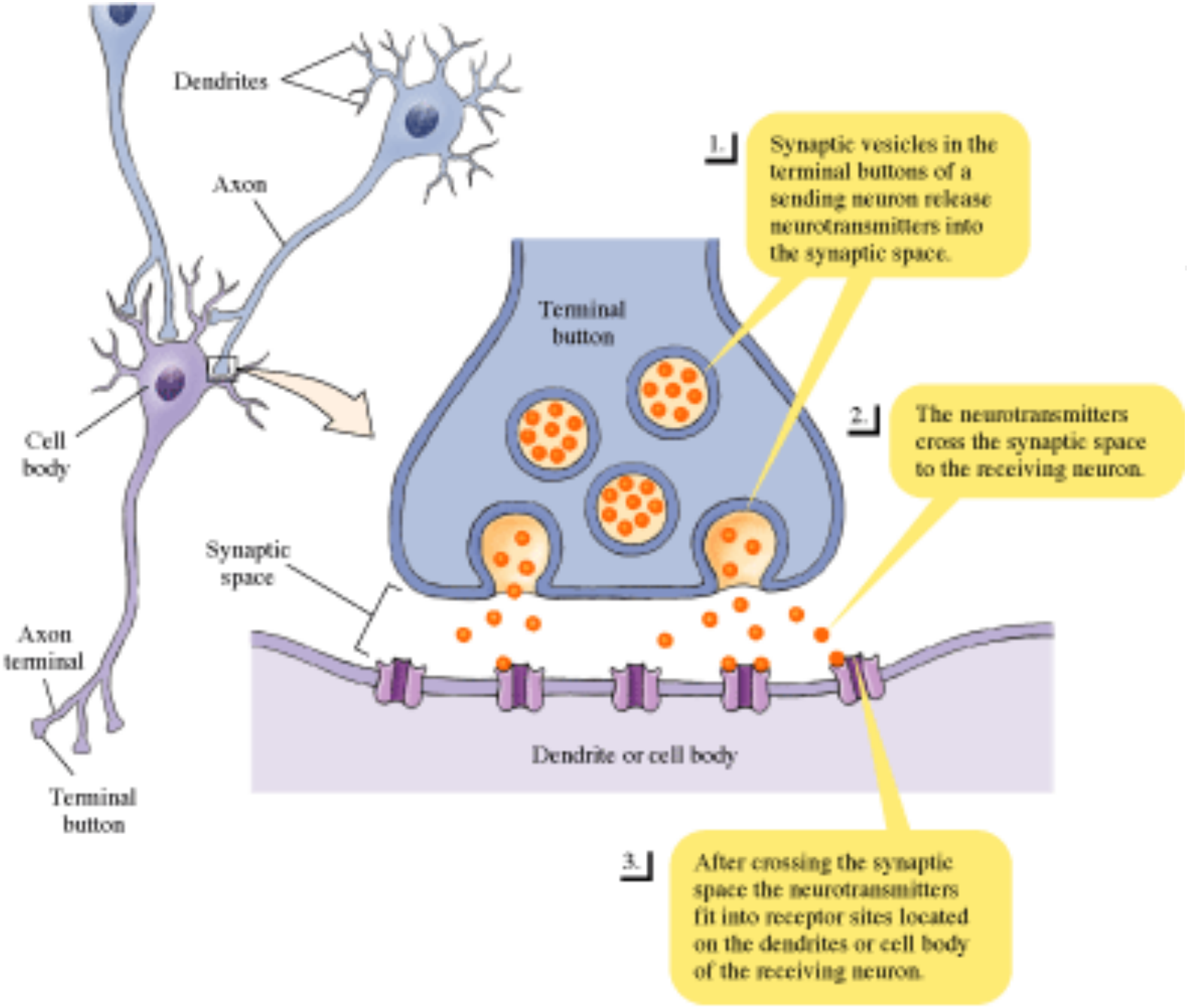


The Synapse

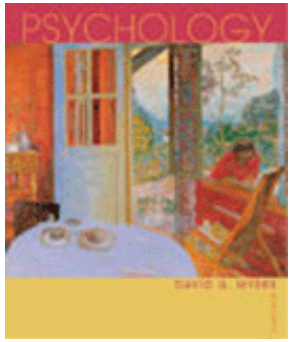
- Synaptic space (synaptic cleft)
  - Tiny gap between neurons
- Terminal button
  - Enlarged area at the end of an axon
- The synapse
  - Composed of the terminal button of one neuron, the synaptic space, and the dendrites or cell body of the receiving neuron

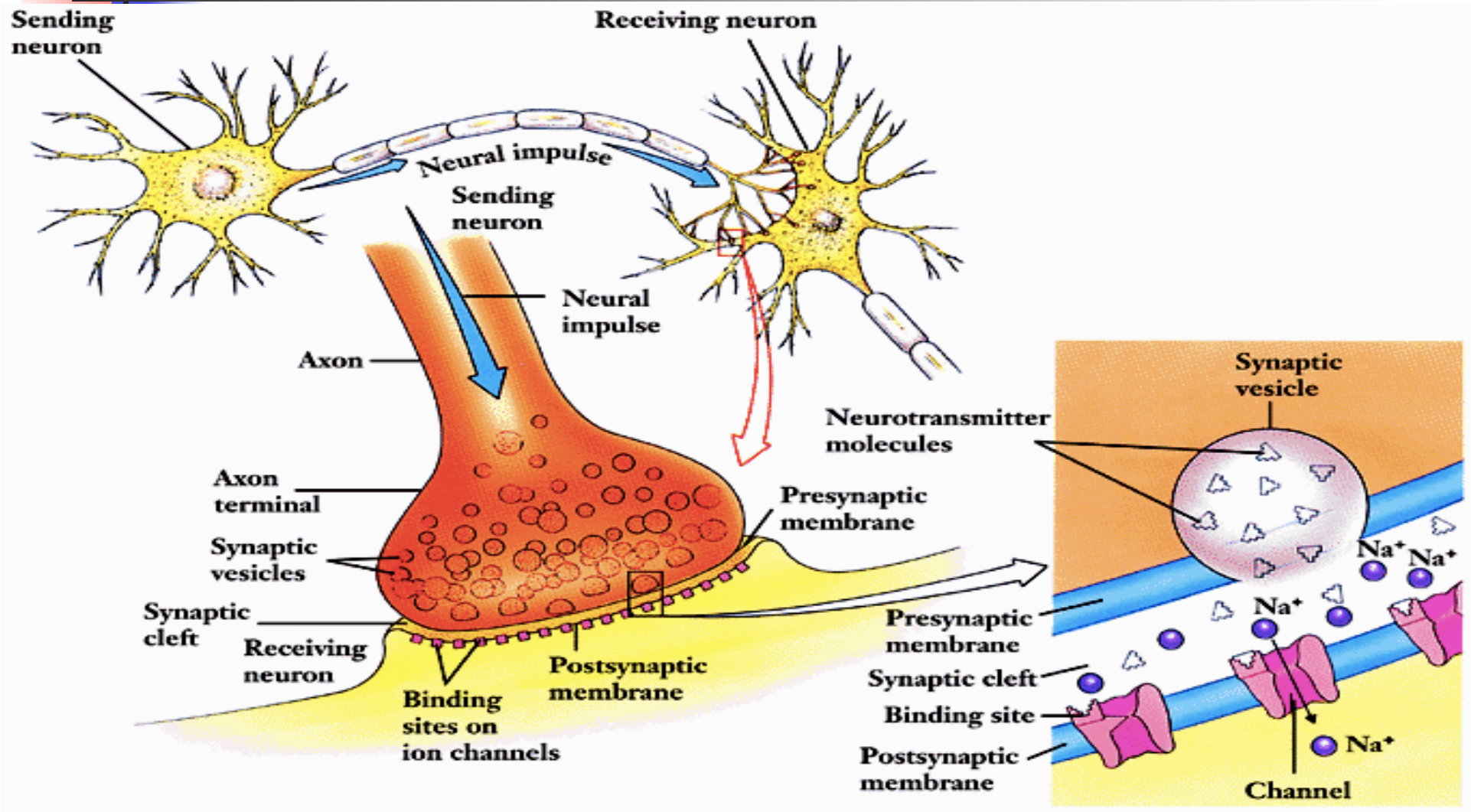
Transmission Between Neurons

- Synaptic vesicles
  - Sacs in terminal button that release chemicals into synaptic space
- Neurotransmitters
  - Chemicals released by synaptic vesicles
- Receptor sites
  - Location on receptor neuron for specific neurotransmitter


Dendrites
Axon
Cell body
Axon terminal
Terminal button
Synaptic space
Terminal button
Dendrite or cell body
1.
Synaptic vesicles in the terminal buttons of a sending neuron release neurotransmitters into the synaptic space.
2.
The neurotransmitters cross the synaptic space to the receiving neuron.
3.
After crossing the synaptic space the neurotransmitters fit into receptor sites located on the dendrites or cell body of the receiving neuron.

Neural Communication





Types of Neurons

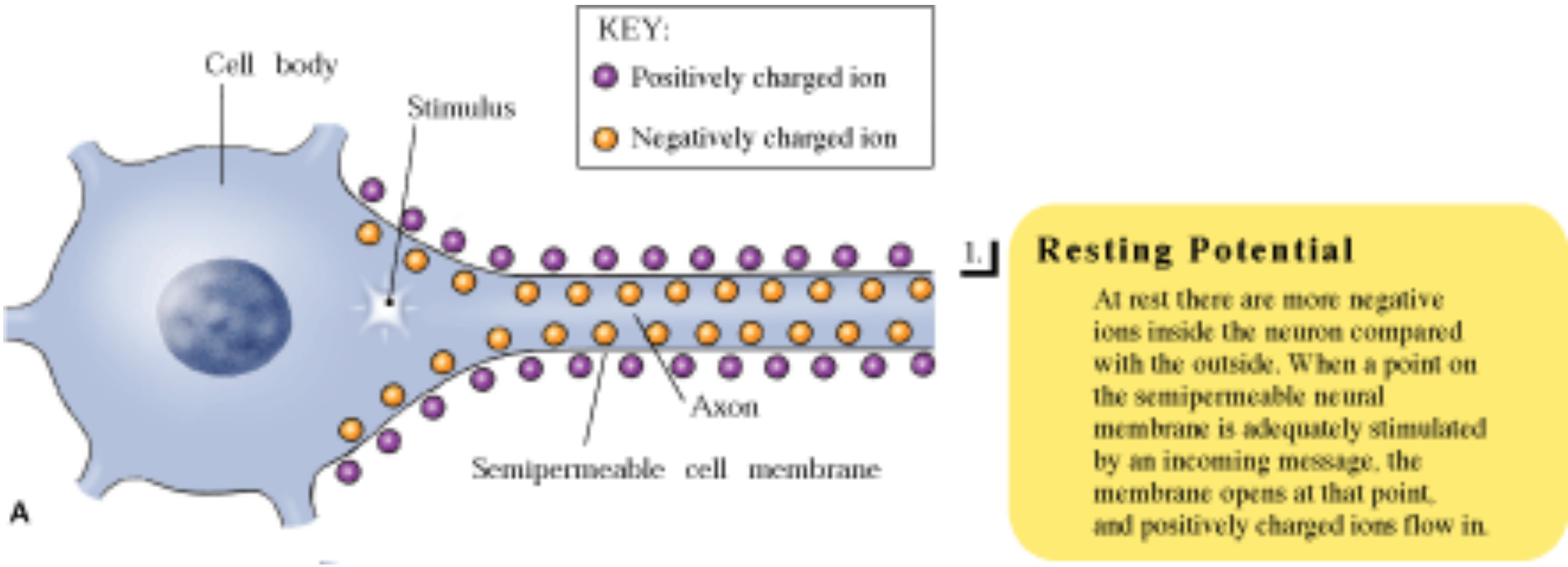
- Sensory neurons
  - Carry information from sensory systems to the brain
  - Also referred to as *afferent*
- Motor neurons
  - Carry information from the brain to muscles and glands
  - Also referred to as *efferent*
- Interneurons
  - Carry information between other neurons

Glial Cells

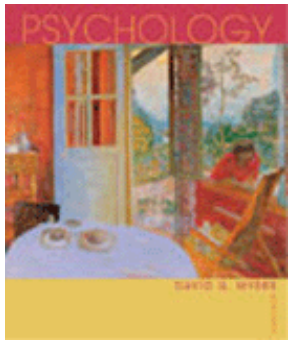
- Cells that insulate and support neurons
- Create the myelin sheath
- Remove waste products
- Provide nourishment
- Prevent harmful substances from entering the brain

The Neural Impulse

- Resting Potential
  - Neuron is not transmitting information – it is resting

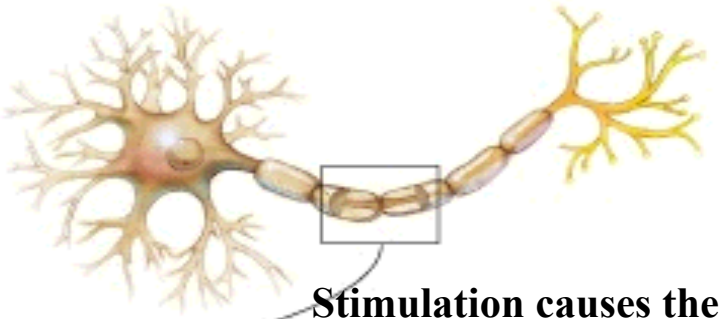


Neural Communication

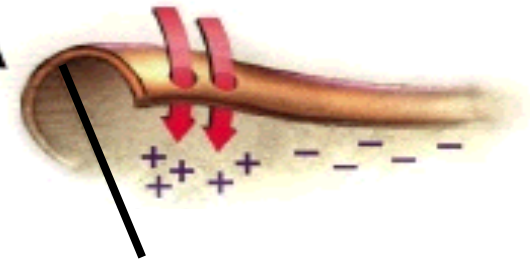


- Resting Potential
  - Nothing is happening. The gates are closed and the positive ions are on the outside with the negative ions on the inside of the cell.
  - "**N**egative Ions inside the **N**euron is **N**atural"
- Action Potential – (Neural Impulse)
  - a neural impulse; a brief electrical charge that travels down an axon
  - generated by the movement of positively charged atoms in and out of channels in the axon's membrane
  - This process is due to stimulation from either heat, chemicals, pressure or light

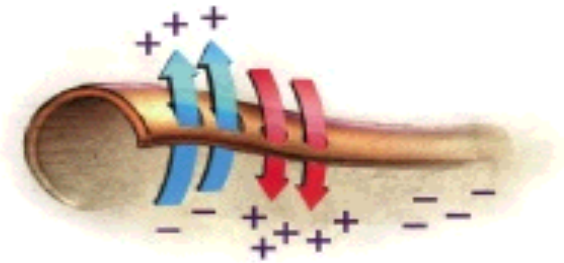
Neural Communication



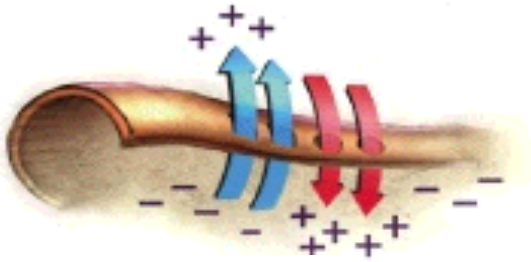
Stimulation causes the gates to open and the positive ions enter the cell. An electrical spark is produced by the process call depolarization. The positive ions are then pumped out.



Cell body end of axon



This chain reaction can occur up to 100 a second.



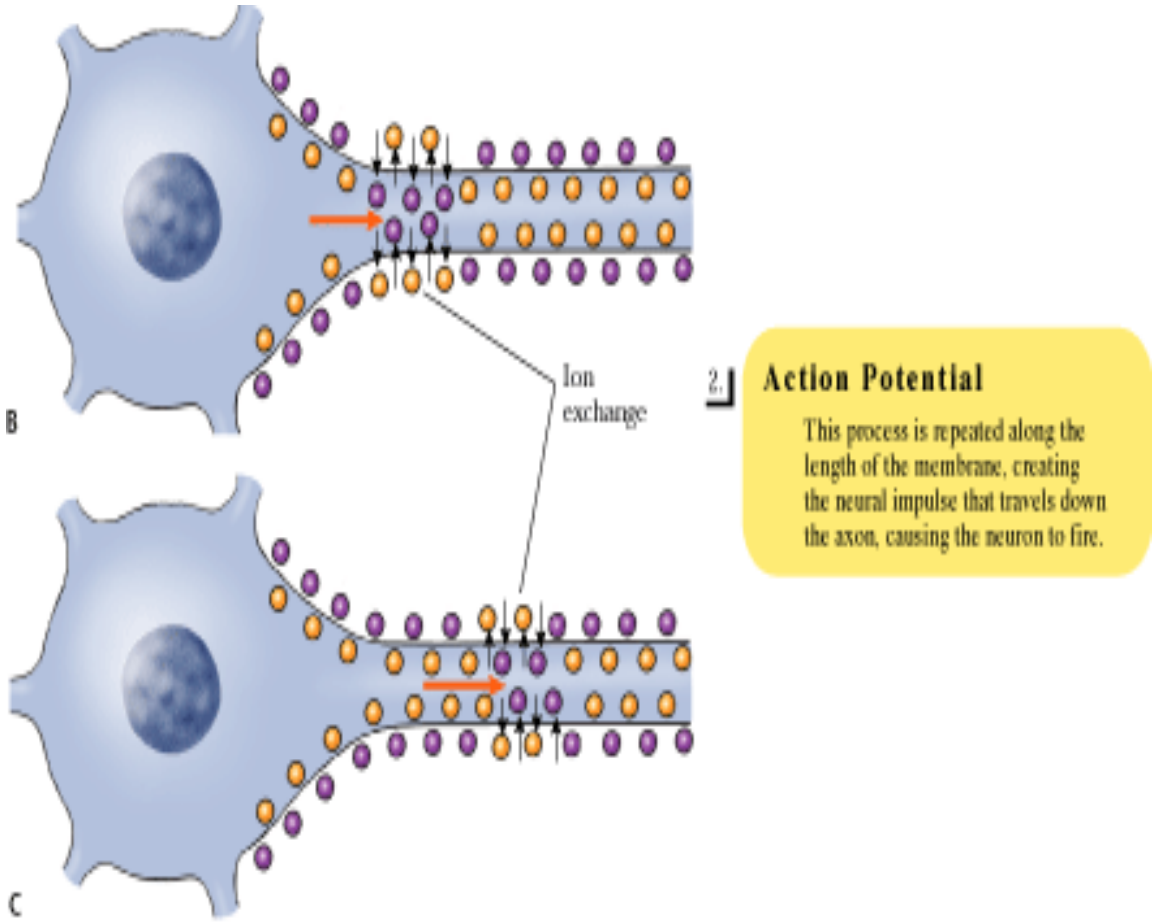
Direction of neural impulse: toward axon terminals

The Neural Impulse

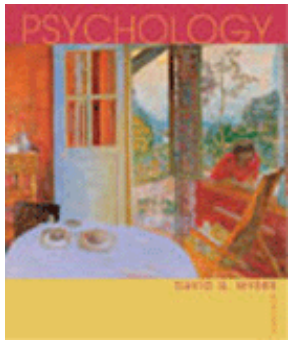
- Polarization
  - When the inside of the Neuron is negatively charged relative to the outside (resting potential)
- Depolarization
  - When the electrical charge of a cell moves toward zero

The Neural Impulse

- Action Potential
  - Sudden, massive change in charge in the neuron
  - Occurs when depolarization reaches the *threshold of excitation*
  - Ions flow across cell membrane
  - 400 ft per second (Myelinated) to 3 ft per second



Neural Communication



- Refractory Period
  - The time it takes for the positive ions to be pumped out.
- Threshold
  - the level of stimulation required to trigger a neural impulse

The Neural Impulse

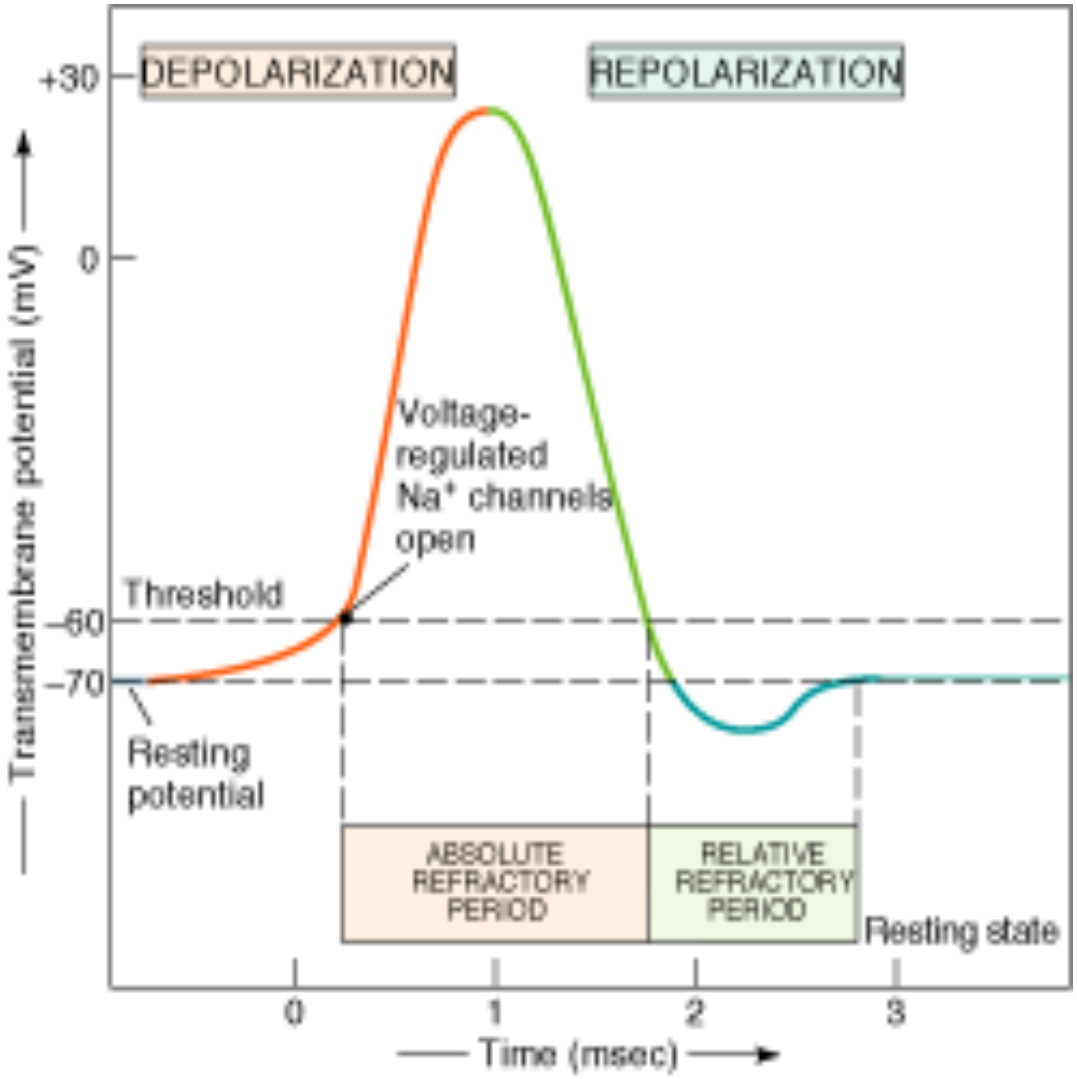
- Graded Potentials
  - What starts this whole process?
  - A shift in the electrical charge in a tiny area of a neuron.
  - Many subthreshold depolarizations are added together to produce an action potential (a process known as *summation*)

The Neural Impulse

- All-or-None Law
  - A neuron either fires or it does not
  - When it does fire, it will always produce an impulse of the same strength
  - Intensity of a stimulus is seen by the **frequency** of action potentials

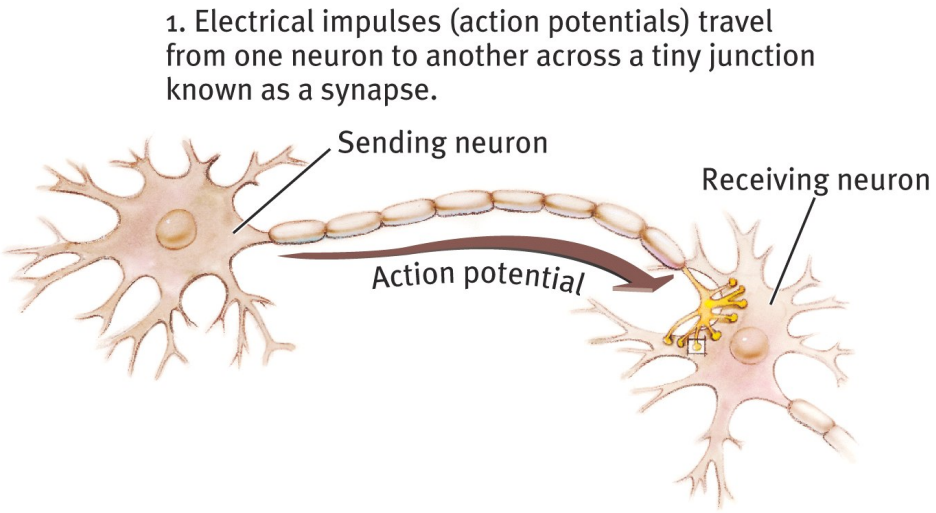
The Neural Impulse

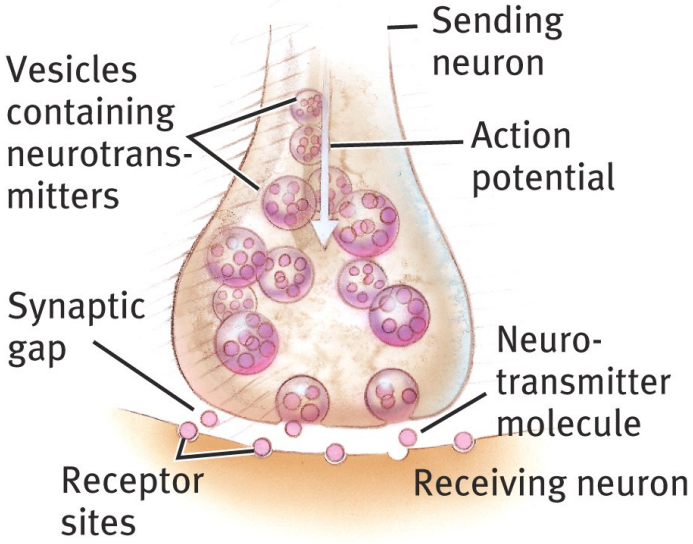
- Absolute refractory period
  - Period immediately after an action potential when another action potential cannot occur
  - 1/1000th of a Second
- Relative refractory period
  - Period following absolute refractory period when a neuron will only respond to a stronger than normal impulse



Synapse

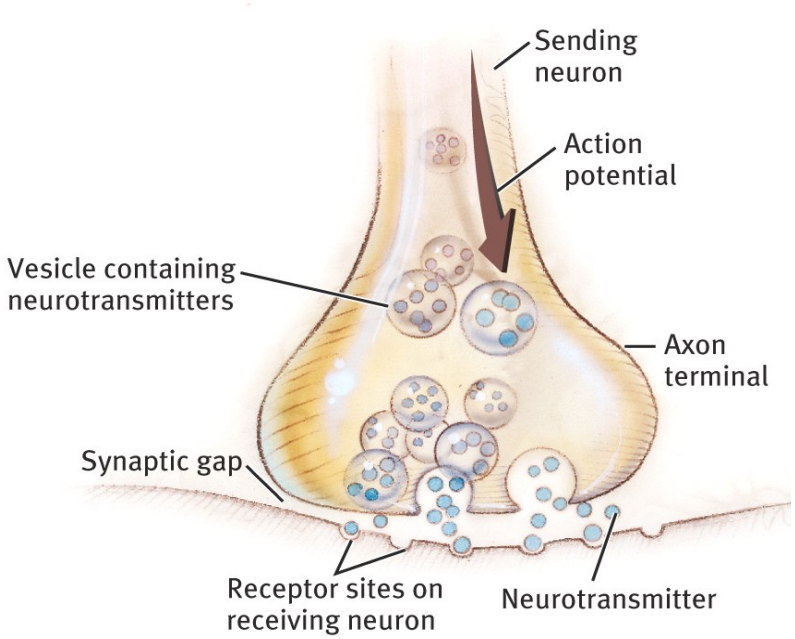
Synapse [SIN-aps] a junction between the axon tip of the sending neuron and the dendrite or cell body of the receiving neuron. This tiny gap is called the *synaptic gap* or *cleft*.





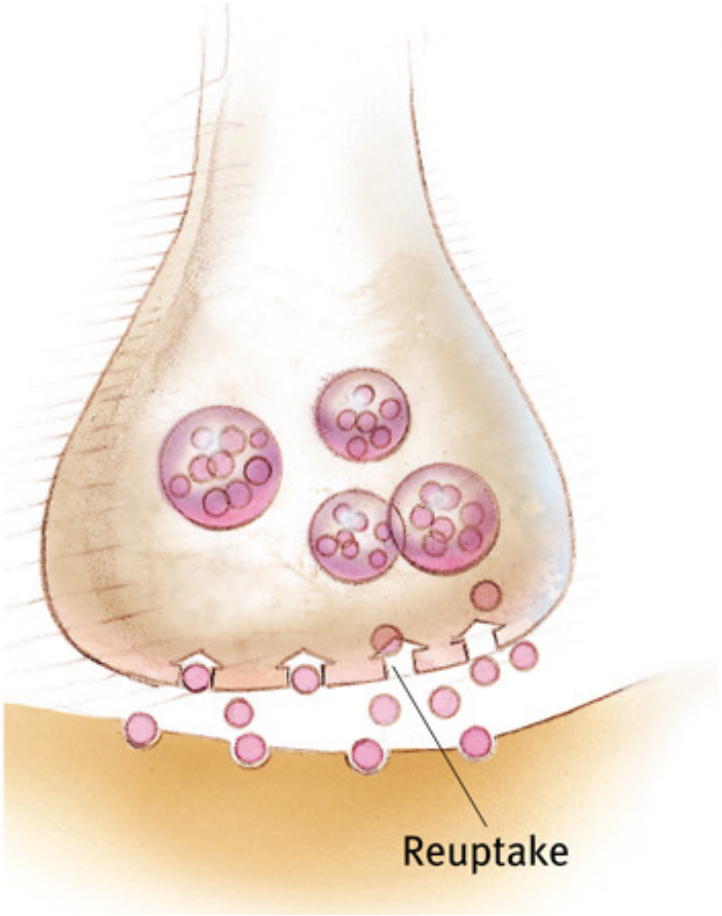
Neurotransmitters

Neurotransmitters (chemicals) released from the sending neuron travel across the synapse and bind to receptor sites on the receiving neuron, thereby influencing it to generate an action potential.



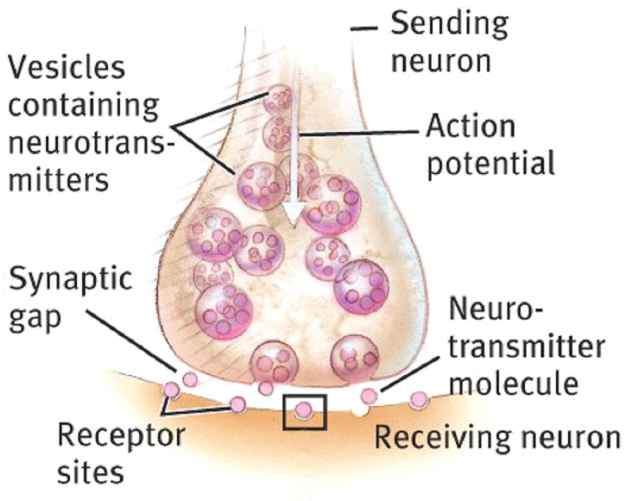
Reuptake

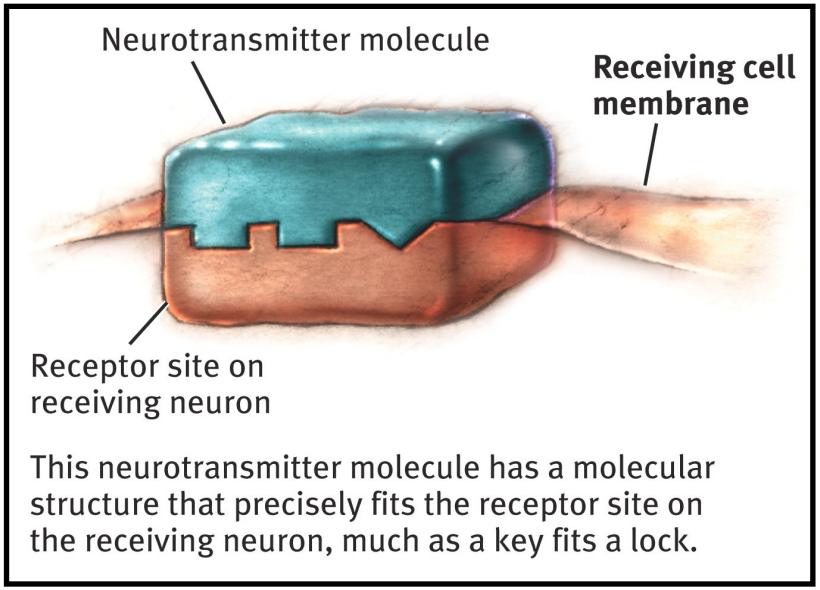
Neurotransmitters in the synapse are reabsorbed into the sending neurons through the process of reuptake. This process applies the brakes on neurotransmitter action.



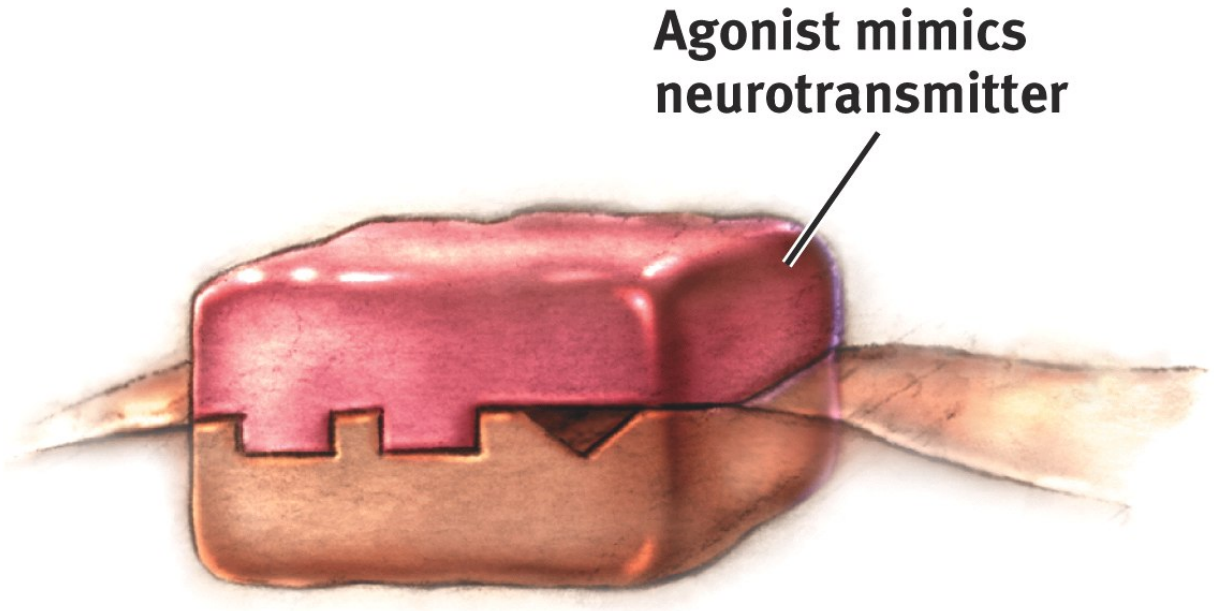
Lock & Key Mechanism

Neurotransmitters bind to the receptors of the receiving neuron in a key-lock mechanism.



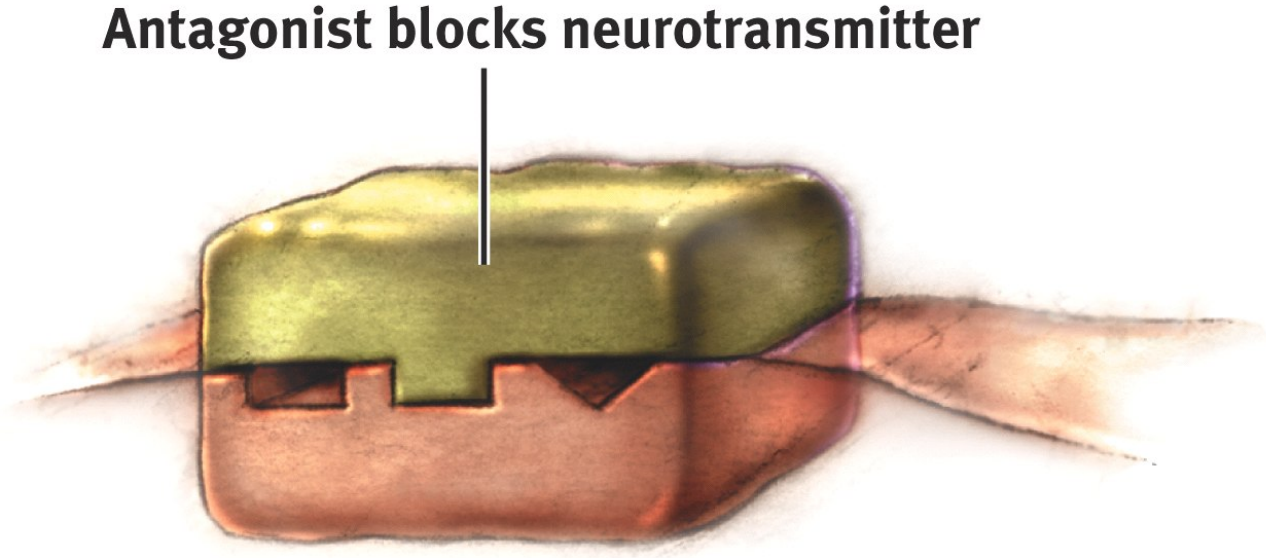


Agonists



This agonist molecule excites.It is similar enough in structure to the neurotransmitter molecule that it mimics its effects on the receiving neuron. Morphine, for instance, mimics the action of endorphins by stimulating receptors in brain areas involved in mood and pain sensations.

Antagonists



This antagonist molecule inhibits. It has a structure similar enough to the neurotransmitter to occupy its receptor site and block its action, but not similar enough to stimulate the receptor. Curare poisoning paralyzes its victims by blocking ACh receptors involved in muscle movement.

Some Well-Known Neurotransmitters

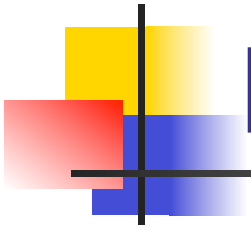
- Acetylcholine (ACh)
  - Released at the neuromuscular junction
  - Plays an important role in arousal and attention
  - Loss of ACh producing cells is linked to Alzheimer's Disease
  - Too much = Spasms / Too Little = Paralysis
- Dopamine
  - Affects neurons associated with voluntary movement and pleasure
  - Plays a role in learning, memory, and emotions
  - Implicated in Parkinson's Disease and Schizophrenia

Some Well-Known Neurotransmitters

- Serotonin
  - Found throughout the brain
  - Appears to sets an “emotional tone”
  - Affects mood, hunger, sleep, and arousal
  - Low serotonin levels are implicated in depression
  - Some antidepressant drugs raise seratonin
- Endorphins
  - Reduce pain by inhibiting or “turning down” neurons that transmit pain information
  - “runner’s high”

Some Well-Known Neurotransmitters

- Norepinephrine
  - Helps control alertness and arousal
  - Undersupply can depress mood
- GABA (Gamma-aminobutyric acid)
  - A major excitatory neurotransmitter; involved in memory
  - Oversupply linked to seizures, tremors, and insomnia



Psychopharmacology

- Most psychoactive drugs (and toxins) work by blocking or enhancing synaptic transmission
- Botulism
  - Blocks release of ACh at the neuromuscular junction, causing paralysis
  - “Botox” is botulism toxin used to prevent facial muscles from making wrinkles

Psychopharmacology

- Curare (koo-ra-ray)
  - Can stun or kill prey quickly
  - Blocks ACh receptors causing paralysis
- Antipsychotic medications
  - Block dopamine receptors
  - Reduces schizophrenic hallucinations
- Caffeine
  - Increases the release of excitatory neurotransmitters by blocking the inhibitory neurotransmitter *adenosine (a-den-oh-seen)*

Psychopharmacology

- Cocaine
  - Prevents reabsorption of dopamine
  - Leads to heightened arousal of entire nervous system
  - http://www.onlinegameshub.com/pages/mouse-party.html

Neural Plasticity

- The brain can be changed, both structurally and chemically, by experience
- Rat studies show that an “enriched” environment leads to larger neurons with more connections
- Has also been shown in humans
- Recent research has uncovered evidence of neurogenesis, or the production of new brain cells, in human brains