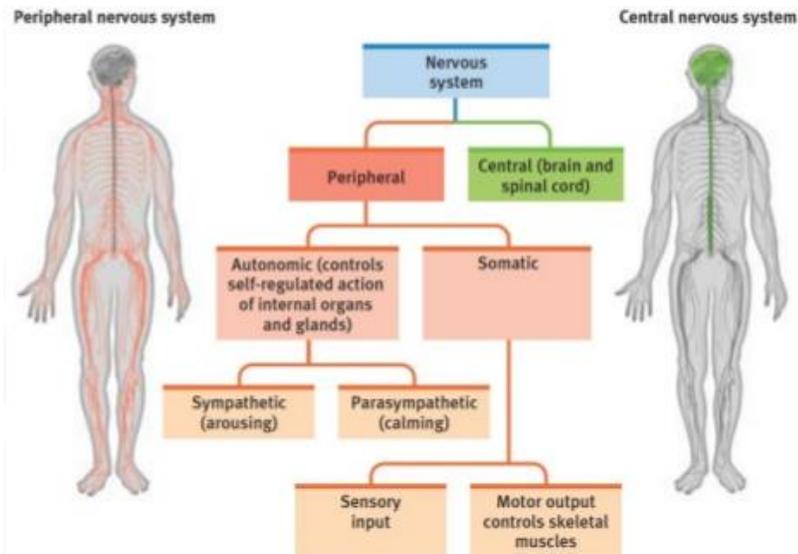


THE NERVOUS SYSTEM

- 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:

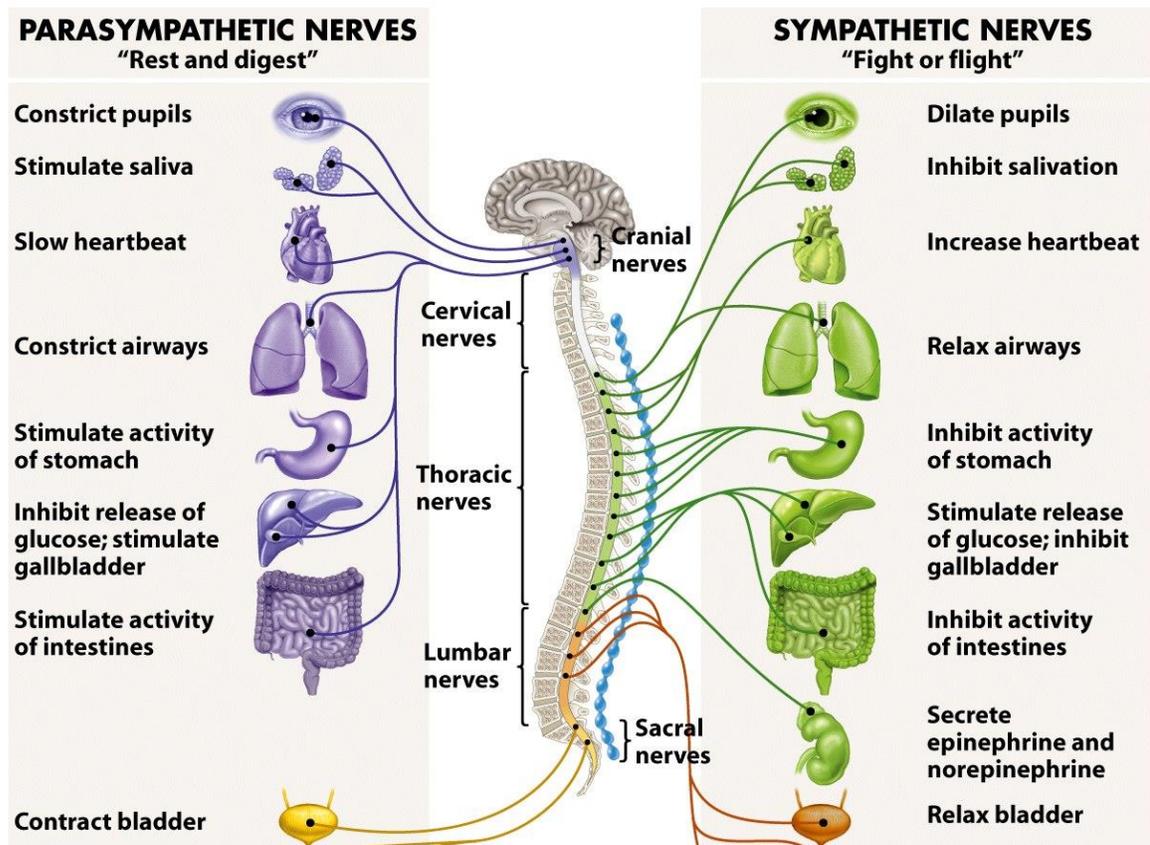


A) Central Nervous System (CNS)

- 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
 - : contains nerves of the skin, skeletal muscle and bone
= **voluntary control**
 - 2) Autonomic Nervous System
 - : nerves which control internal organs
= **involuntary**
 - : further divided into the **sympathetic** & **parasympathetic** systems
= complementary action
- damage to your CNS often results in **reduced function** or **movement**, while damage to parts of the PNS often results in death



The Brain -- King of the Nerves

- is a complex organ composed of a large cluster of neurons
= control center of an animal's body
- functions of the brain:
 - : receives, analyzes and stores information
 - : controls the body
- is composed of 3 major parts:
 - 1) **Cerebrum**
 - the largest part of the brain
 - responsible for interpreting sensory information, thinking and planning, controlling voluntary activities
 - folded outer layer (**cortex**) **increases surface area** allowing for more reasoning power
 - is divided into 2 hemispheres (halves) connected by the **corpus callosum** to allow communication via the **thalamus (relay station)**
 - a) Left Hemisphere = controls language, math and the right side of the body
 - b) Right Hemisphere = controls emotions, creativity and left side of the body
 - each hemisphere is composed 4 lobes
 - Frontal lobe**: responsible for voluntary movement, reasoning and judgment
 - Temporal lobe**: responsible for hearing, language, memory and emotions
 - Parietal lobe**: sensory information and association
 - Occipital lobe**: vision and visual recognition

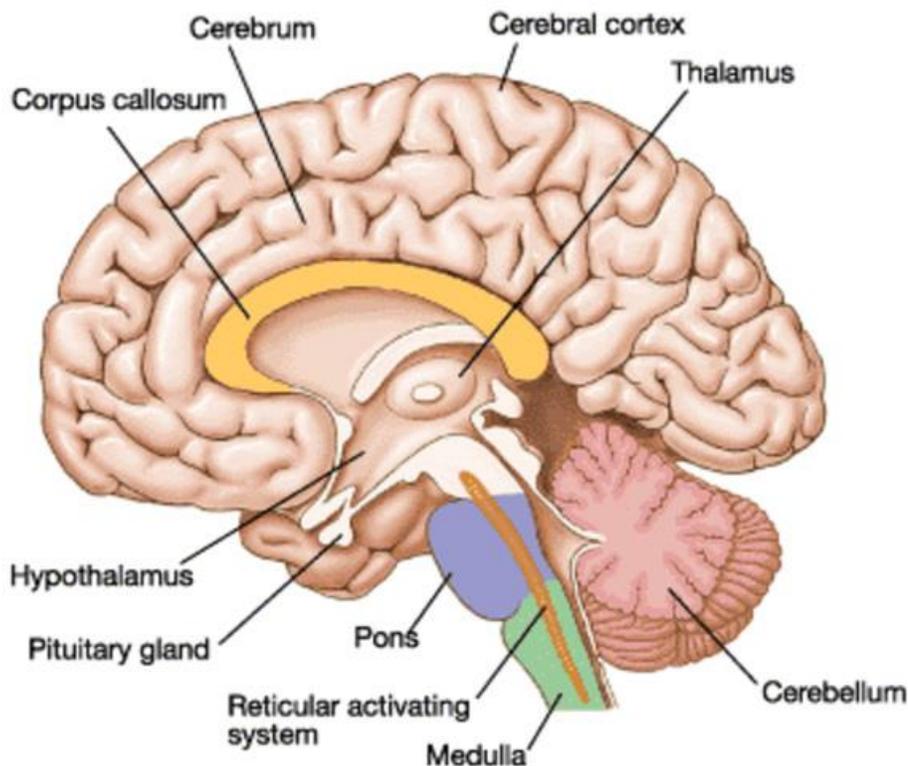
2) Cerebellum

- behind the cerebrum
- responsible for **balance, action of muscles and coordination of movement**

3) Brain Stem (Medulla Oblongata)

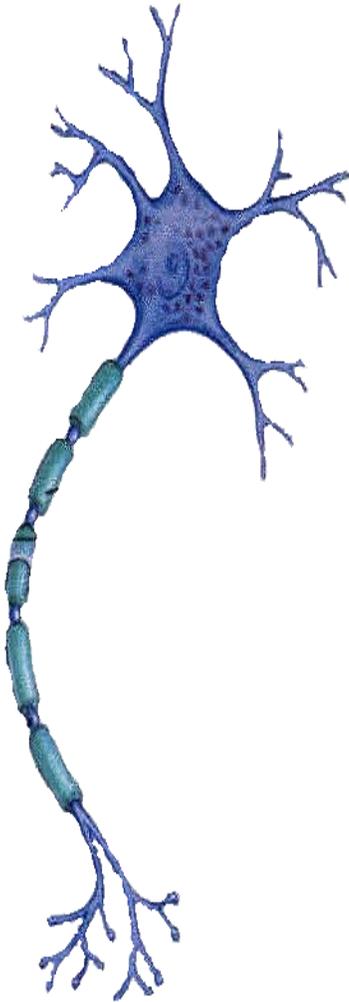
- base of the brain; connects to the spinal cord
- contains the **vagus nerve** which controls vital involuntary life processes such as breathing, heart rate, digestion
- **pons**: area of the brain stem responsible for relaying information between the PNS and CNS

- the brain is incased in bone skull and covered with the **meninges** (membranes located between bone and soft tissue). These together with the **cerebrospinal fluid** protect the brain from injury.



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

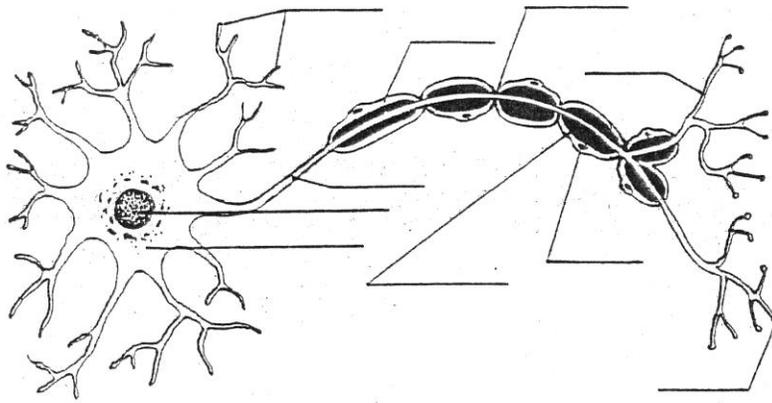


Neuron Structure(p. 200)

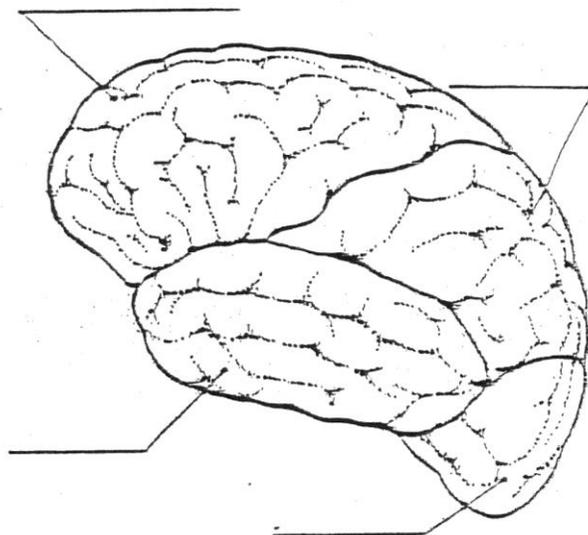
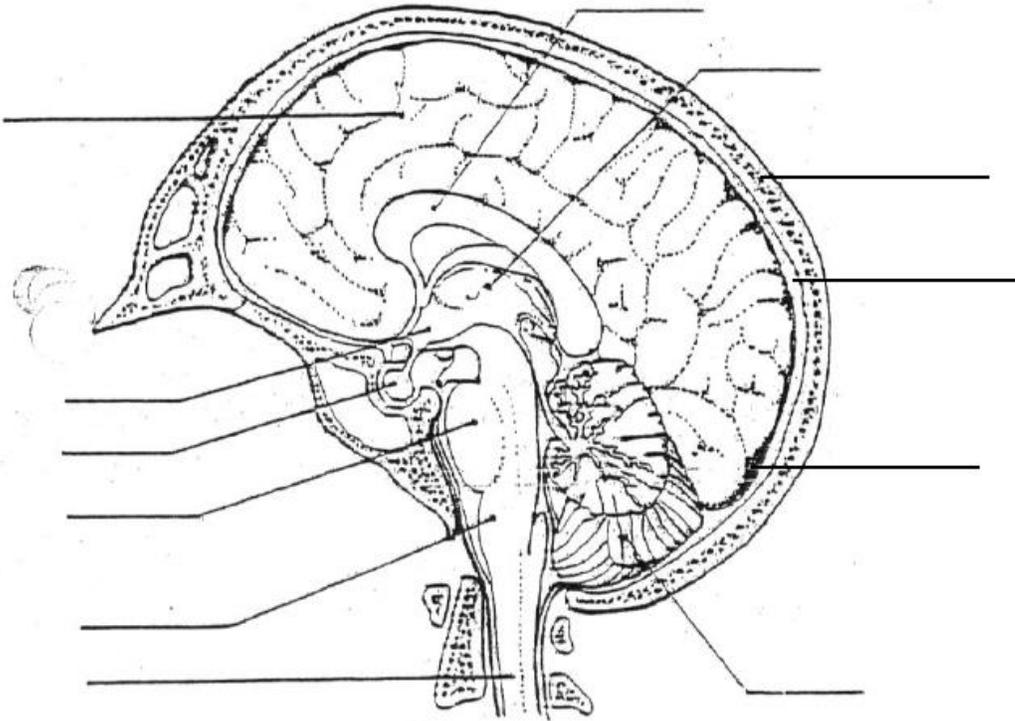
- although neurons differ in size and function, all are composed of similar parts:
 - a) Cell body - area of the nerve containing the **nucleus**
 - b) Dendrites - made of **cytoplasm**
 - carry nerve impulses **toward the cell body**
 - c) Axon - **cytoplasmic tail** that carries the nerve impulse to 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

Neuron

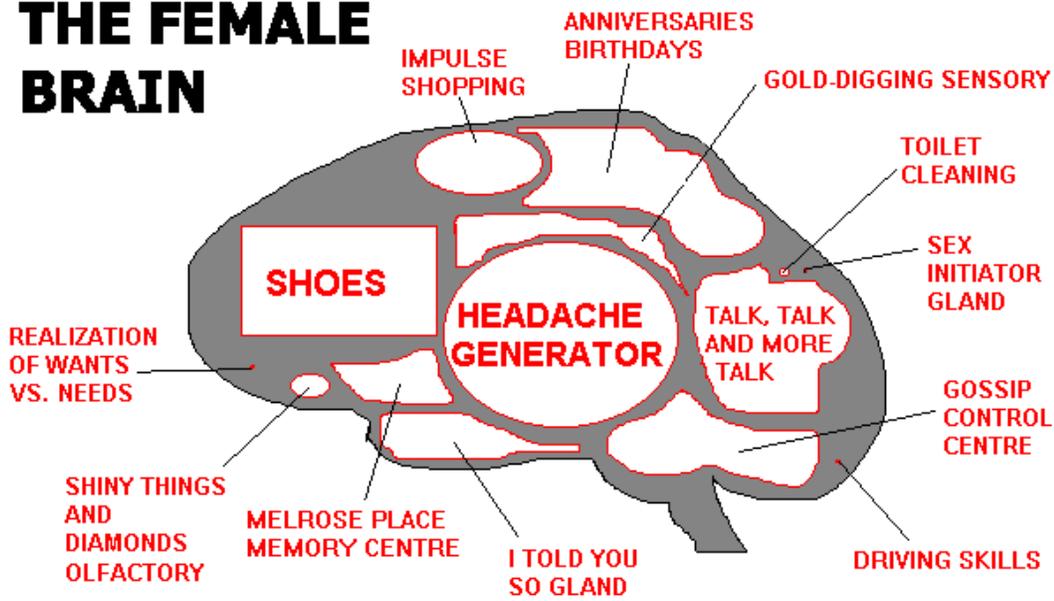
Label the diagram at the left.



- a. cell body (cyton)
- b. nucleus
- c. dendrites
- d. axon
- e. node of Ranvier
- f. terminal branches
- g. synaptic knobs
- h. Schwann cell
- i. Schwann cell nucleus
- j. myelin sheath

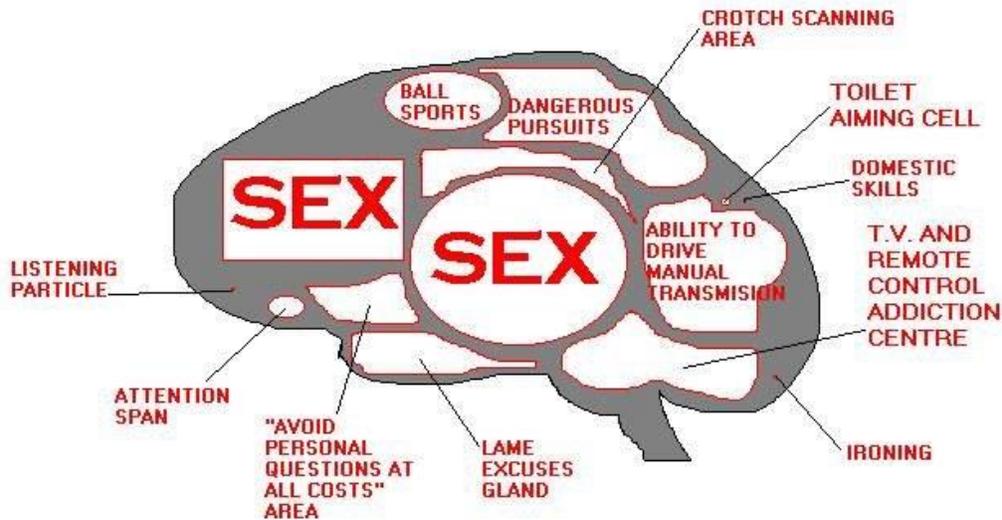


THE FEMALE BRAIN



FOOTNOTE: The "Put Oil into the Car" and "Be Quite During the Game" glands are active only when the "SHINY THINGS AND DIAMONDS" OLFactory has been satisfied or when there is a shoe sale.

THE MALE BRAIN



FOOTNOTE: the "Listening to children cry in the middle of the night" gland is not shown due to it's small and underdeveloped nature. Best viewed under a microscope.

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

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

- range in size up to 1m long

b. Motor

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

- also can be up to a meter long

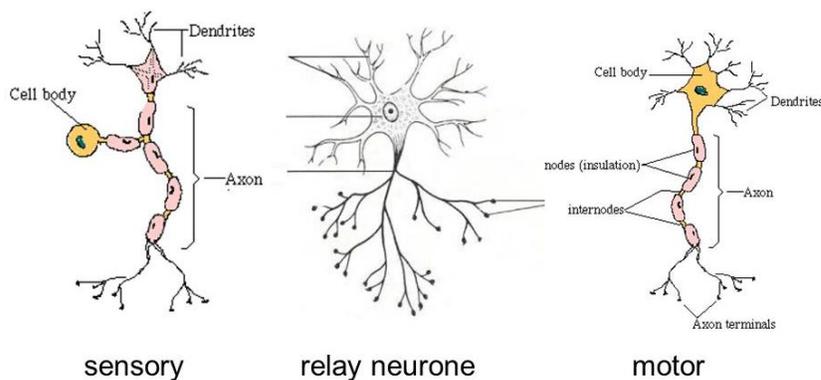
c. Associative (aka Interneuron)

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

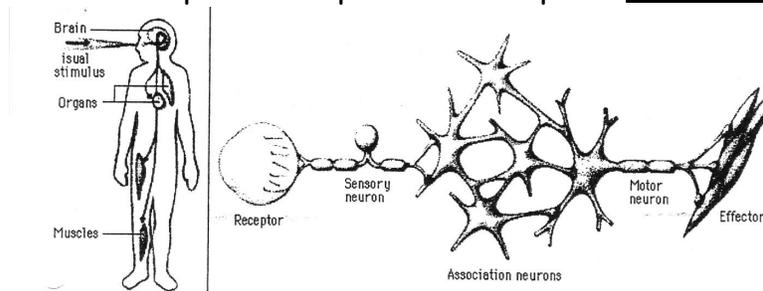
- are microscopic in size

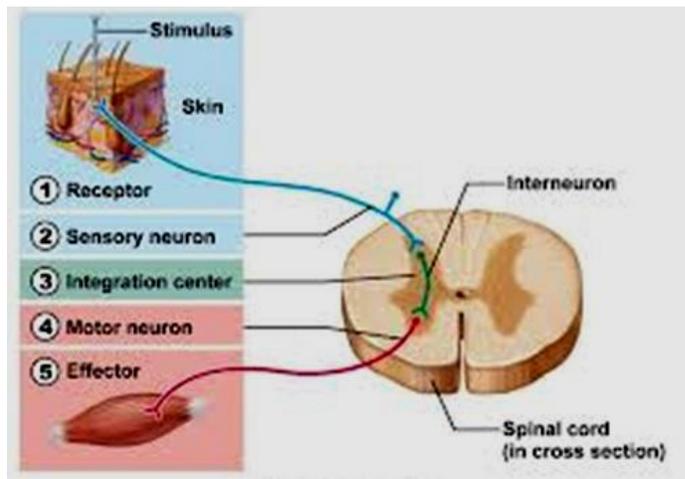
- is the middle neuron of the three involved in impulse transmission

- 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

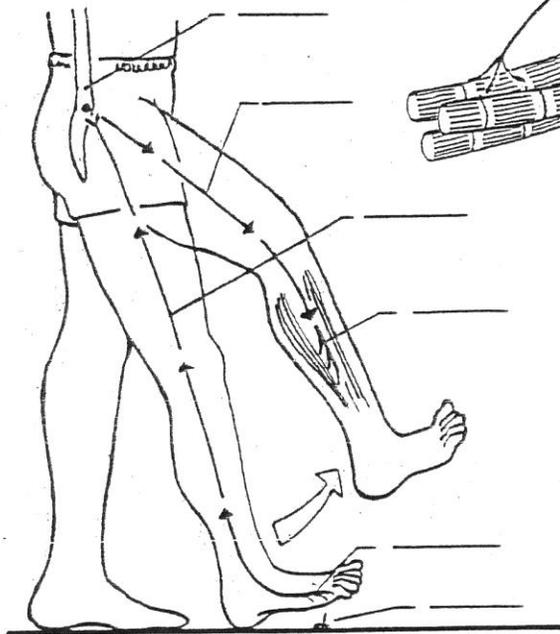
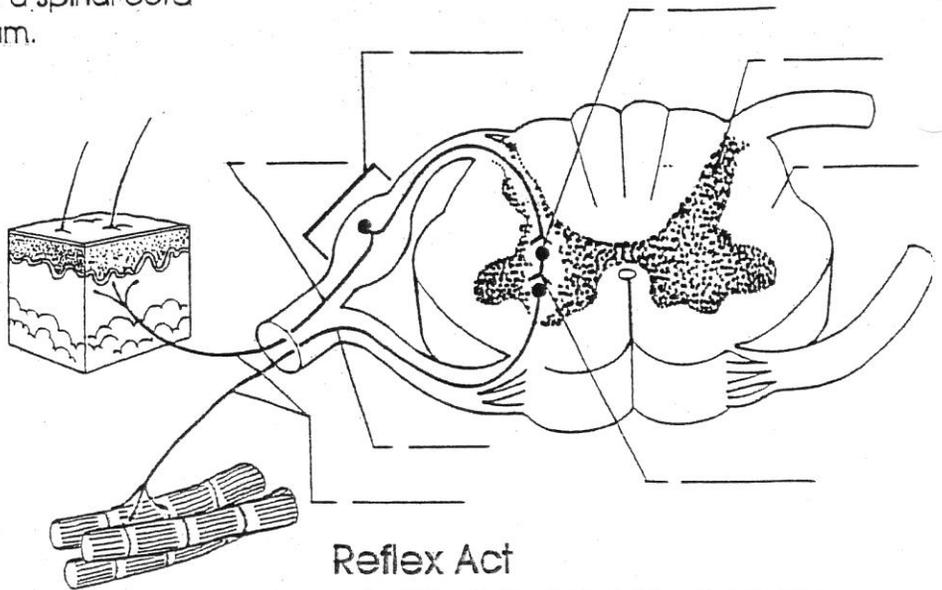
** Collectively, stimulants, depressants and hallucinogens:

- 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.

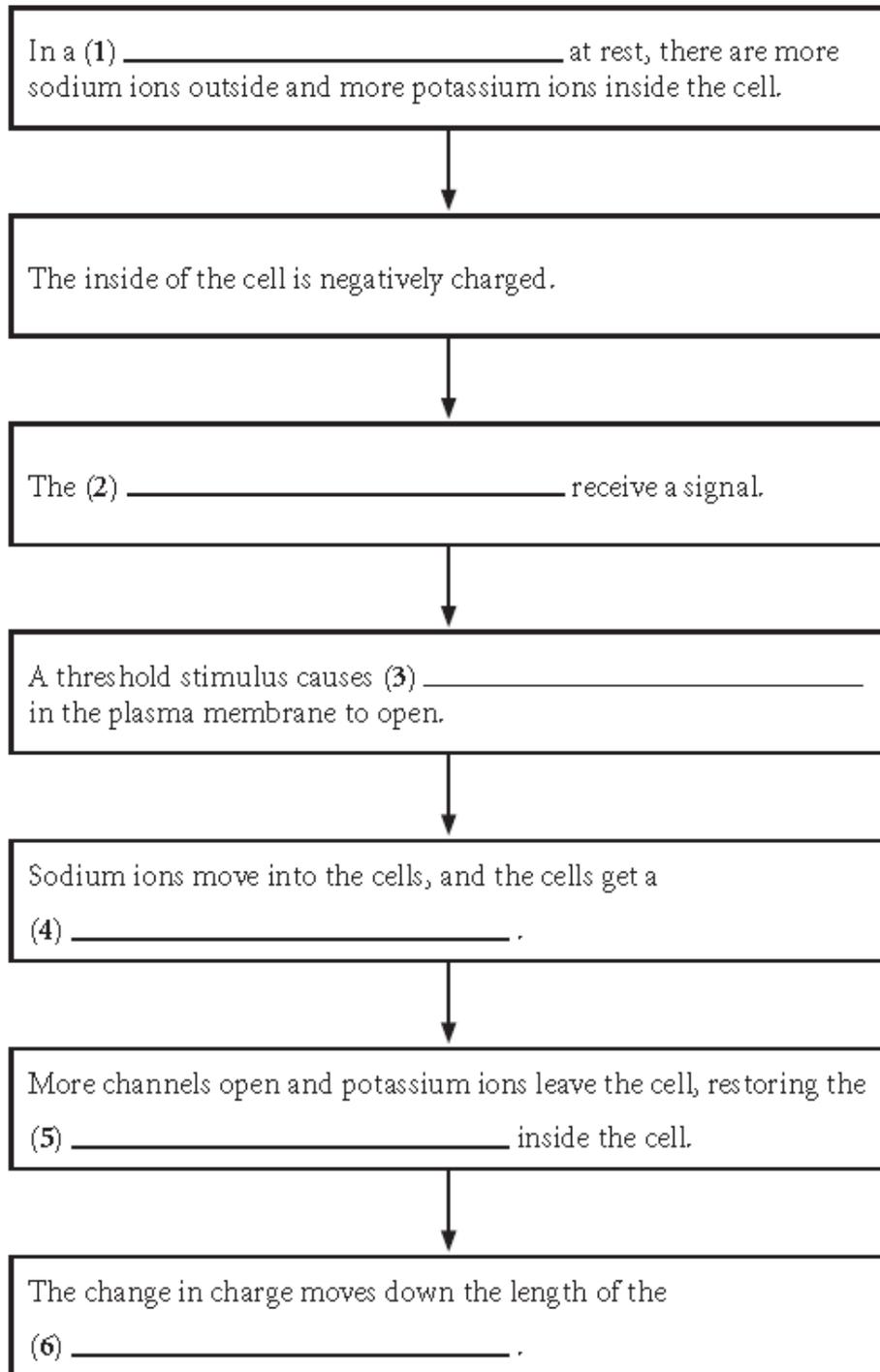
Suppose you stepped on a tack. You jerked your leg away _____, you were aware of what happened. The impulse traveled from the _____, the skin, along a(an) _____ neuron into the _____. The impulse jumped across a(an) _____ to a(an) _____; then across another synapse to a _____ neuron. The impulse traveled 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.



Disorders of the Nervous System

1. Concussion

- Bruising of brain due to it hitting the inside of skull
- Causes dizziness, seeing stars, unconsciousness, vomiting
- Paralysis and coma

2. Stroke

- Blocked blood vessels to brain
- Brain tissue dies from lack of oxygen
- Paralysis, slurred speech, numbness, blurred vision

3. Alzheimer's Disease

- Brain tissue deteriorates due to abnormal protein deposits on it
- Memory loss, disorientation, personality change

4. Multiple Sclerosis

- Myelin sheath damaged
- Impaired vision and speech
- Muscle weakness, tremors, paralysis

5. Polio

- Virus affects gray matter of spinal cord
- Damages motor neurons
- Paralysis

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
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** Collectively, stimulants, depressants and hallucinogens:

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

The Brain -- King of the Nerves

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= control center of an animal's body
- functions of the brain:
 - : receives, analyzes and stores information
 - : controls the body
- is composed of 3 major parts:
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 - the largest part of the brain
 - responsible for interpreting sensory information, thinking and planning, controlling voluntary activities
 - folded outer layer (**cortex**) increases surface area allowing for more synapses
 - is divided into 2 hemispheres (halves) connected by the **corpus callosum** to allow communication via the **thalamus** (relay station)
 - a) Left Hemisphere = controls language, math and the right side of the body
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 - each hemisphere is composed 4 lobes
 - Frontal lobe: responsible for voluntary movement, reasoning and judgment
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 - Parietal lobe: sensory information and association
 - Occipital lobe: vision and visual recognition
 - 2) **Cerebellum**
 - behind the cerebrum
 - responsible for balance, action of muscles and coordination of movement
 - 3) **Brain Stem (Medulla Oblongata)**
 - base of the brain; connects to the spinal cord
 - contains **vagus nerve** which controls vital involuntary life processes such as breathing, heart rate, digestion
 - **pons**: area of the brain stem responsible for relaying information between the PNS and CNS
- the brain is incased in bone skull and covered with the meninges (membranes located between bone and soft tissue). These together with the cerebrospinal fluid protect the brain from injury.

NEUROMUSCULAR JUNCTION

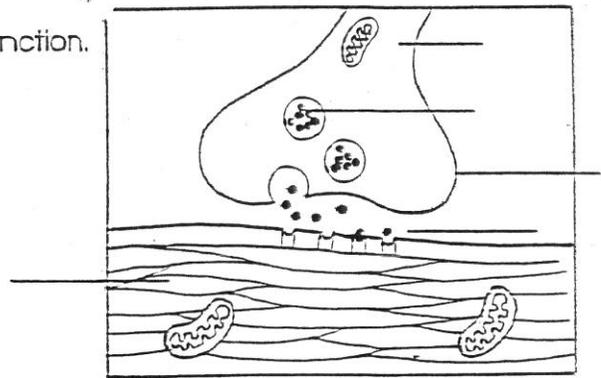
Fill in the blanks with the correct answers.

_____ are specialized for the transmission of nerve impulses. The nucleus is located in the _____ of the neuron. From the cell body, two types of structures carry out transmission functions. _____ transmit nerve impulses from other cells or sensory systems. _____ provide for the transmission of nerve impulses away from the cell body. A single neuron cell can be over a meter long due to the length of its _____. _____ are the supporting cells associated with axons. They form a(an) _____ around many vertebrate neurons. _____ interrupt the myelin sheath where the axon is in direct contact with surrounding intercellular fluid. The junction between a neuron and a muscle is called a(an) _____ junction. _____ is the neurotransmitter. At a neuromuscular junction, acetylcholine released from a(an) _____ depolarizes the muscle cell membrane and triggers muscle contractions.

Neuromuscular Junction

Label the following parts of a neuromuscular junction.

- a. axon
- b. cleft
- c. synaptic knob
- d. muscle fiber
- e. acetylcholine sacs



Use the following to fill in the blanks above:

cell body

axons

myelin sheath

acetylcholine

nodes of ranvier

synaptic knob

dendrites

neurons

schwann cells

axon

neuromuscular

THE NERVOUS SYSTEM

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

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

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- contains the _____ and _____
- coordinates all incoming and outgoing information
= all of the nerves you can control
ie.) _____

B) Peripheral Nervous System (PNS)

- communicates between the _____ and the _____
- is further subdivided into:

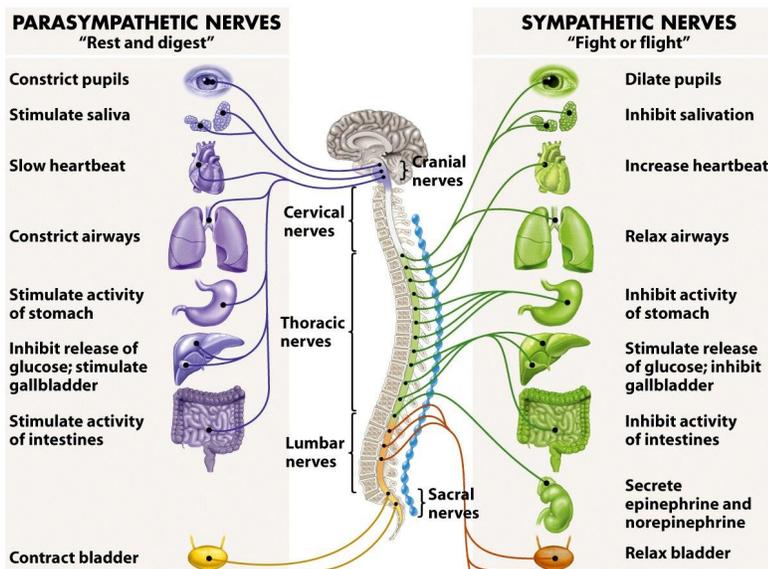
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- : contains nerves of the skin, skeletal muscle and bone
= _____

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= _____
- : further divided into the _____ & _____ systems
= complementary action

- damage to your CNS often results in _____ or _____, while damage to parts of the PNS often results in _____



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= control center of an animal's body
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 - _____ : sensory information and association
 - _____ : vision and visual recognition

2) Cerebellum

- behind the cerebrum
- responsible for _____

3) Brain Stem (Medulla Oblongata)

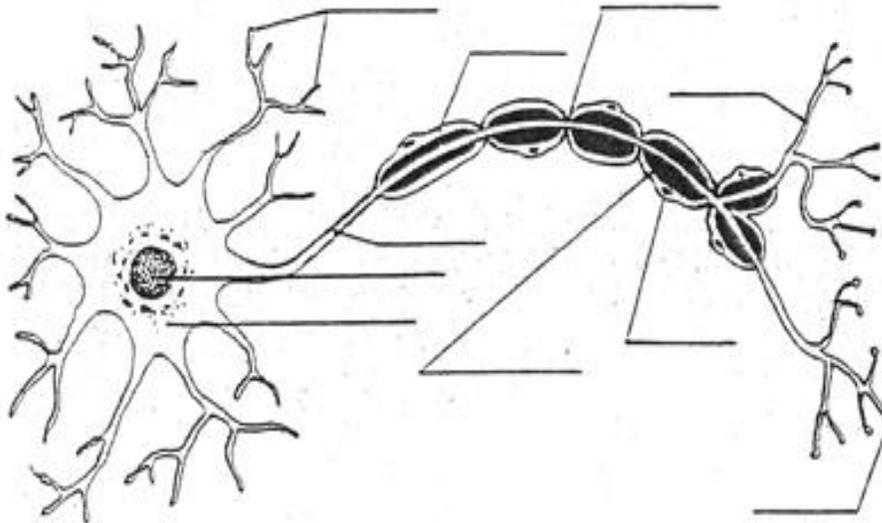
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Neurons & Neuron Structure (p. 200)

- are the building blocks of all nervous systems
- most _____ are composed of many neurons
- transmit impulses (_____) from neuron to neuron
- these messages are a few thousandths of a second long
- although neurons differ in size and function, all are composed of similar parts:
 - a) Cell body - area of the nerve containing the _____
 - b) Dendrites - made of _____
 - carry nerve impulses _____
 - c) Axon - _____ that carries the nerve impulse to other _____ or _____
 - d) Myelin sheath - _____ along the axon of a nerve made of _____
 - speed the rate of _____ along the axon
 - e) Neurilemma - thin membrane surrounding the axons of the nerves of the _____ which promotes the _____

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



Neuron

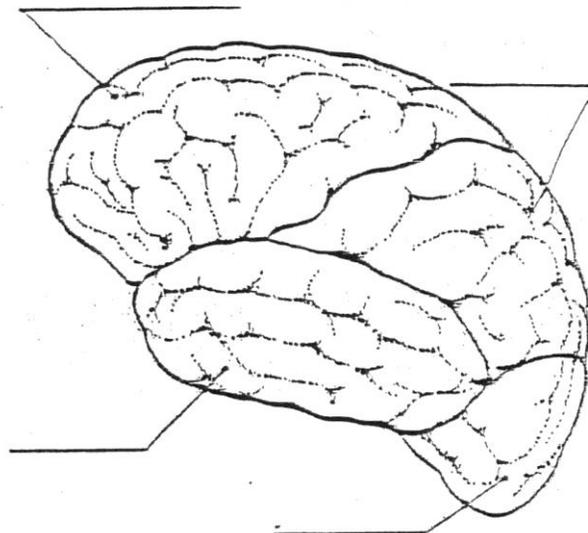
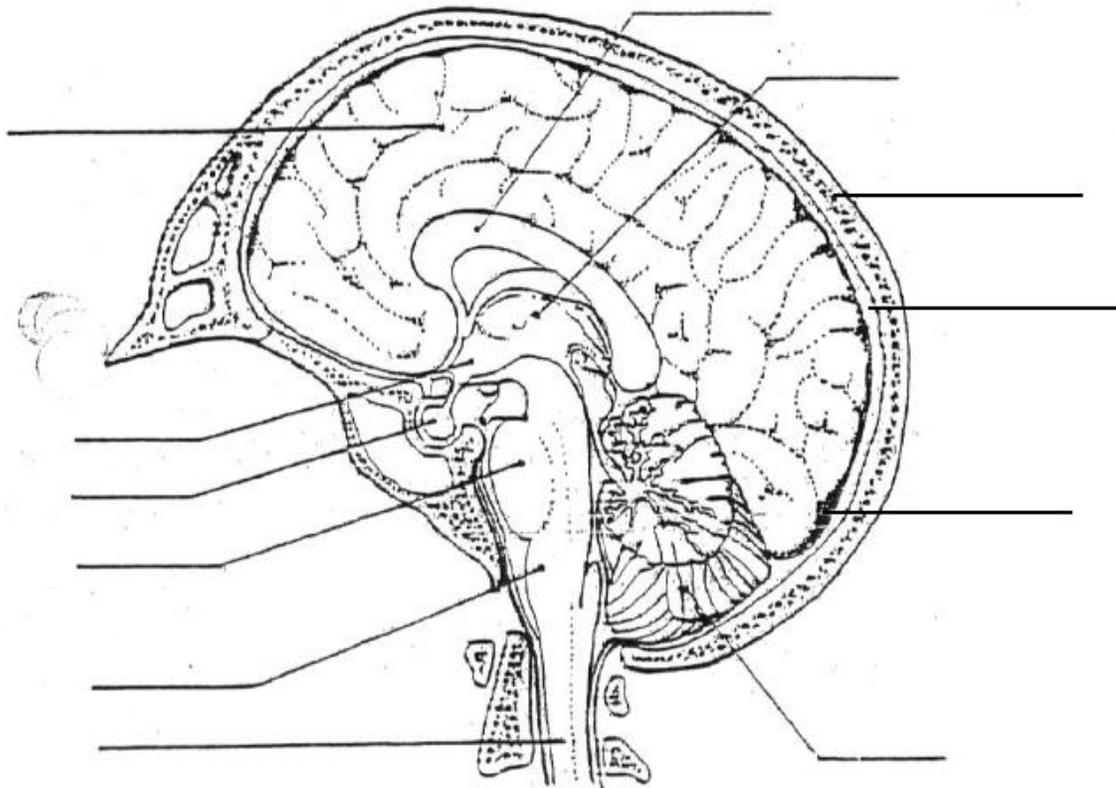
Label the diagram at the left.

- a. cell body (cyton)
- b. nucleus
- c. dendrites
- d. axon
- e. node of Ranvier
- f. terminal branches
- g. synaptic knobs
- h. Schwann cell
- i. Schwann cell nucleus
- j. myelin sheath

The Brain

Use the following to fill in the blanks:

- | | | | | |
|---------------|--------------|---------------|----------|-----------------|
| Cerebellum | Meninges | Parietal Lobe | Thalamus | Spinal Cord |
| Pituitary | Frontal Lobe | Pons | Cerebrum | Occipital Lobe |
| Temporal Lobe | Hypothalamus | Medulla | Skull | Corpus Collosum |
- Cerebrospinal Fluid



How The Nervous System Works (p. 204)

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

1) Receptors

: any organ that picks up _____
: ie. _____

2) Effectors

: any organ that _____
: ie. _____

3) Conductors

: aka neurons

: transmit information about stimuli between the _____ & an _____
in the form of electrochemical impulses

: there are 3 types of neurons in mammals:

a. Sensory

- receives an impulse from a _____ & passes it to the _____
- range in size up to a meter long

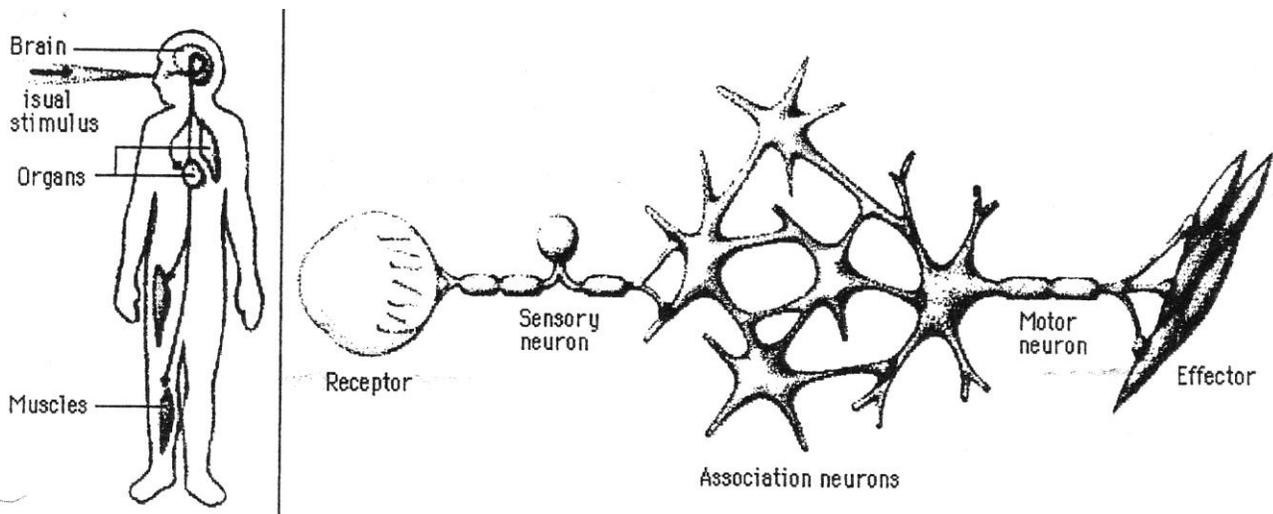
b. Motor

- carries impulses to an _____, such as a _____, or a _____
- also can be up to 1m long

c. Associative

- in control center (CNS) = _____
- are microscopic in size
- is the middle neuron of the three involved in impulse transmission
- transmit the impulses from a _____ to a _____, or vice versa.

- these 3 neurons, combined with the receptor, which detects impulses, and the effector, which acts upon the impulse makes up the _____.



Impulse Transmission

- the nervous system uses electrochemical messages to control the actions of the body
- transmission within the nerve cell = _____
- transmission across a synapse = _____
- Synapse
 - = space between neurons
 - : contain a chemical _____ that passes the impulse from neuron to neuron
 - : transmit impulses _____
 - = 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 _____
 - = causes Na^+ ions to rush in
 2. As the Na^+ ions rush into the neuron, the electrical charge of the neuron changes.
 - = _____
 3. The Na^+ ions move through the neuron, changing its electrical charge
 - = _____
 4. A second neurotransmitter stops the flood of Na^+ ions and allows K^+ ions to leave the cell letting it recover Cholinesterase is released after neuron stimulation
 - = _____
 5. Impulse reaches the end of the axon and is passed to the next neuron via neurotransmitters in the synapse (ie. dopamine, acetylcholine, cholinesterase)
 - = _____
 6. Continues from neuron to neuron until the message reaches the desired effector

Factors Affecting Impulse Transmission Rates

- thickness of the axon _____
- myelinated vs nonmyelinated _____
- temperature _____

Other Factors Effecting Impulse Transmission

1. Endorphins

- : _____ 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
 - = _____
- : 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 _____
- ie. _____

b) Stimulants

- stimulate neurotransmitters production
- = impulses travel more quickly and easily at synapses
- causes _____
- 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. _____

d) Hallucinogens

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

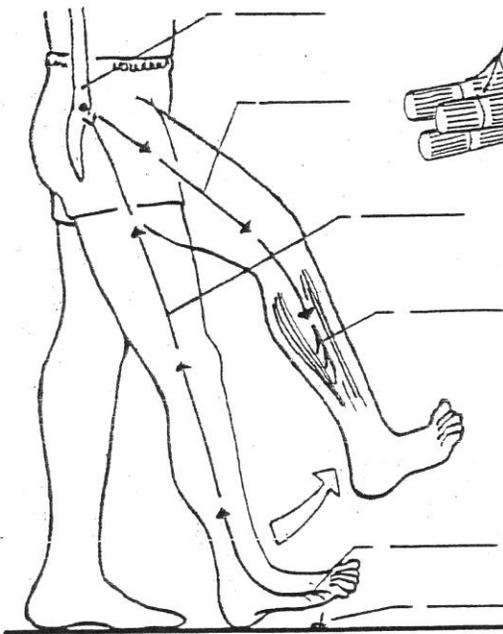
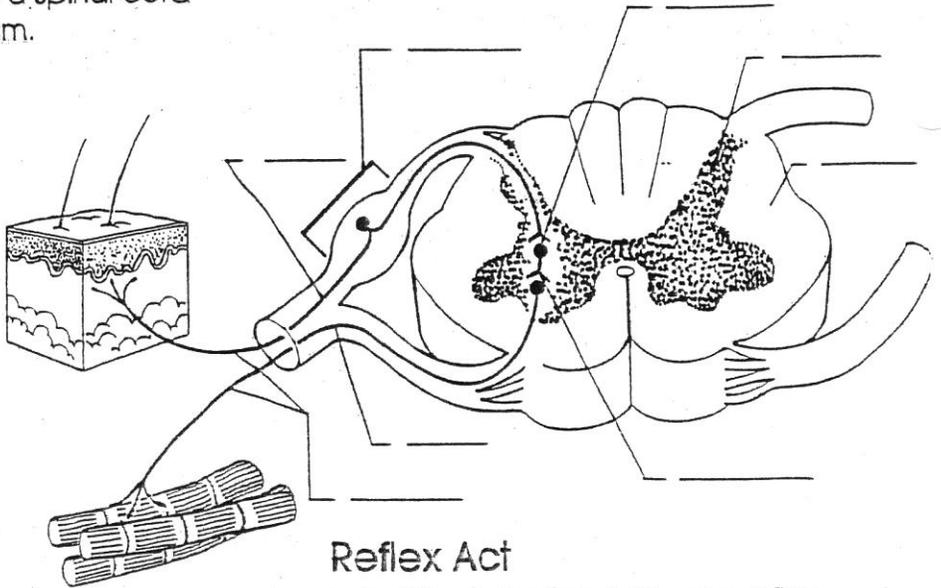
** Collectively, stimulants, depressants and hallucinogens:

- 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.

Neuromuscular Junction

Use the following to fill in the blanks:

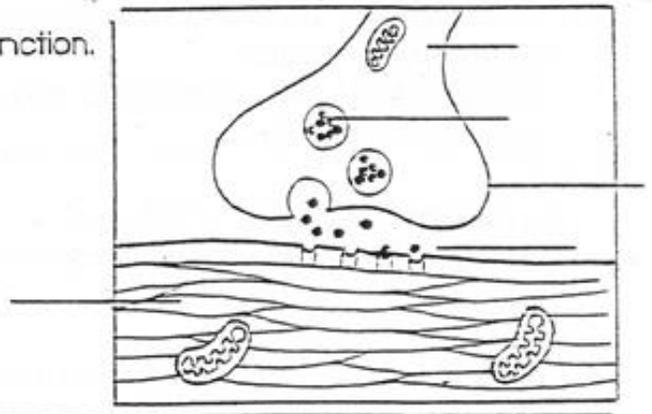
| | | | |
|-----------|------------------|---------------|---------------|
| cell body | synaptic knob | axons | dendrites |
| neurons | myelin sheath | acetylcholine | neuromuscular |
| axon | nodes of ranvier | schwann cells | |

_____ are specialized for the transmission of nerve impulses. The nucleus is located in the _____ of the neuron. From the cell body, two types of structures carry out transmission functions. _____ transmit nerve impulses from other cells or sensory systems. _____ provide for the transmission of nerve impulses away from the cell body. A single neuron cell can be over a meter long due to the length of its _____. _____ are the supporting cells associated with axons. They form a(an) _____ around many vertebrate neurons. _____ interrupt the myelin sheath where the axon is in direct contact with surrounding intercellular fluid. The junction between a neuron and a muscle is called a(an) _____ junction. _____ is the neurotransmitter. At a neuromuscular junction, acetylcholine released from a(an) _____ depolarizes the muscle cell membrane and triggers muscle contractions.

Neuromuscular Junction

Label the following parts of a neuromuscular junction.

- axon
- cleft
- synaptic knob
- muscle fiber
- acetylcholine sacs



Disorders of the Nervous System

1. _____

- Bruising of brain due to it hitting the inside of skull
- Causes dizziness, seeing stars, unconsciousness, vomiting
- Paralysis and coma

2. _____

- Blocked blood vessels to brain
- Brain tissue dies from lack of oxygen
- Paralysis, slurred speech, numbness, blurred vision

3. _____

- Brain tissue deteriorates due to abnormal protein deposits on it
- Memory loss, disorientation, personality change

4. _____

- Myelin sheath damaged
- Impaired vision and speech
- Muscle weakness, tremors, paralysis

5. _____

- Virus affects gray matter of spinal cord
- Damages motor neurons
- Paralysis

HUMAN BRAIN -SIDE VIEW

