

8<sup>th</sup> Grade  
Information Processing

Question:

How do your feet know when to move  
when you want to walk?

Answer:

Your Nervous System

# Neuroscience

- Neuroscience – is the study of the brain and the nervous systems, including structure, function, and disorders.
- Neuroscience is a relatively new field. New information is always being discovered and there are still many unexplained mysteries of the brain.

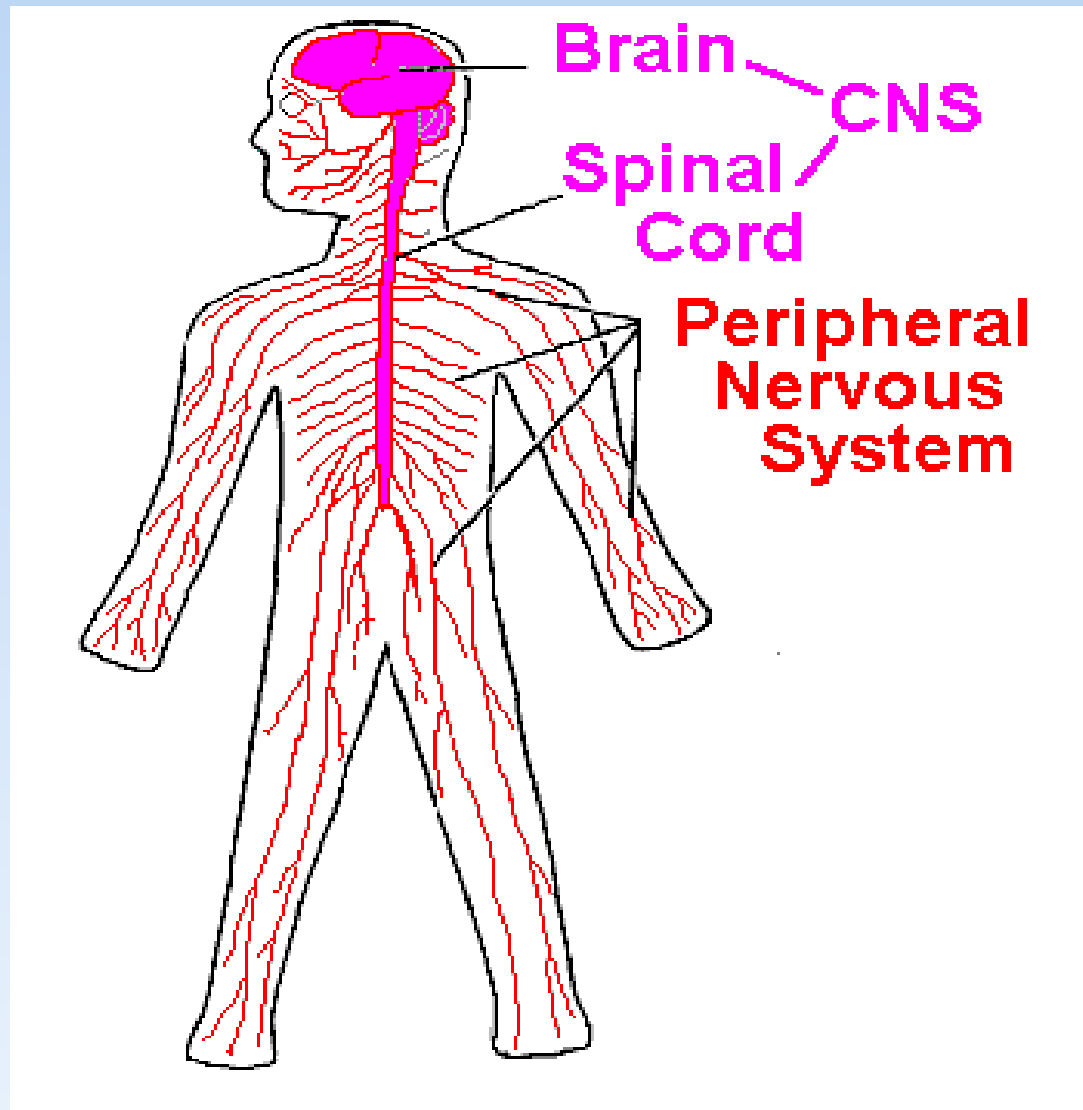
# The Nervous System

- The **nervous system** is the part of an animal's body that coordinates its voluntary and involuntary actions and transmits signals between different parts of its body.

# The Nervous System

- Involuntary actions
  - Blinking
  - breathing
  - Digestion
- Voluntary actions
  - Moving of the arms and legs
  - Eating

# The Nervous System is Split Into Two Parts

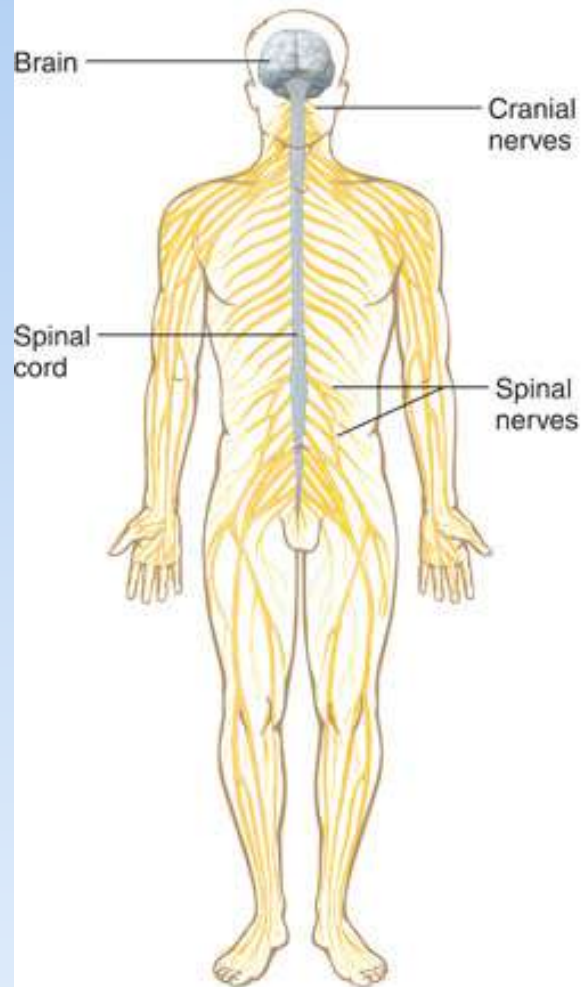


# The Nervous System

- The nervous system provides sensory, integrative, and motor functions to the body.
  - Motor functions can be divided into the consciously controlled **somatic nervous system** and the unconscious **autonomic system**.



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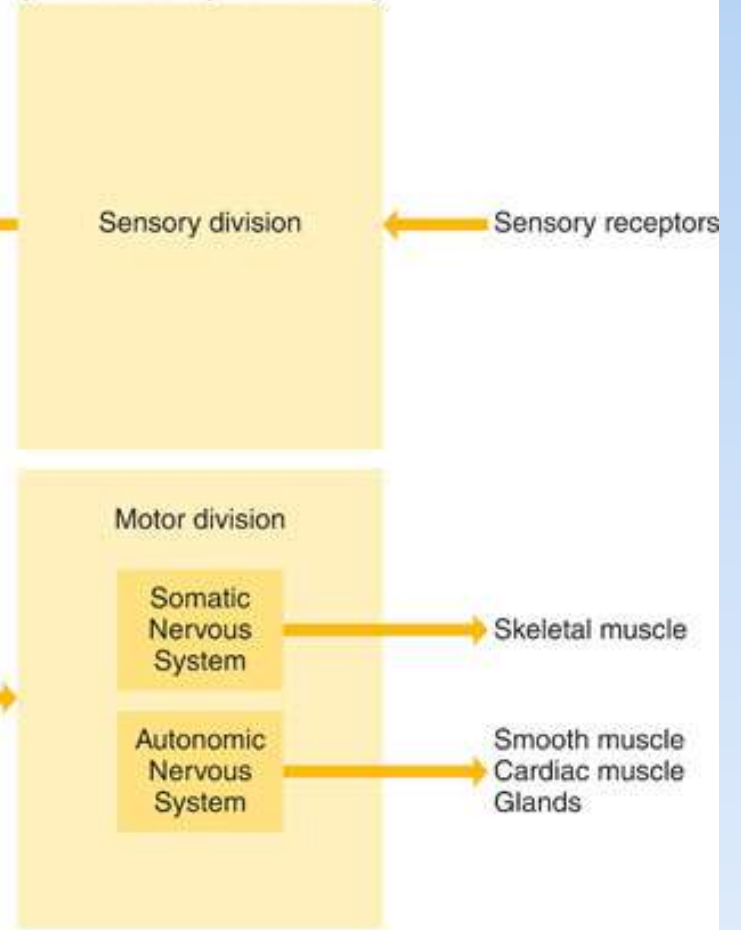


Central Nervous System  
(Brain and Spinal Cord)



(b)

Peripheral Nervous System  
(Cranial and Spinal Nerves)

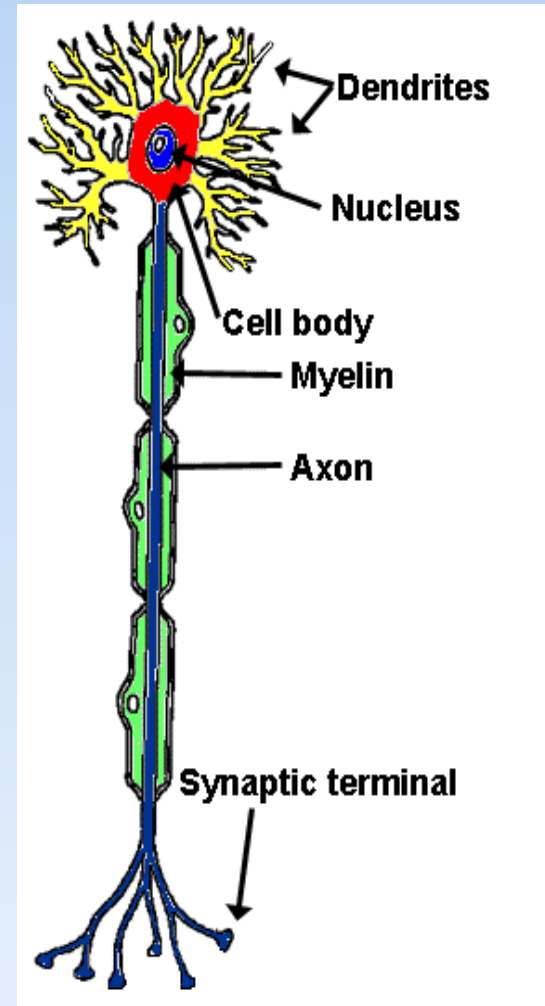


# General Functions of the Nervous System

- Communication and coordination
  - Adapt and respond to changes from both inside and outside the body
- Site of reasoning- your brain
- Two main divisions
  - Central nervous system (CNS): brain and spinal cord
  - Peripheral nervous system- the nerves

# The Neuron

- Basic structural unit of the nervous system is the Neuron
- **Neurons** are microscopic nerve cells that make up the brain, spinal cord, and nerves
- 30,000 Neurons can fit on a pinhead

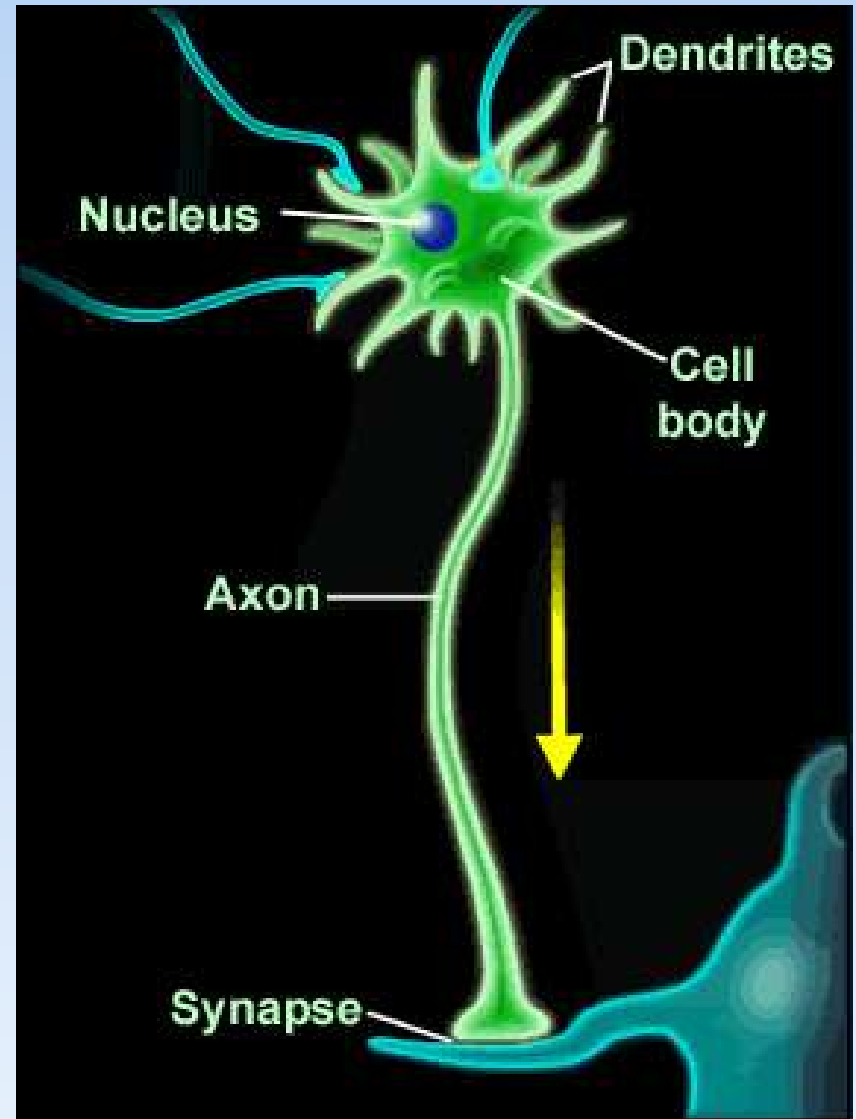


# Anatomy of the Neuron

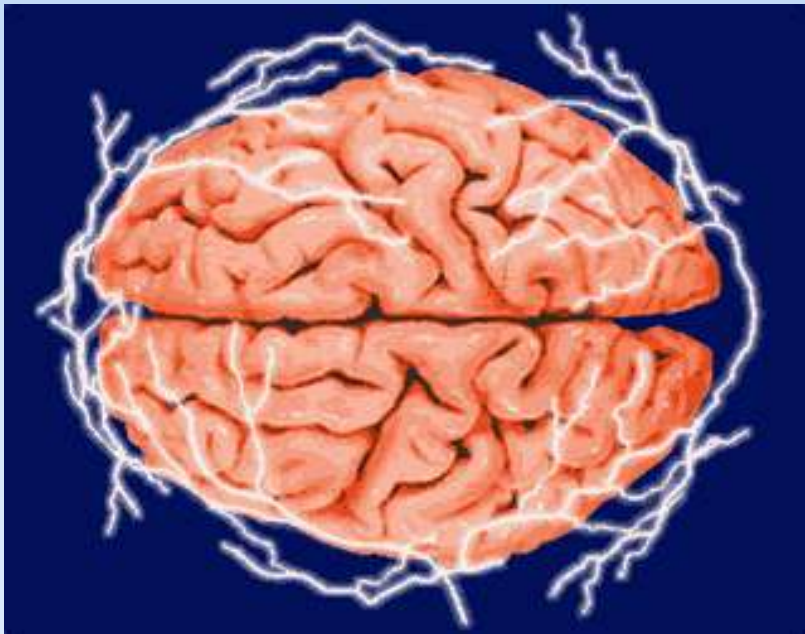
- **Cell Body** – with Nucleus
- **Dendrites**- fibers that receive messages from other neurons
- **Axon**- fibers that send messages to other neurons
- **Myelin sheath**- Membrane around the axons

# Anatomy of the Neuron

- **Synapse** -Neurons do NOT touch; there is a gap between them called a synapse
- **Neurotransmitters** - Special chemicals that are send messages across the synapses



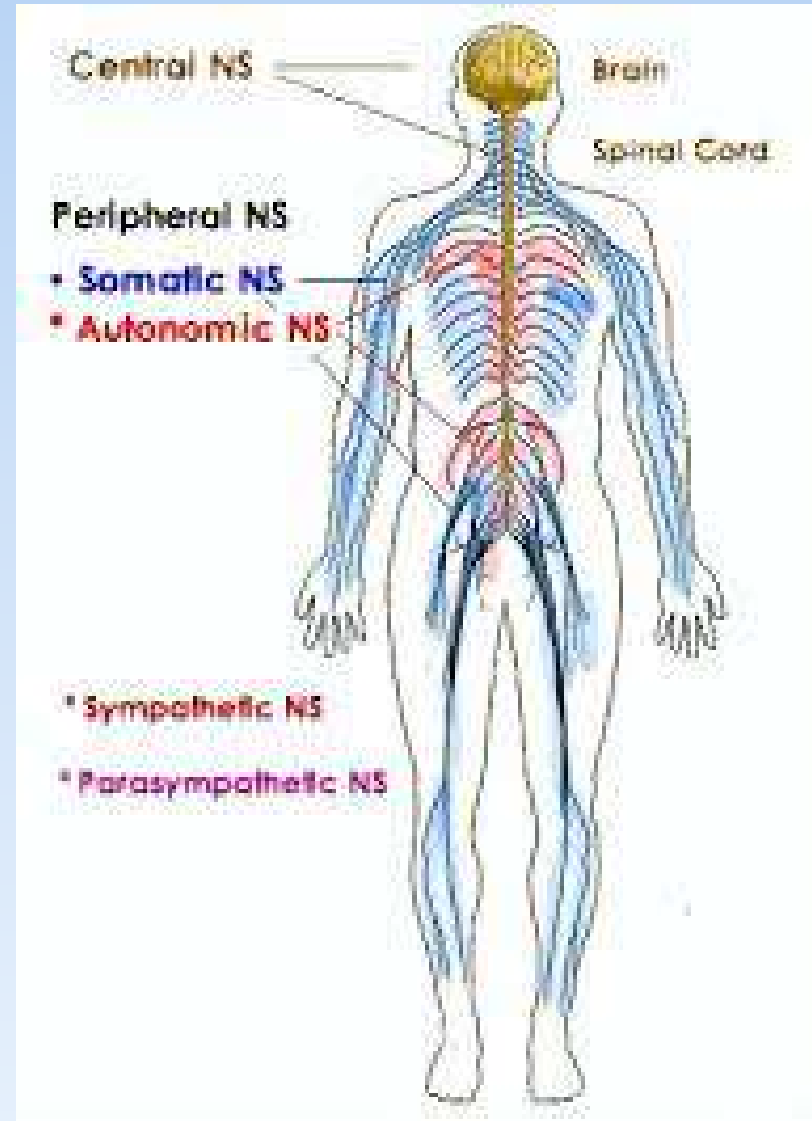
# Communication Between Neurons



- The use of neurotransmitters causes an electrical current to be transmitted
- There is enough electrical current in the brain to power a flashlight

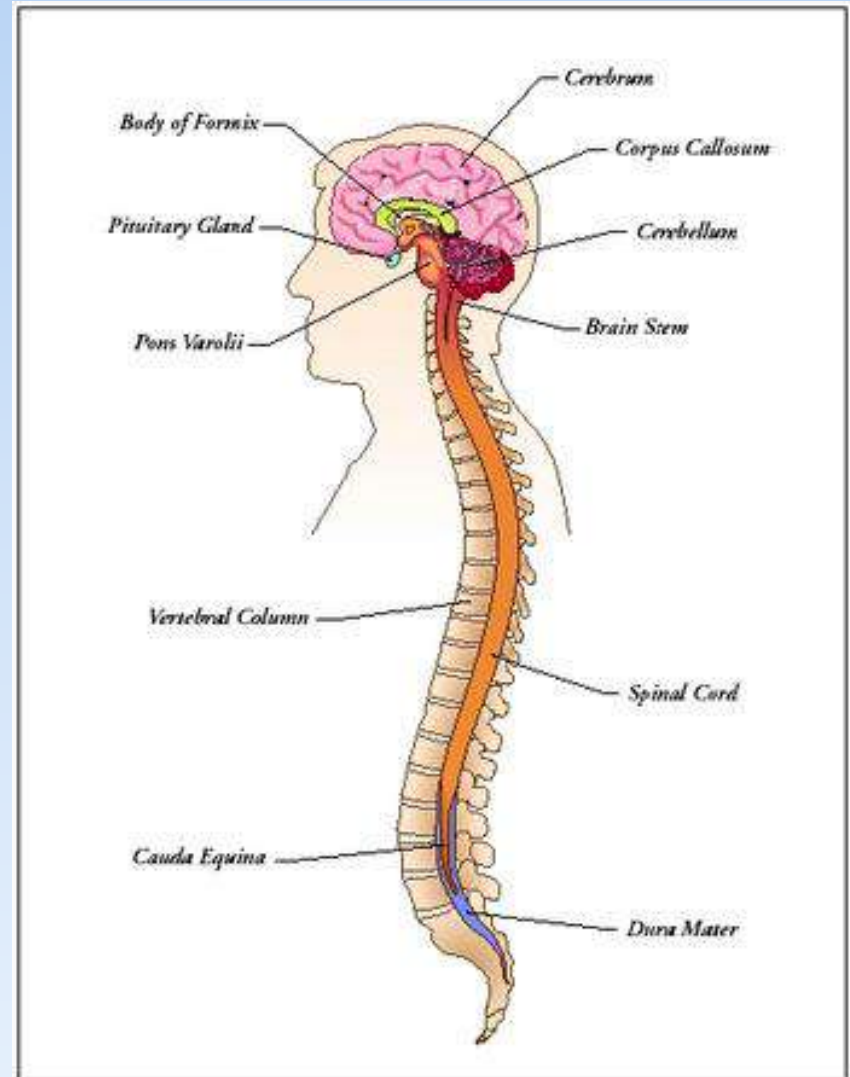
# Two Parts of the Nervous System

- The Nervous are split into two parts
  - The Central Nervous System (CNS)
  - Peripheral Nervous System (PNS)



# The Central Nervous System

- The **Central Nervous System** is composed of the brain and the spinal cord.
- It is the major information processing center of the body.





# The Central Nervous System

- **Brain** a mass of 100 billion neurons located inside the skull
- Learning occurs as more and stronger connections are made between neurons

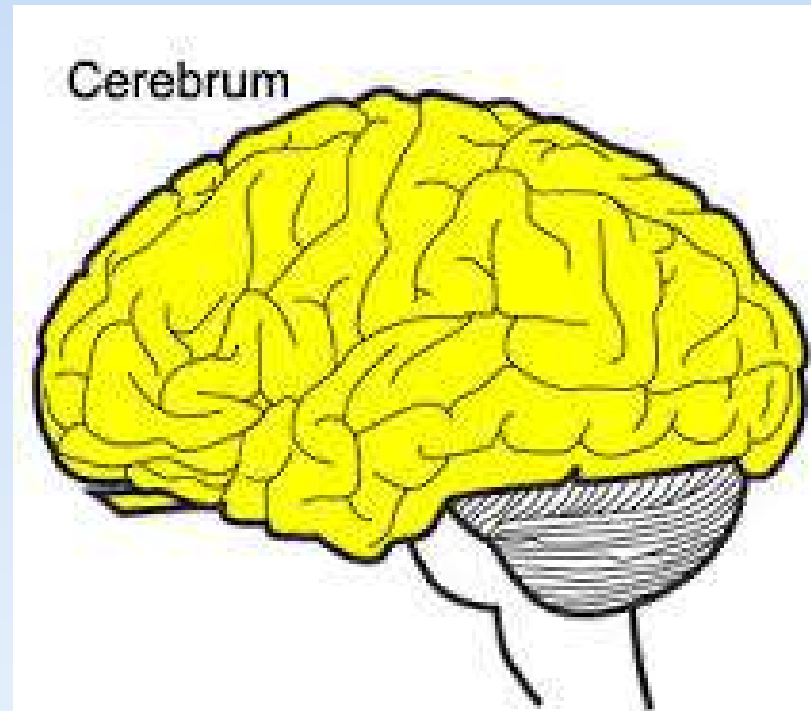


# The Central Nervous System

- The brain is both the integrator and director of information through our bodies.
- Our brain devotes most of its considerable volume, energy, and computational power to processing various sensory inputs.

# The Central Nervous System

- Parts of the Brain
  - **Cerebrum** : largest part of human brain
    - Responsible for:
      - Thought
      - Language
      - Senses
      - Memory
      - Voluntary movement



# The Central Nervous System

- The Cerebrum is further split into four parts
  - Frontal Lobe
    - Control of voluntary muscles
    - Concentrating , planning, and problem solving
    - Planning
    - Speech
  - Temporal Lobe
    - Combines visual and auditory information

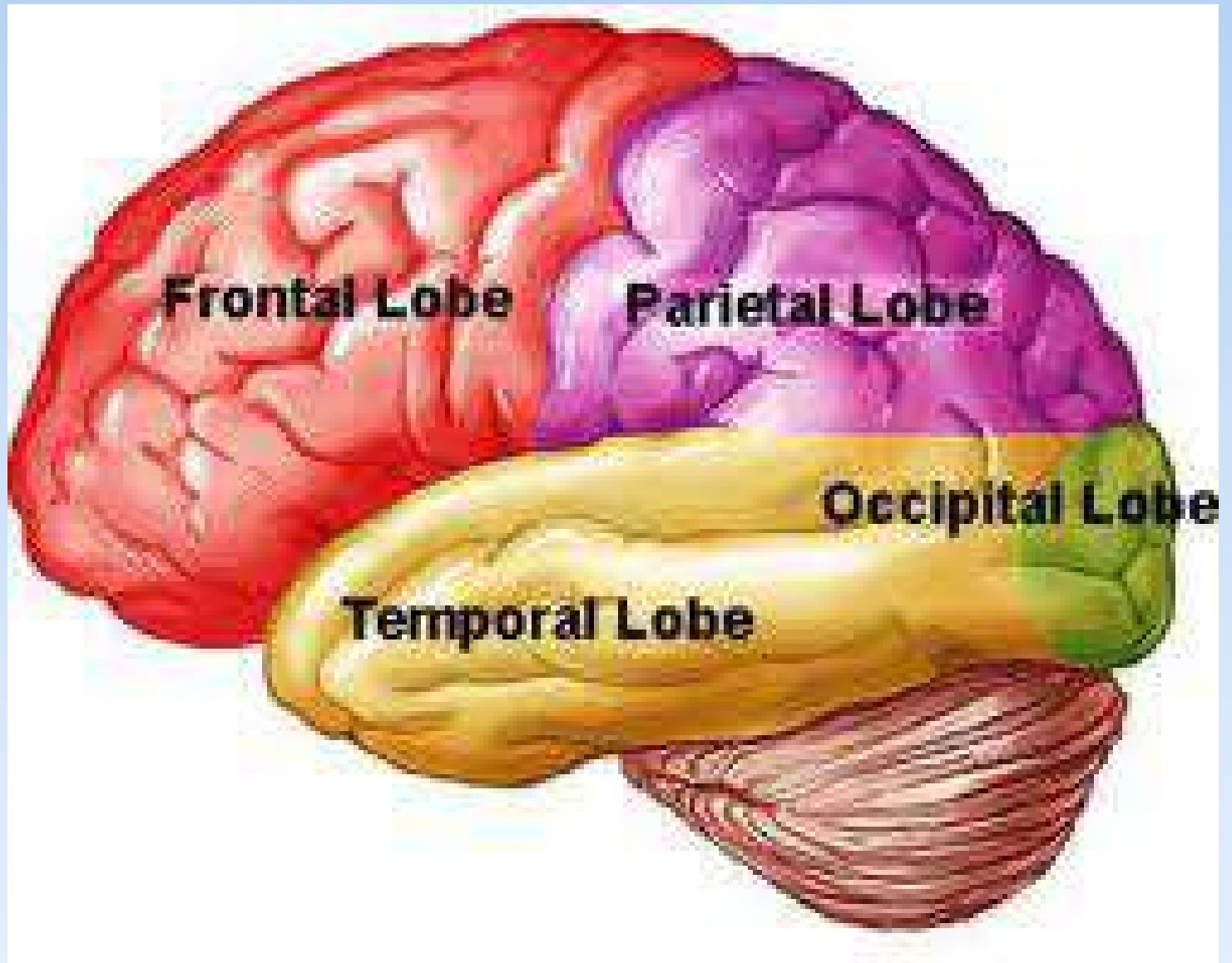
# The Central Nervous System

## – Occipital Lobe

- Visual recognition

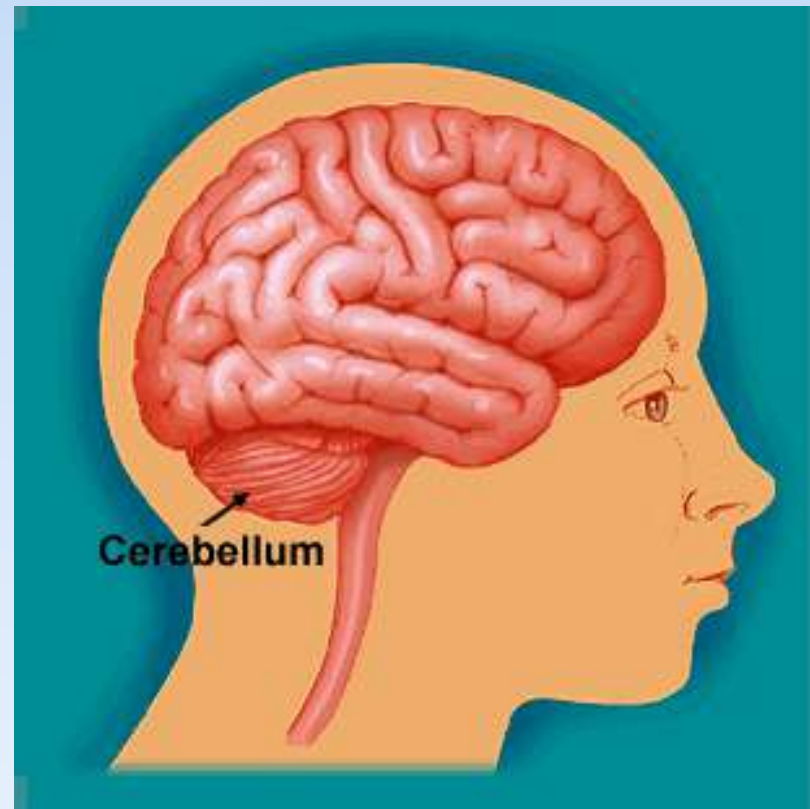
## – Parietal Lobe

- Understanding Speech
- Receives sensory information



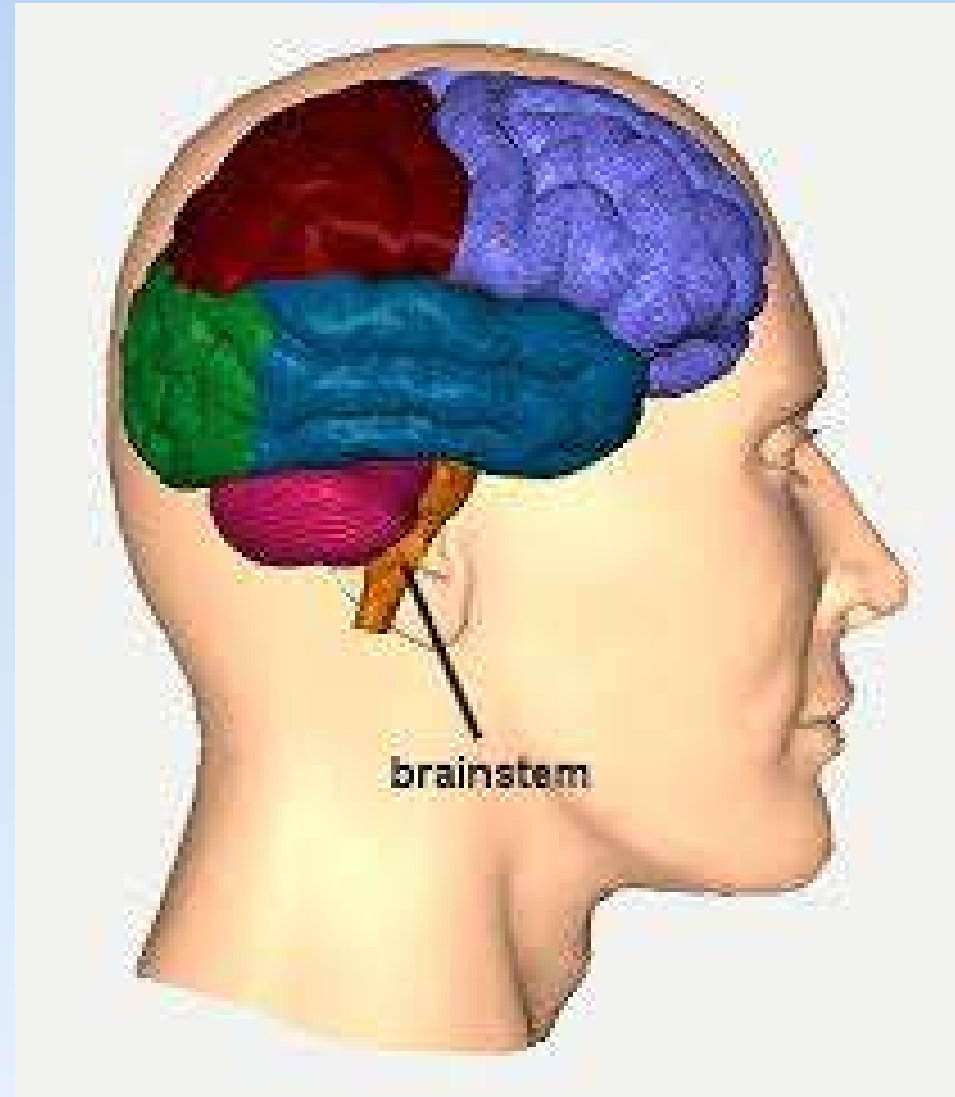
# The Central Nervous System

- **Cerebellum** is located at base of brain
  - Responsible for:
    - - Muscle coordination
    - - Balance
    - - Posture



# The Central Nervous Center

- **Brain Stem** - beneath the cerebrum and in front of the cerebellum.
- Connects the brain to the spinal cord; controls life functions
  - circulation, breathing, digestion, sleeping, heart rate and controls all involuntary muscles



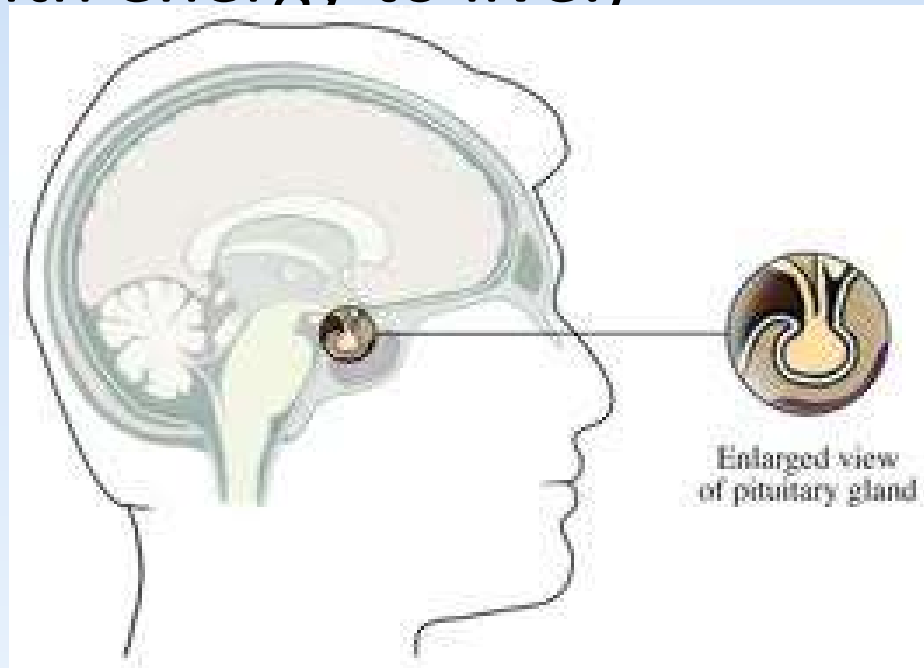


# The Central Nervous System

- **Spinal Cord** Column of nerves from brain to tailbone – protected by vertebrae of spine
  - Responsible for:
    - Conducting impulses between the brain and the rest of the body
- \*Impulses may travel as fast as 268 miles/hr

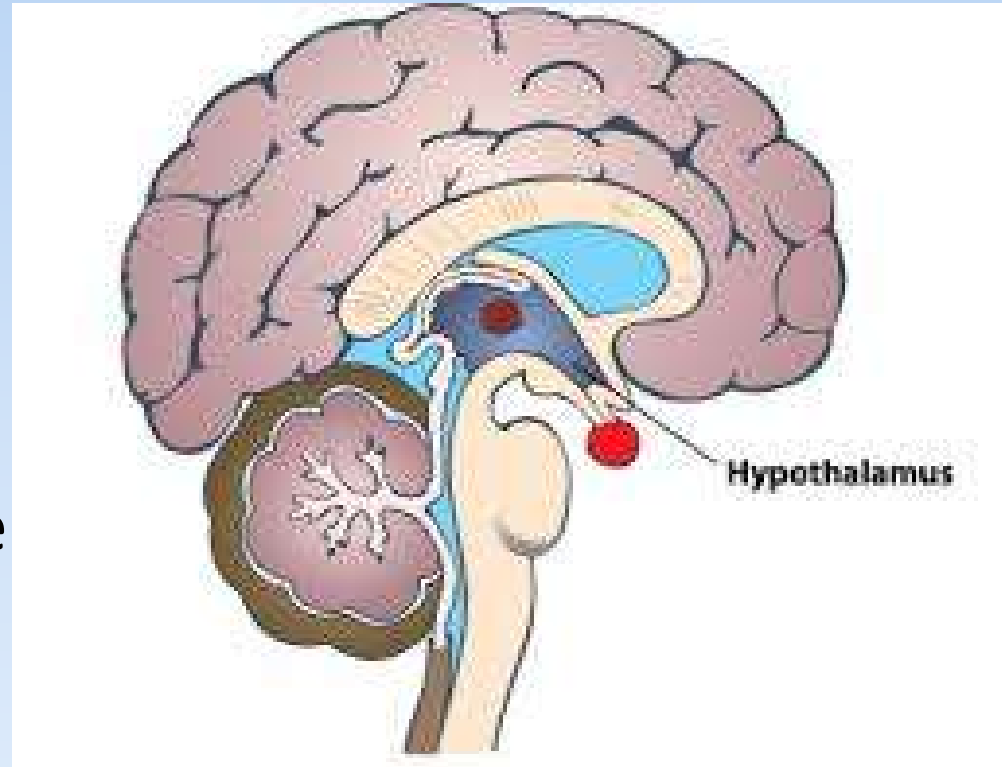
# The Central Nervous System

- **Pituitary Gland:** pea size; produces and releases hormones for growth and puberty.
- Also important for metabolism (supplying your body with energy to live.)

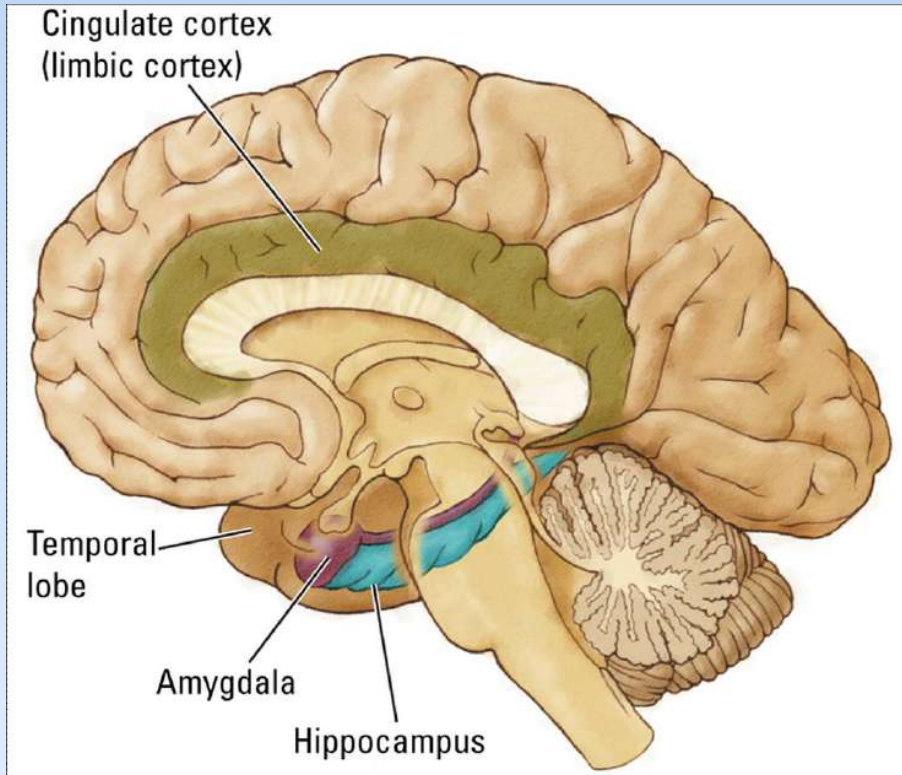


# The Central Nervous System

- **Hypothalamus:** like a thermostat, controls body temperature to approximately 98.6
- Makes you sweat or shiver to get back to the right temperature.



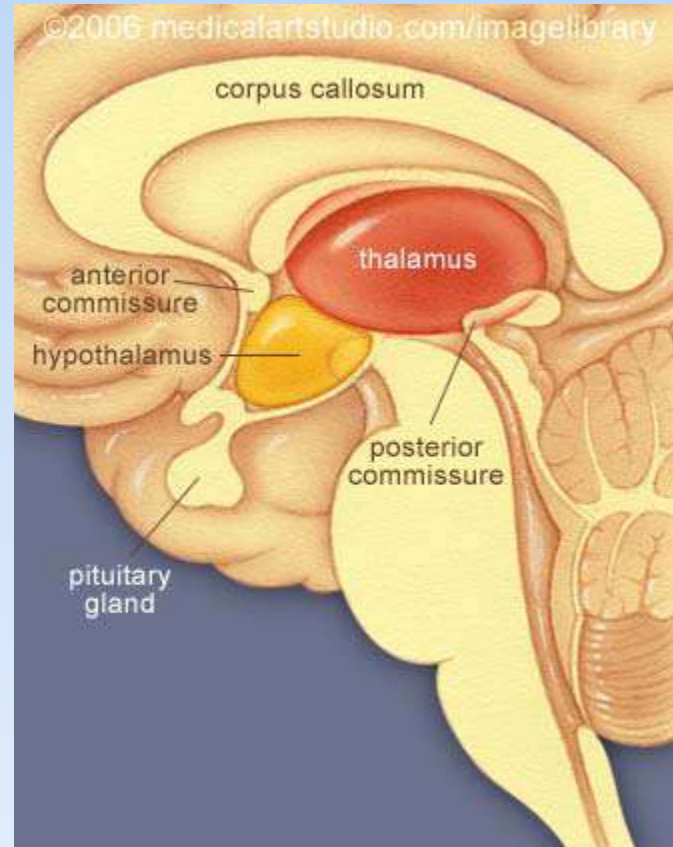
# The Central nervous System



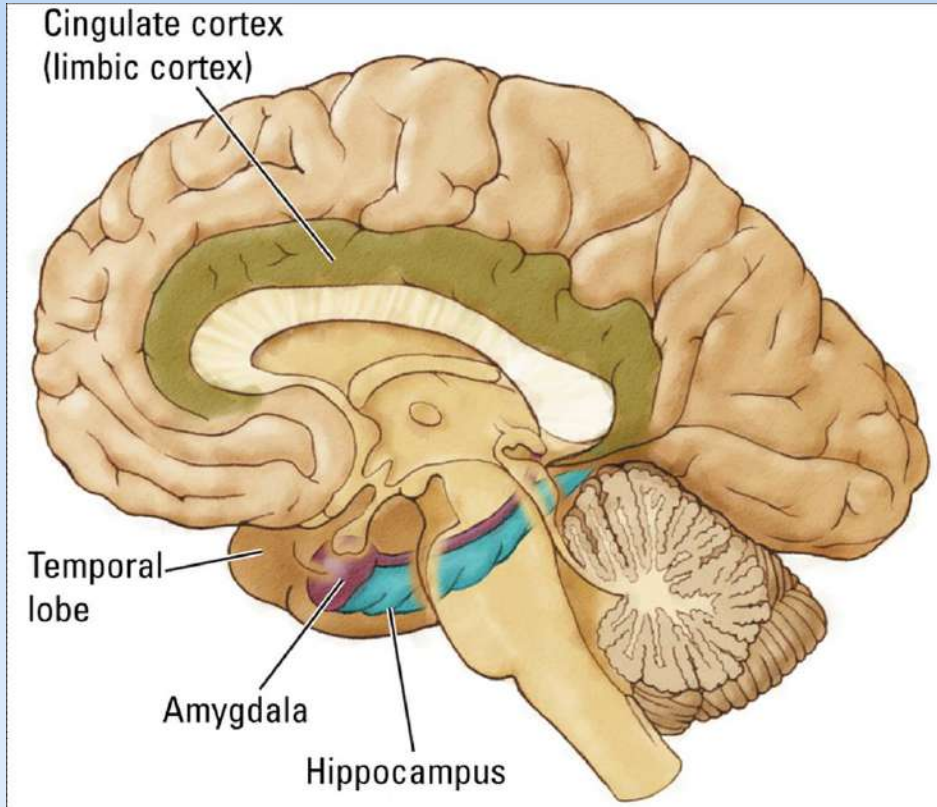
- Hippocampus: lies deep inside your brain; important to memory and learning.
- It's where the brain converts to long-term memory.

# The Central Nervous System

- **Thalamus:** On top of the brain stem; it's a two-way relay station;
- Takes information to/from the spinal cord and the cerebrum



# The Central Nervous System

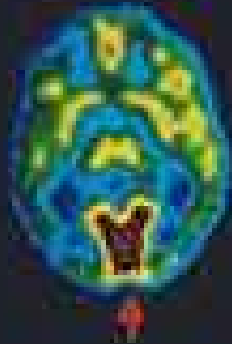


- **Amygdala**: a cluster of cells on each hemisphere of the brain.
- Controls emotions, especially fear, anger, and fight or flight/stress reaction.

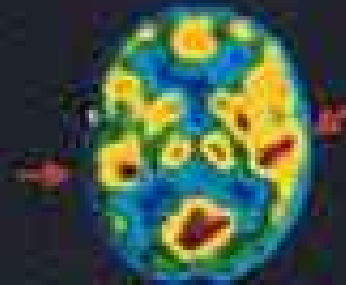
# The Central Nervous System

- Not all of the body's motor responses travel through the brain for processing.
- The spinal cord alone is able to direct simple reflex actions, such as a knee jerk reflex.

**Looking**



**Listening**



**Thinking**



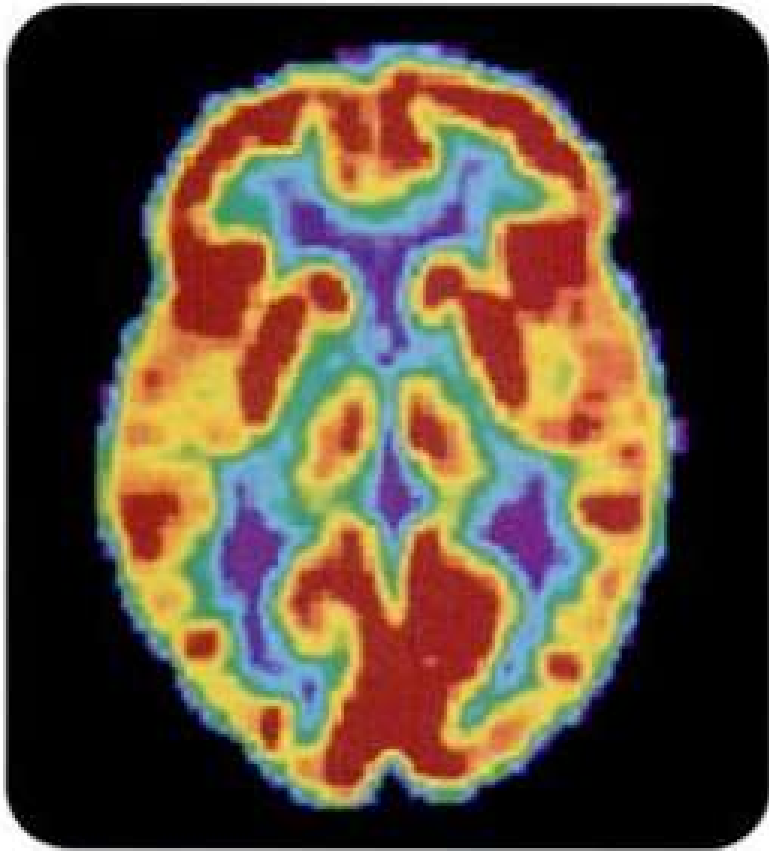
**Remembering**



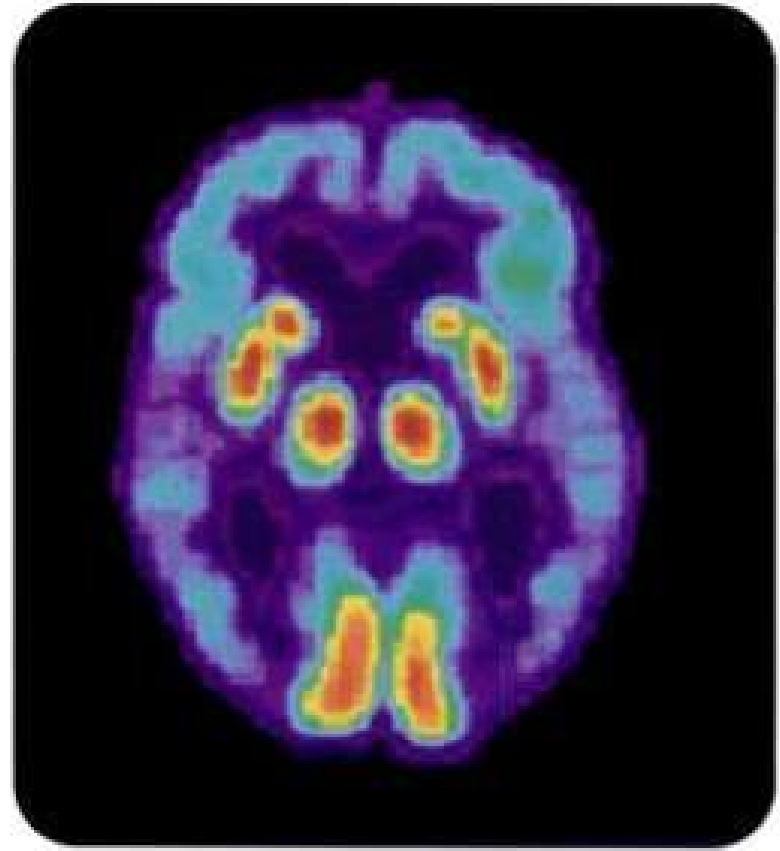
**Working**







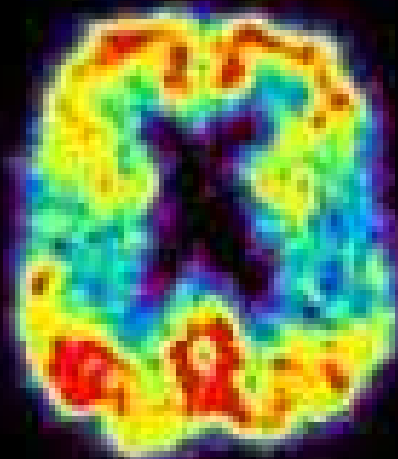
**PET Scan of Normal Brain**



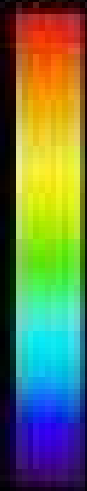
**PET Scan of Alzheimer's Disease Brain**

AD

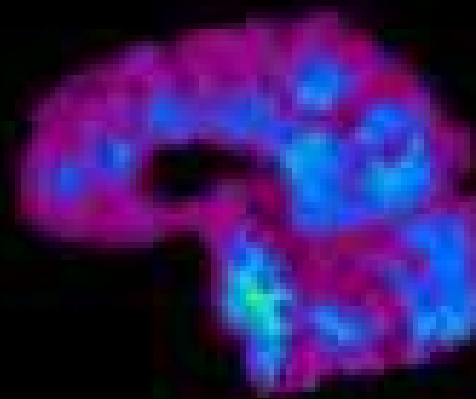
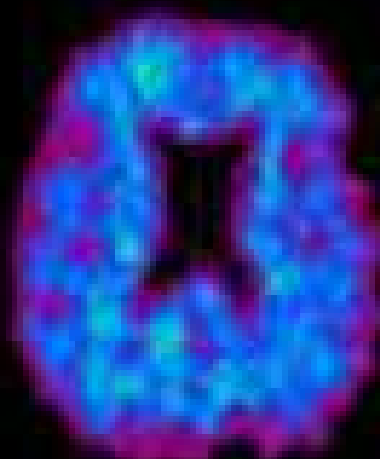
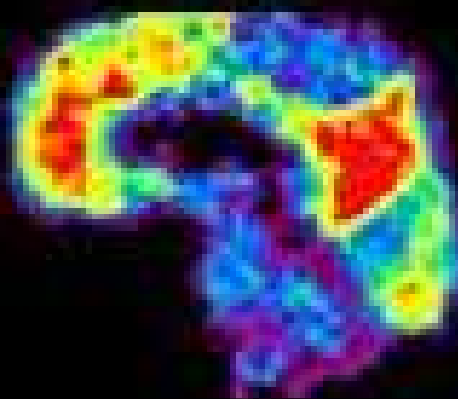
Control

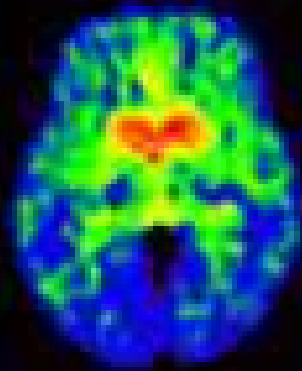


Max

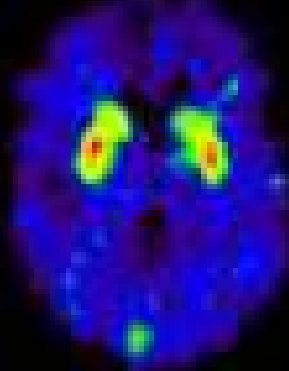


Min

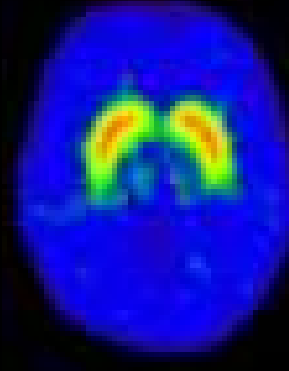




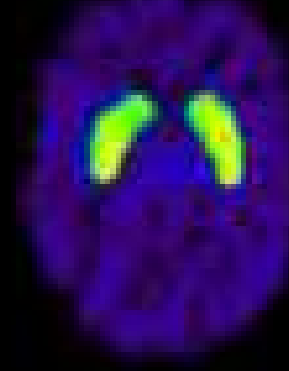
**Smoker**



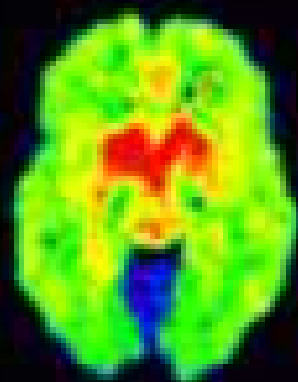
**Alcoholic**



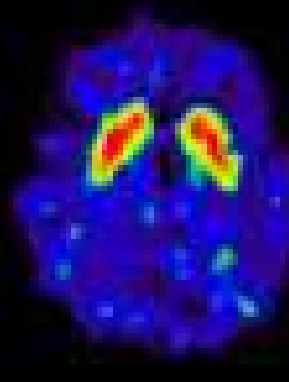
**Obese**



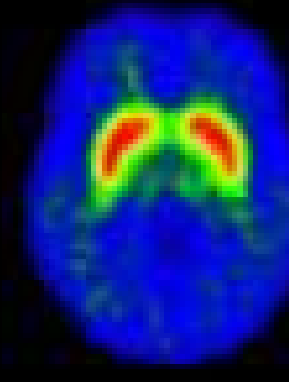
**Cocaine**



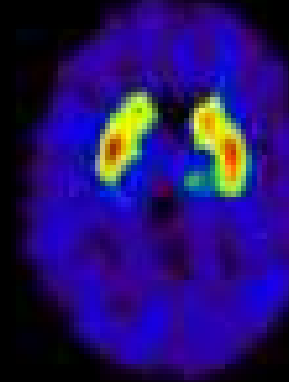
**Non-Smoker**



**Normal**

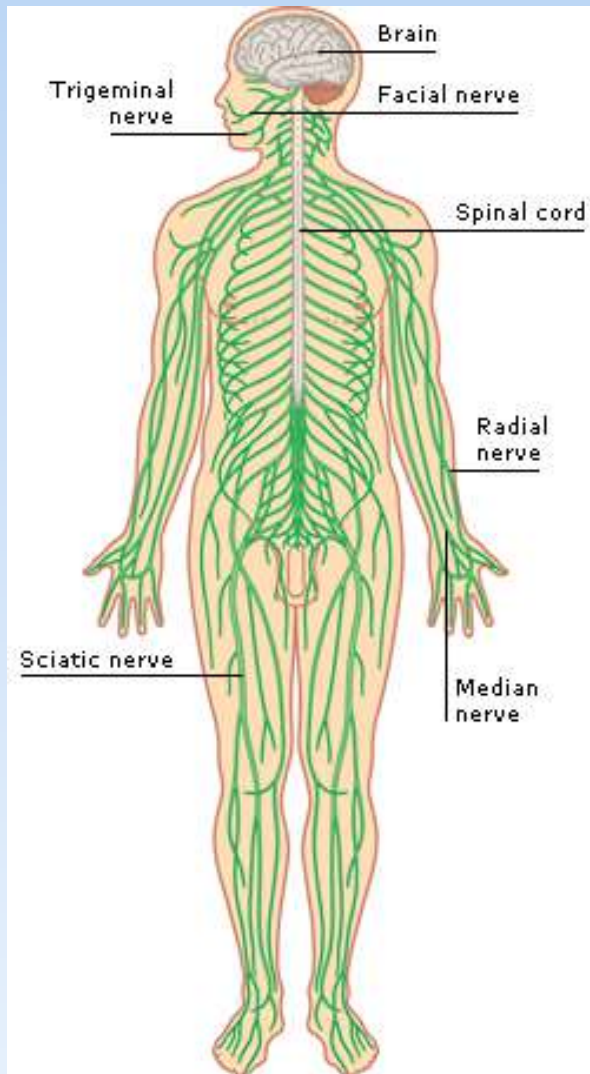


**Normal**



**Normal**

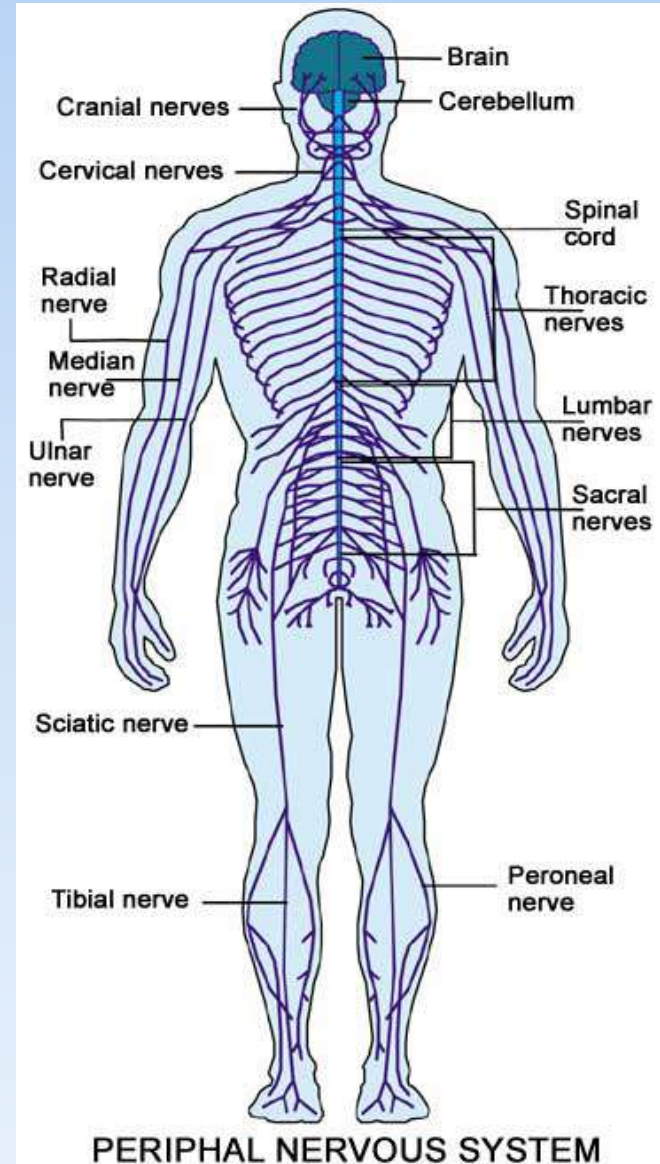
# The Peripheral Nervous System



- The **Peripheral Nervous System** (PNS) is composed of the nerves that are located outside the Central Nervous System parts of your body
- The PNS delivers information between the body and the CNS.

# The Peripheral Nervous System

- Parts of the Peripheral Nervous System
  - **Nerves** - visible bundles of axons and dendrites that extend from the brain and spinal cord to all other parts of the body

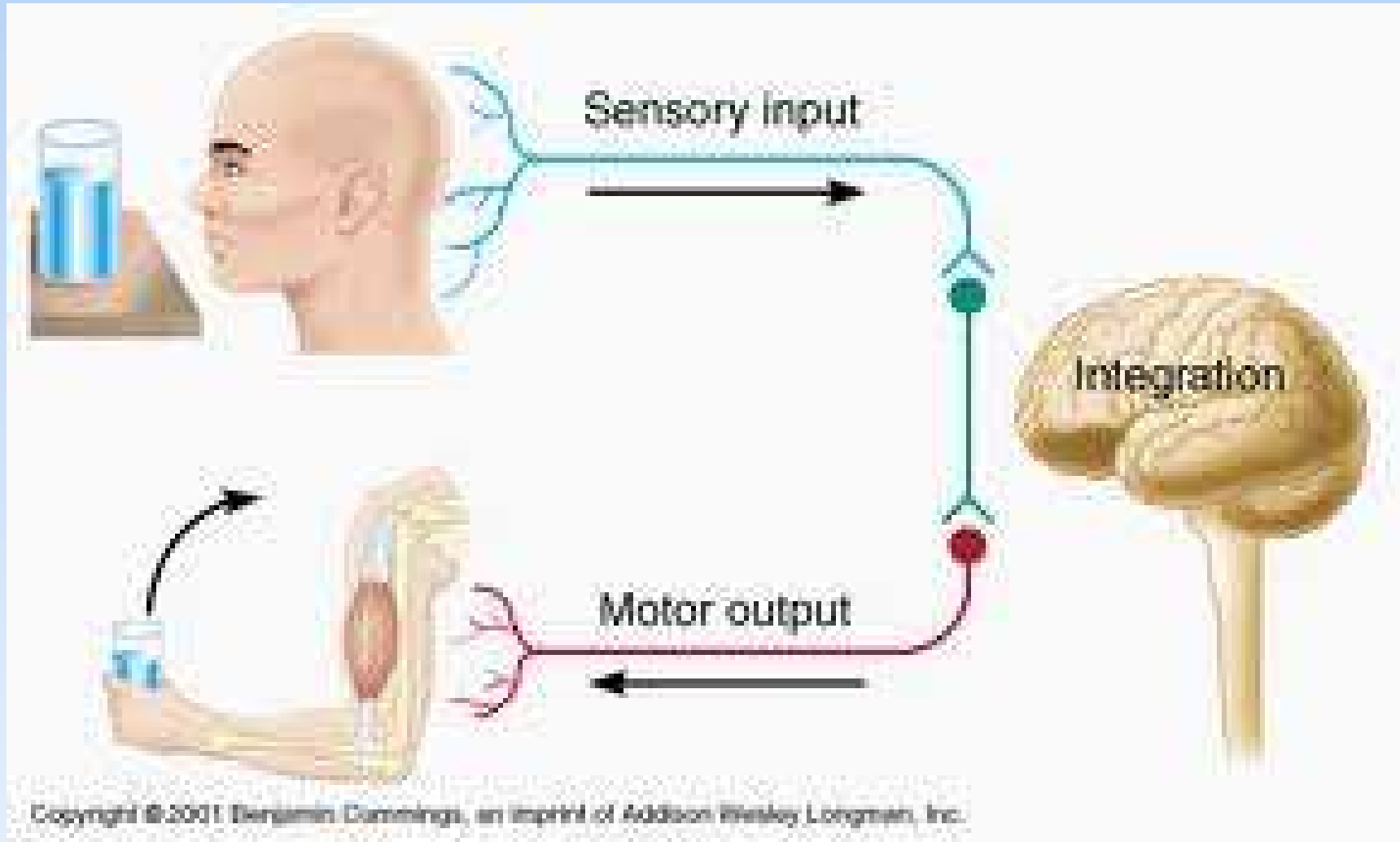


# The Peripheral Nervous System

## Types of Nerves:

- Sensory nerves - carry messages from body to brain (pain, pressure, temperature)
- Motor nerves – carry messages from brain to body to respond

# The Peripheral Nervous System



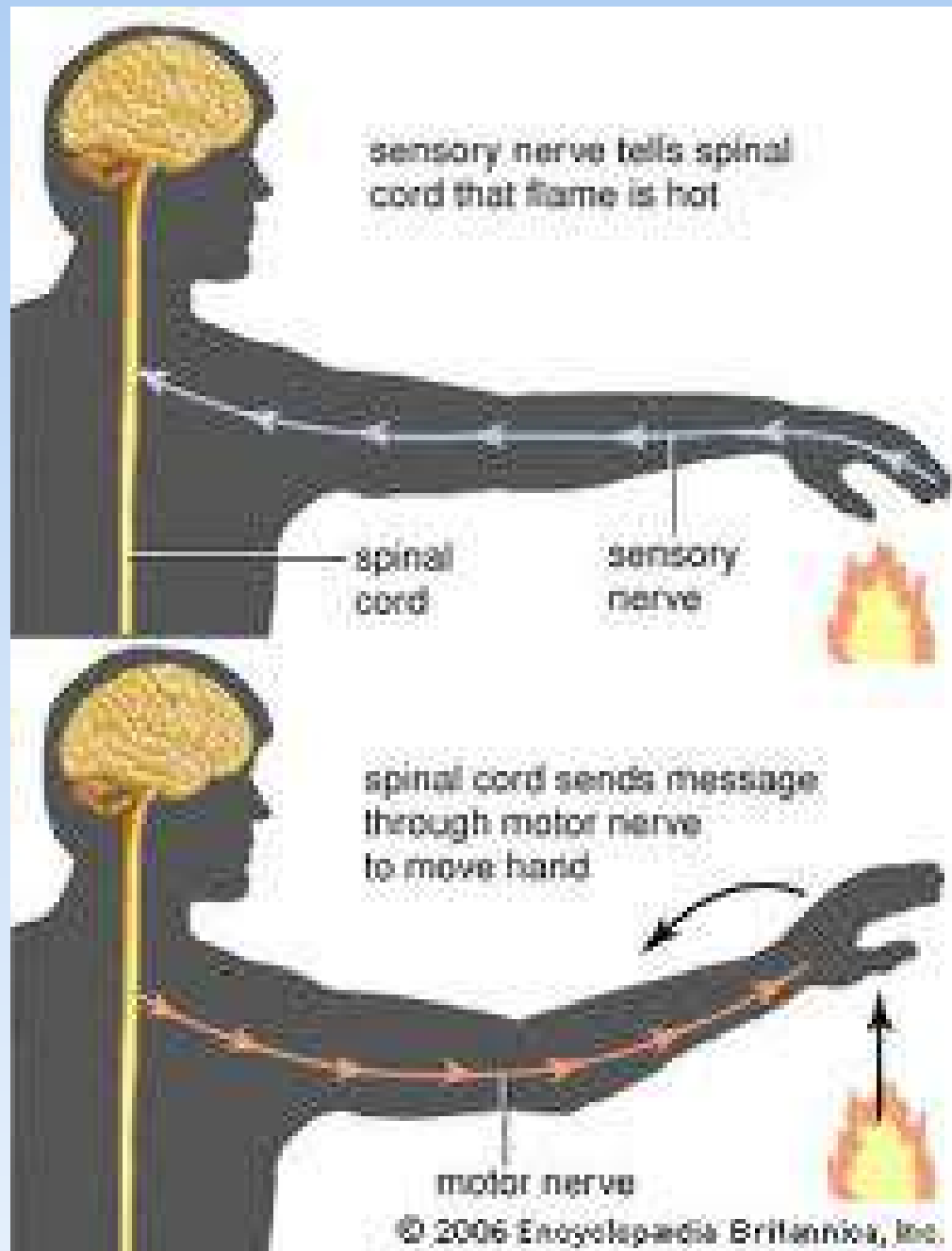
# The Peripheral Nervous System

- PNS is divided into two parts
  - Somatic Nervous System
  - Autonomic Nervous System



# The Peripheral Nervous System

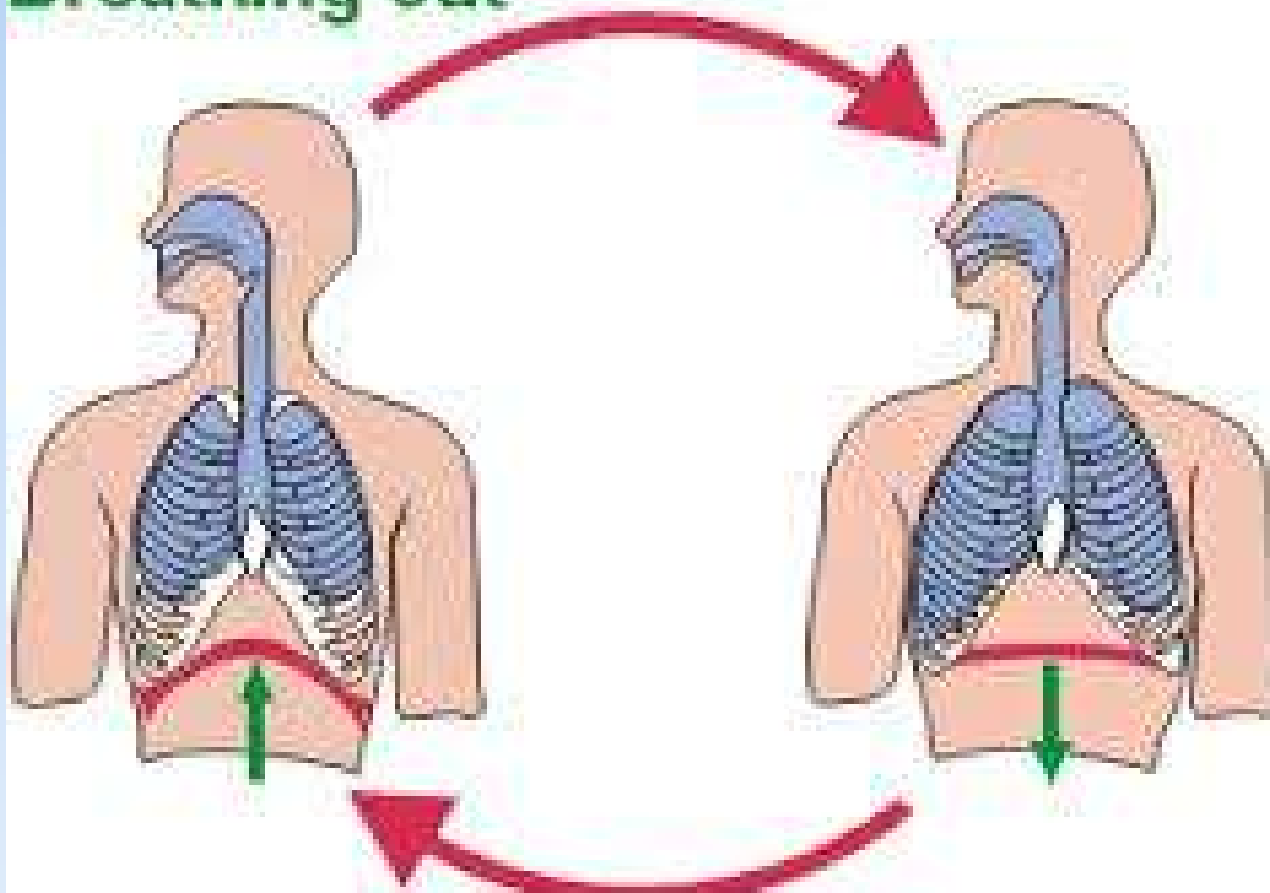
- The Somatic Nervous System
  - Carries messages between the CNS and the body's sensory organs and voluntary muscles.
  - It allows us to detect changes in the world around us, and it delivers information related to actions that we decide to perform.



# The Peripheral Nervous System

- The Autonomic Nervous System
  - Carries messages between the CNS and our internal organs.
  - It delivers information related to automatic tasks such as the regulation of breathing and digestive functions.

**Breathing out**



**Breathing in**

# How Information Travels Through The Nervous System

## 1. Neuron is stimulated

- Temperature
- Touch
- Sound
- Some other message



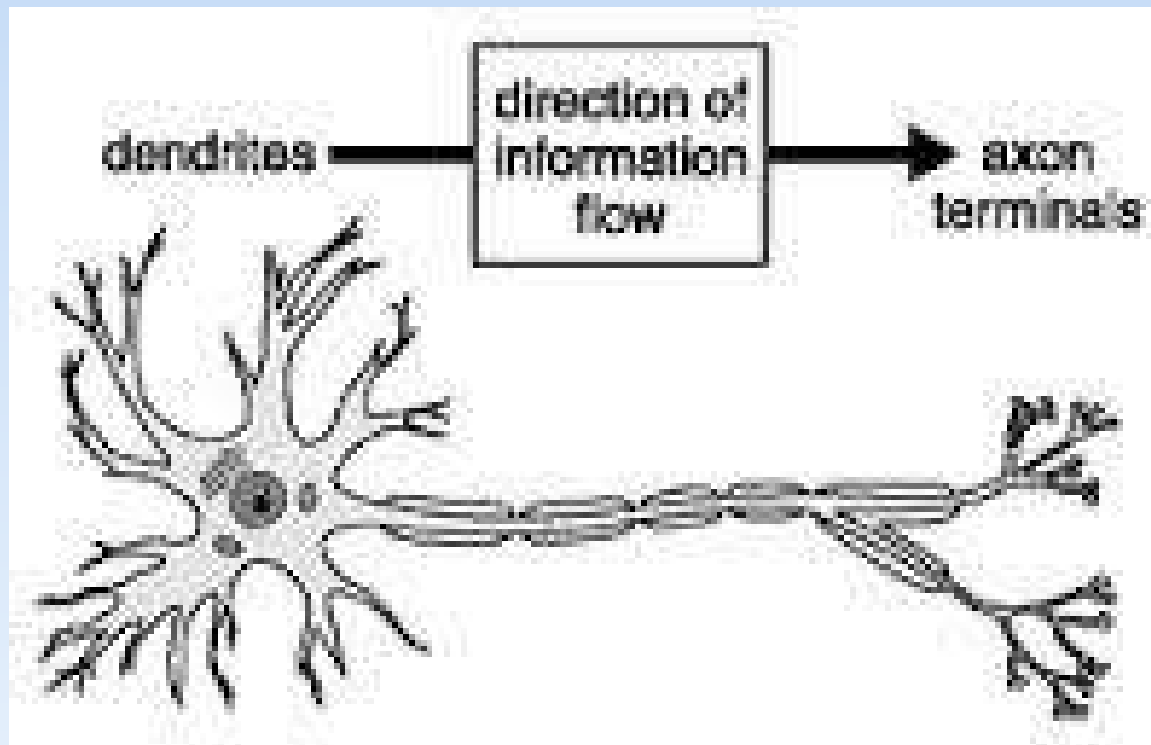
# How Information Travels Through The Nervous System

2. Neuron begins to generate a tiny electrical pulse
  - A electrical impulse flowing along the length of a neuron is called a **nerve impulse**



# How Information Travels Through The Nervous System

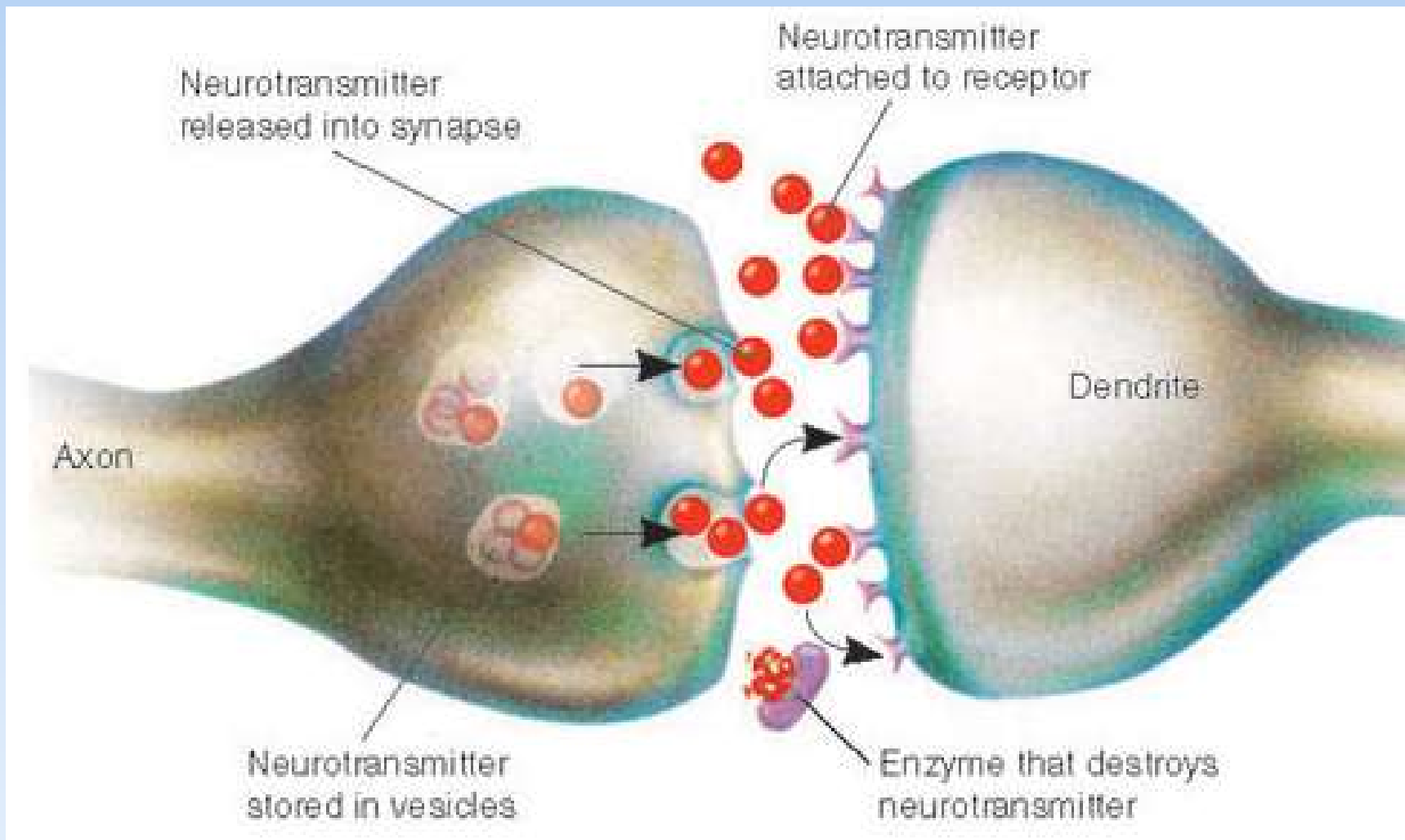
3. The pulse travels the length of the neuron.
  - Moving from dendrites to axon



# How Information Travels Through The Nervous System

4. Once the information arrives at the synaptic gap, neurotransmitters send information across the gap to the next neuron.
  - The cells do not touch one another





# How Information Travels Through The Nervous System

5. The chemicals trigger a nerve impulse in the next neuron.
  - This cause a reaction that takes the information from the point of stimulation to the brain or spinal cord.
  - The brain or spinal cord then sends a message telling the body what to change.
    - The brain or spinal cord sends information back the same way.

## Structure of a Typical Neuron

