

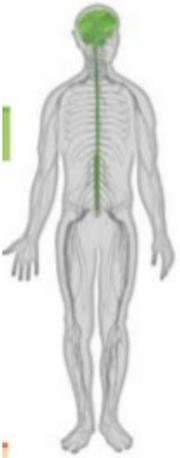
THE NERVOUS SYSTEM

- one of the 2 control systems of the body
- responsible for **coordinating the actions of the body**.
- all animals have a nervous system, the complexity of which varies with the organism
- humans have a dorsally located nerve cord encased in bone (**vertebrae**)
- the anterior end of the nerve cord is enlarged (**brain**) and is the dominant controller of the whole nervous system.

Nerves and Internal Coordination of the Body (p.197)

- there are two main groups or systems of nerves in the body:

Central nervous system



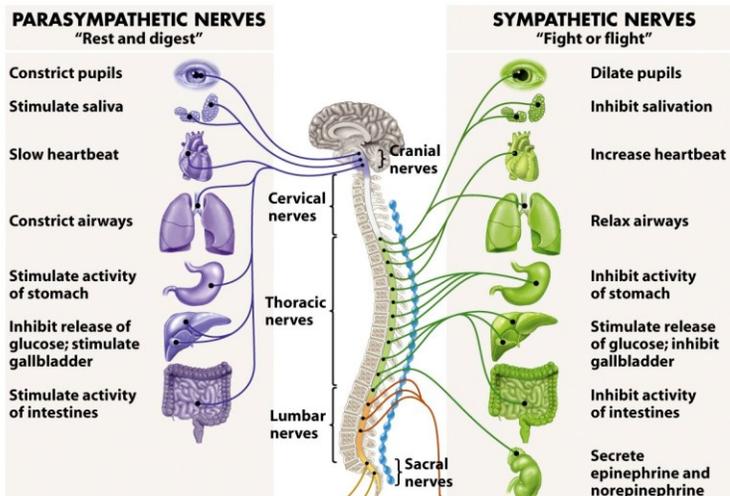
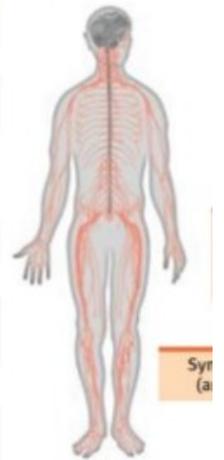
A) Central Nervous System (CNS)

- contains the **brain** and **spinal cord**
- coordinates all incoming and outgoing information
= all of the nerves you can control
ie.) **speaking, walking, eating**

B) Peripheral Nervous System (PNS)

- communicates between the **CNS** and the **rest of the body**
- is further subdivided into:
 - 1) Somatic Nervous System
 - : nerves of the skin, skeletal muscle, bone
= **voluntary control**
 - 2) Autonomic Nervous System
 - : nerves which control internal organs
= **involuntary**
 - : further divided into the **sympathetic** & **parasympathetic** systems
= complementary action

Peripheral nervous system



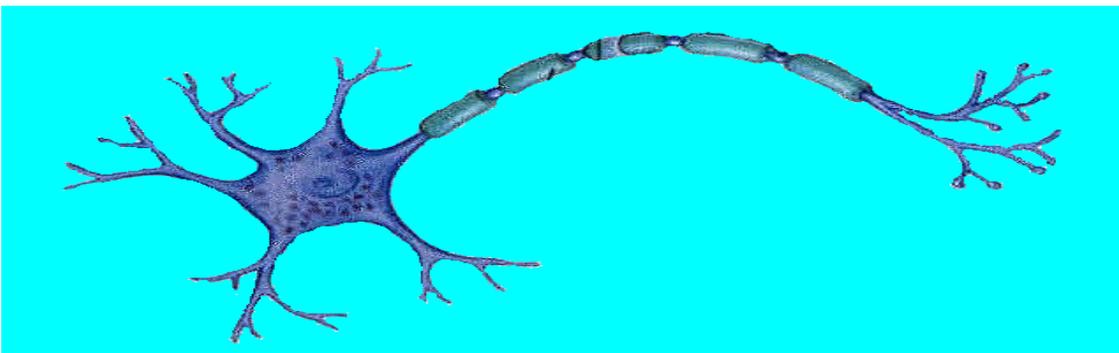
- damage to your CNS often results in **reduced function** or **movement**, while damage to parts of the PNS often results in death

Neurons & Neuron Structure (p. 200)

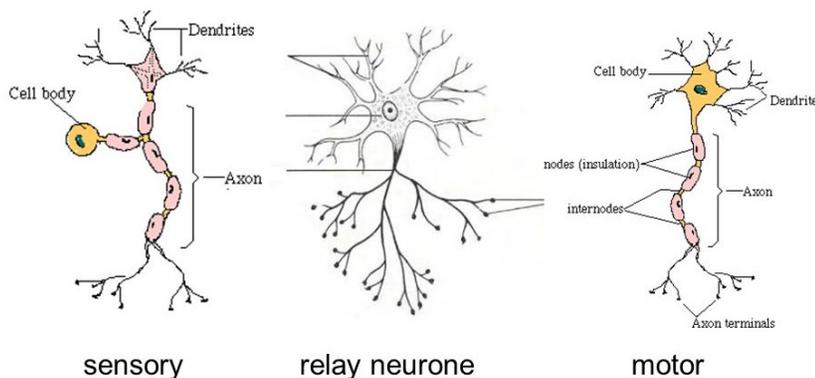
- are the building blocks of all nervous systems
- most **nerves** are composed of many neurons
- transmit impulses (**electrochemical messages**) from neuron to neuron
- these messages are a few thousandths of a second long

Neuron Structure(p. 200)

- although neurons differ in size and function, all are composed of similar parts:
 - a) Cell body - area of the nerve containing the **nucleus**
 - b) Dendrites - made of **cytoplasm**
 - carry nerve impulses **toward the cell body**
 - c) Axon - **cytoplasmic tail** that carries the nerve impulse to other **nerves** or **effectors**
 - d) Myelin sheath -fatty covering along the axon of a nerve made of **Schwann cells**
 - speed the rate of impulse transmission along the axon
 - e) Neurilemma -thin membrane surrounding the axons of the nerves
 - of the **peripheral nervous system** which promotes the **repair of damaged axons**



-Variations of this general structure result from specialization of neurons for different functions



How the Nervous System Works (p.204)

- each response coordinated by the nervous system involves 3 elements:

1) Receptors

: any organ that picks up **stimulus**

: ie. **eye, nose, skin**

2) Effectors

: any organ that **reacts to a stimulus**

: ie. **muscle, gland**

3) Conductors

: aka neurons

: transmit information about stimuli between the **receptor** & an **effector** in the form of electrochemical impulses

: there are 3 types of neurons in mammals:

a. Sensory (Afferent)

- receives an impulse from a **receptor** & passes it to the **control center (CNS)**

- range in size up to 1m long

b. Motor (Efferent)

- carries impulses to an **effector**, such as a **muscle**, or a **gland**

- also can be up to a meter long

c. Associative (aka Interneuron)

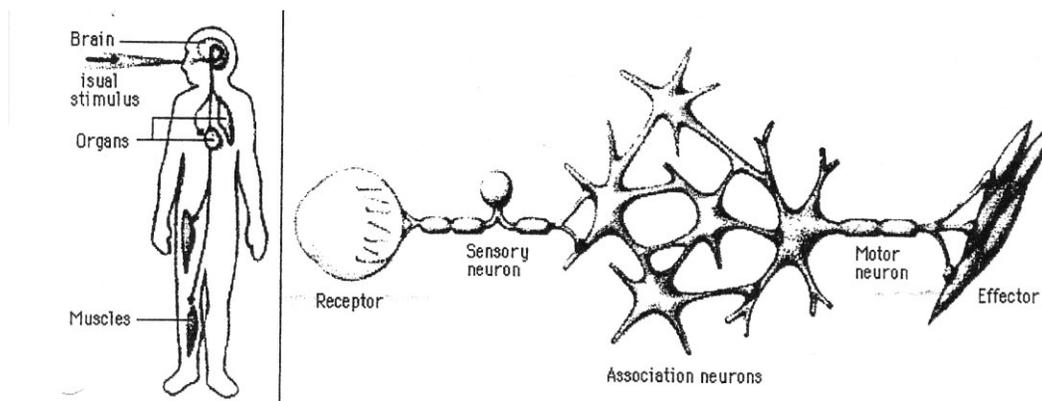
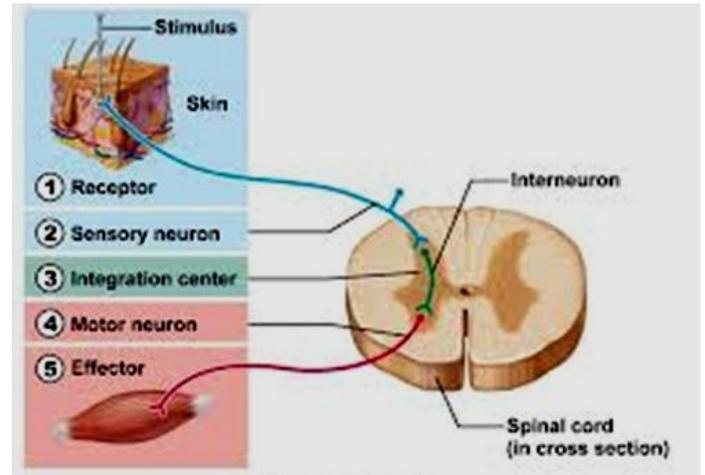
- in control center (CNS) = brain and spinal column

- are microscopic in size

- is the middle neuron of the three involved in impulse transmission

- transmit the impulses from a sensory neuron to a motor neuron, or vice versa

- these 3 neurons, combined with the receptor, which detects impulses, and the effector, which acts upon the impulse makes up the **REFLEX ARC** p. 204



Impulse Transmission

- the nervous system uses electrochemical messages to control the actions of the body
- transmission within the nerve cell = **electrical**
- transmission between neurons = **chemical**
- Synapse
 - = space between neurons
 - : contain a chemical (**neurotransmitter**) that passes the impulse from neuron to neuron
 - : transmit impulses **in one direction only**
 - : chain reaction
 - : neurons have a slightly negative charge
 - : messages sent by the nervous system are caused by a neuron trying to maintain homeostasis of positive and negative ions within the cell
 1. A dendrite picks up an impulse in the form of a neurotransmitter
 - = causes Na^+ ions to rush in
 2. As the Na^+ ions rush into the neuron, the electrical charge of the neuron changes.
 - = **depolarization**
 3. The Na^+ ions move through the neuron changing its electrical charge
 - = **action potential wave (electrical)**
 4. A second neurotransmitter stops the flood of Na^+ ions and allows K^+ ions to leave the cell letting it to recover
 - = **repolarization**
 5. Impulse reaches the end of the axon and passed to the next neuron via neurotransmitters in the synapse (ie. dopamine, acetylcholine)
 - = **chemical**
 6. Continues from neuron to neuron until the message reaches the desired effector.

Factors Affecting Impulse Transmission Rates

- thickness of the axon (thicker = faster)
- myelinated vs nonmyelinated (myelin allows for **salutatory conduction** = faster)
- temperature (warmer = ions move faster)

Other Factors Effecting Impulse Transmission

1. Endorphins

- : natural painkillers produced by the brain
- : block the pain receptor sites in the brain
 - = pain intensity is reduced

2. Nerve Fatigue

- : caused by constant stimulation of neurons
- : impulses are blocked because the transmitter release & clearing can't keep up
 - = can't depolarize and repolarize quick enough
- : ie. wearing a watch, ring, etc. (not aware of wearing it)

3. Chemicals

a) Insecticides and Pesticides

- block the break down of neurotransmitters
 - = cause a state of contraction or paralysis
- ie. Cyanide, Strychnine

b) Stimulants

- stimulate neurotransmitters production
- = impulses travel more quickly and easily at synapses
- causes heightened awareness, increased heart rate & b.p., elevate mood
- ie. Caffeine, nicotine, amphetamines (dieters and athletes), cocaine

c) Depressants

- reduce neurotransmitter production
- = slow or stop movement of impulses across synapses
- causes slower reaction times, dulling of senses, decreased heart rate & b.p.
- ie. Pain killers, tranquilizers, alcohol, anesthetics, pot

d) Hallucinogens

- block the uptake of neurotransmitters in the brain
- = causes distortion of the senses (sensations that really are not there)
- ie. LSD, PCP, ecstasy

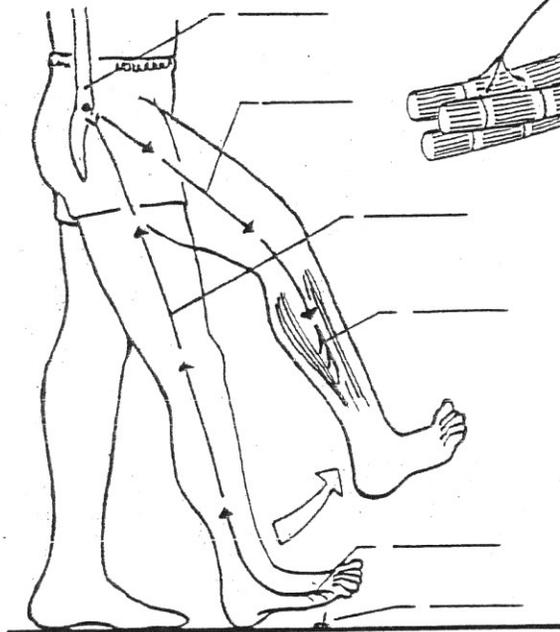
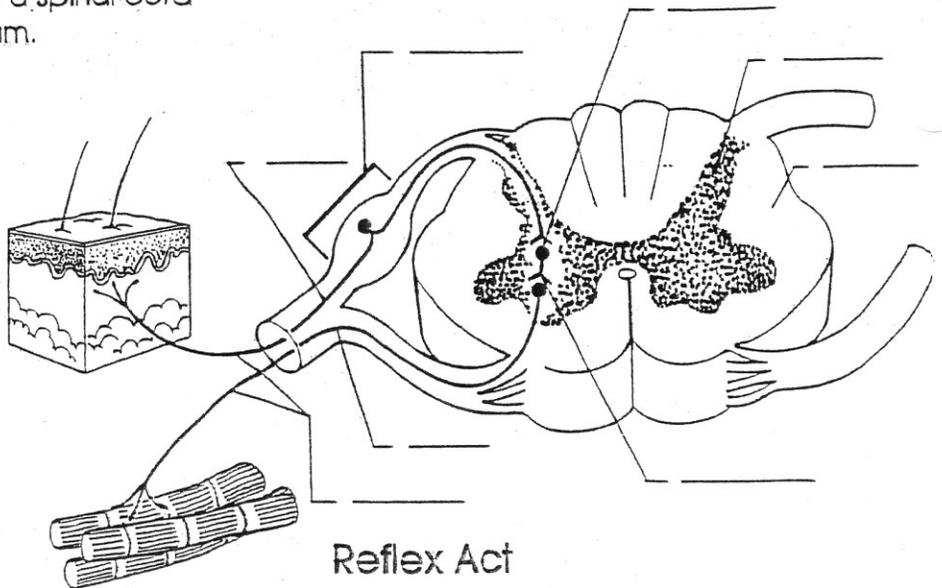
** Collectively, stimulants, depressants and hallucinogens:

- most are psychologically and physically addictive
- most were originally used for medicinal purposes
- all cause emotional and behavioral changes
- many damage the body permanently; large amounts are potentially lethal

Cross Section of Spinal Cord

Label the following parts of a spinal cord on the cross-section diagram.

- white matter
- grey matter
- dorsal root ganglion
- nerve fibers
- interneuron
- synapse
- sensory neuron
- motor neuron



Reflex Act

Label the following parts of a reflex act on the diagram of a boy stepping on a tack and jerking his leg away.

- sensory neuron
- motor neuron
- stimulus
- spinal cord
- receptor (in skin)
- effector (muscle)

Fill in the blanks with the correct answers.

Suppose you stepped on a tack. You jerked your leg away _____, you were aware of what happened. The impulse traveled from the _____, the skin, along a(an) _____ neuron into the _____. The impulse jumped across a(an) _____ to a(an) _____; then across another synapse to a _____ neuron. The impulse traveled along this nerve to a muscle, _____, in your leg. You jerked your leg away. Only a fraction of a second later, a(an) _____ traveled up your _____ to your _____. But you had _____ reacted. This kind of reaction is known as a(an) _____. Reflex acts occur without thinking.

Concept Mapping

CHAPTER 33

A Nerve Impulse

Complete the events chain about what happens during a nerve impulse. These terms may be used more than once: axon, channels, dendrites, negative charge, neuron, positive charge.

