



# NERVOUS SYSTEM

# Day one – January 10 and 11

- ▶ Introduction
  - ▶ Organization of the Nervous System
  - ▶ How Google is Changing your Brain
- 

# MAIN FUNCTION

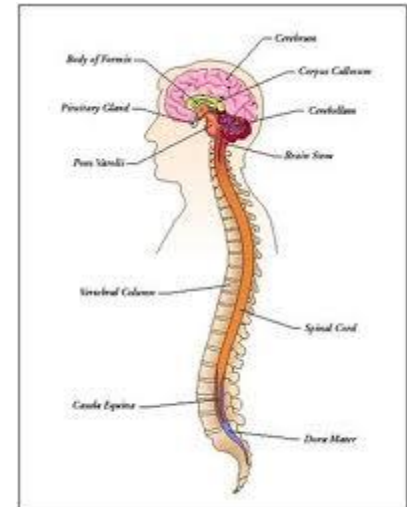
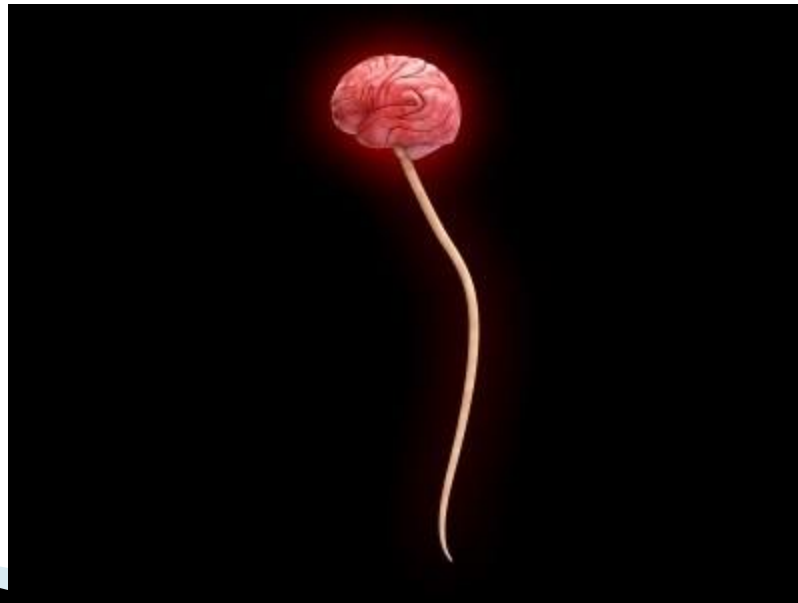
- ▶ The nervous system is the master control and communication system of the body
- ▶ Mostly, it controls the bodies QUICK responses



# ANATOMY

## Structural Organization

- ▶ TWO MAIN PARTS
  1. CENTRAL NERVOUS SYSTEM
    - Includes the brain and the spinal cord

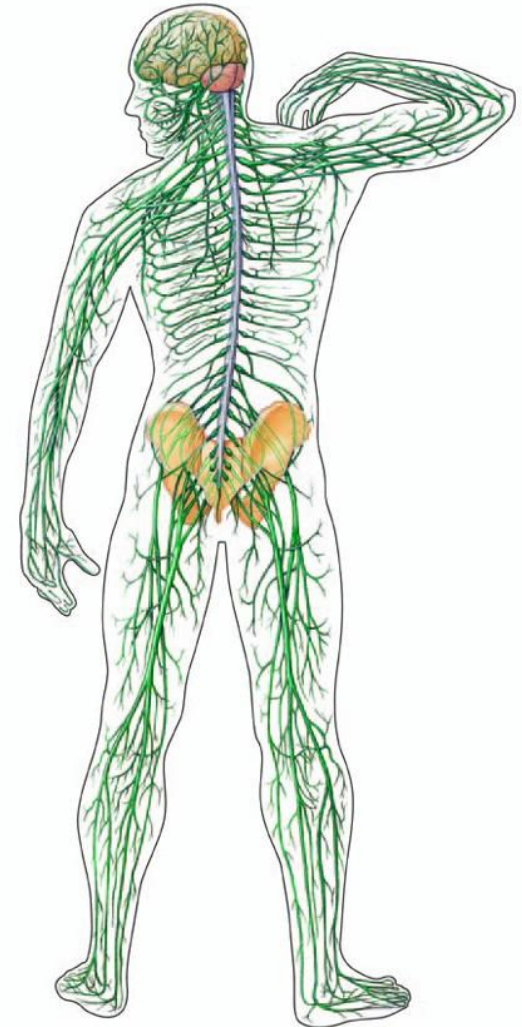


# ANATOMY

## Structural Organization

### 2. PERIPHERAL NS

- Includes all the nerves that extend from your central nervous system to your body and back



# FUNCTIONAL ORGANIZATION

## 1. SENSORY NERVES

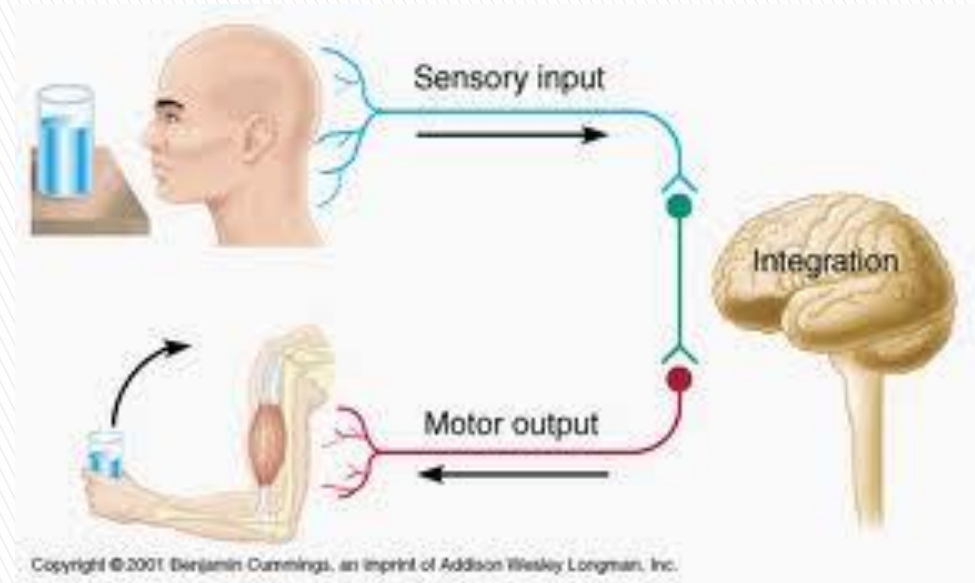
- Body to brain

## 2. INTEGRATION NERVES

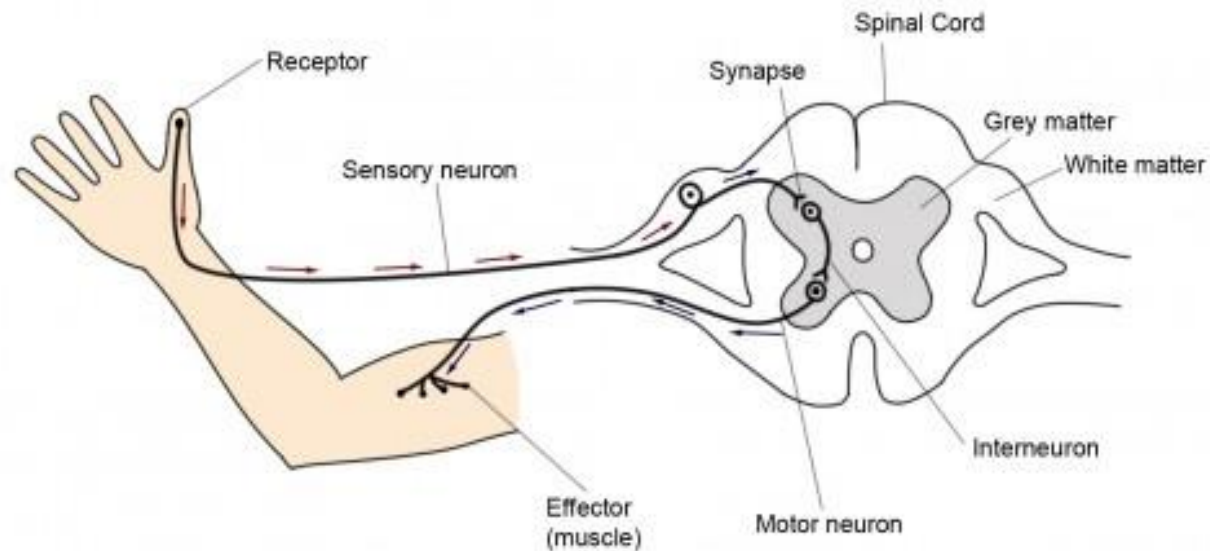
- process the information

## 3. MOTOR NERVES

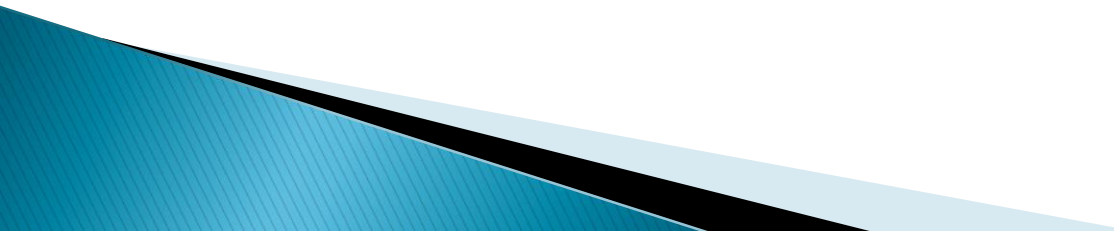
- Brain to body



# THE THREE NERVES TOGETHER – A reflex arc



# Day Two – Jan 12

- ▶ Brain Regions
  - ▶ Coloring
  - ▶ Histology
  - ▶ Project time 1
- 



# HUMAN BRAIN



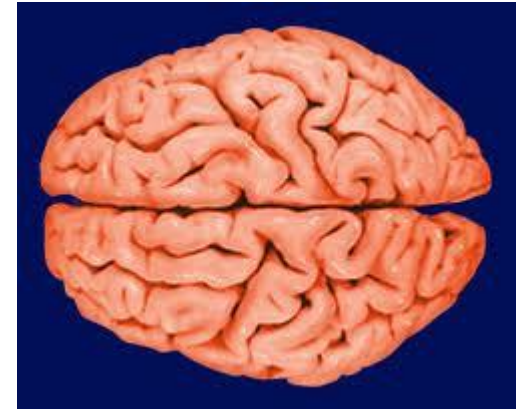
# TOP VIEW



BACK

FRONT

# HEMISPHERES



- LEFT AND RIGHT
- HAVE DIFFERENT FUNCTIONS
- CORPUS CALLOSUM
  - Left and right connect
  - Sends information from left to right

# Four major parts of the brain

## ➤ CEREBRAL CORTEX

- HIGHER ORDER REASONING

## ➤ CEREBELLUM

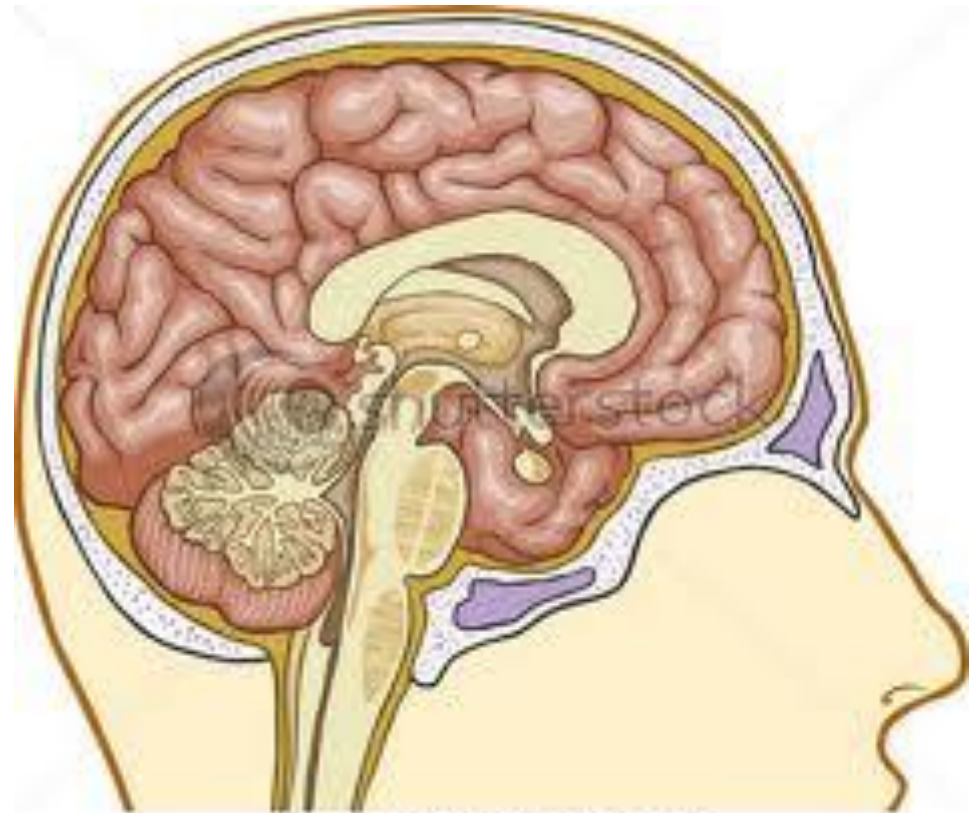
- MOTOR CONTROL

## ➤ BRAIN STEM

- AUTOMATIC FUNCTIONS

## ➤ DIENCEPHALON

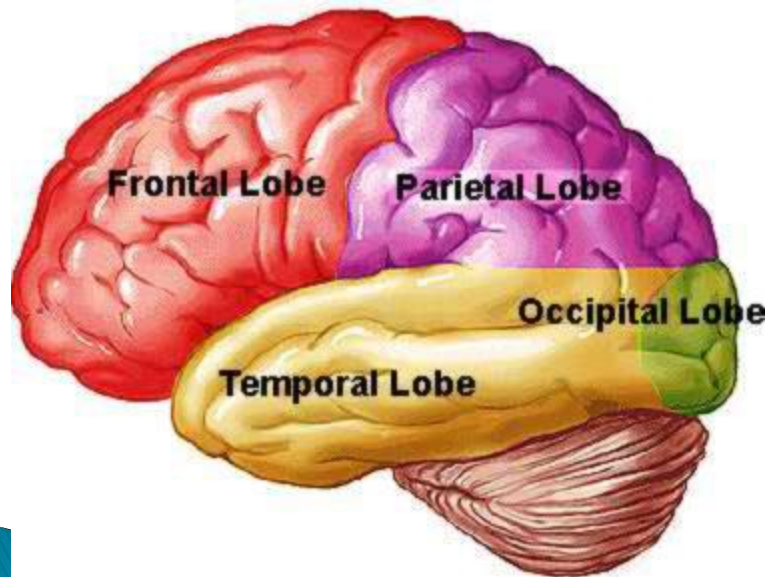
- CHEMICAL REGULATION



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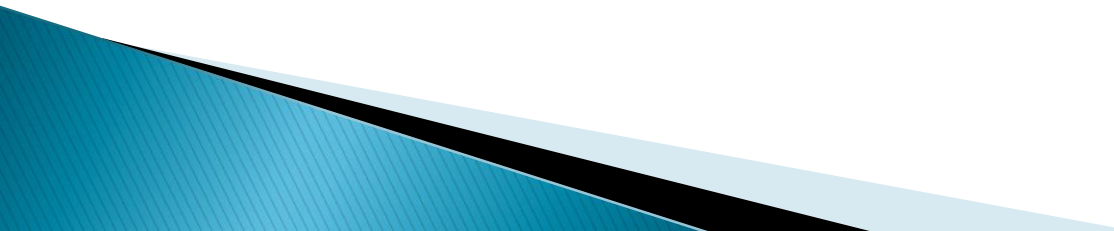
# THE CEREBRAL CORTEX

- REASONING
- STILL DEVELOPING IN THE TEENAGE BRAIN



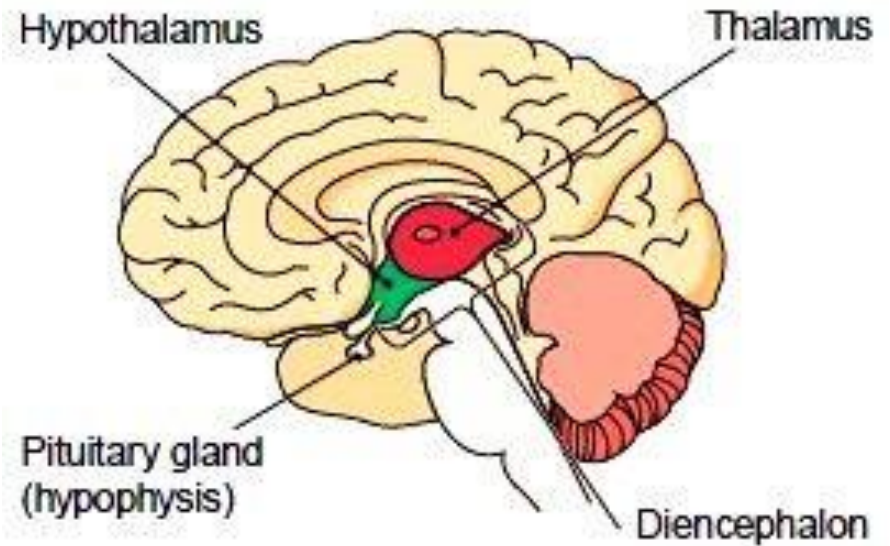
- ▶ **FRONTAL**
  - Thinking
- ▶ **PARIETAL**
  - Your place in space
- ▶ **TEMPORAL**
  - Auditory processing
- ▶ **OCCIPITAL**
  - visual

# CONVOLUTIONS OR FOLDING

- ▶ WHY DOES THE BRAIN HAVE THAT FOLDED UP LOOK?????
  - TO INCREASE SURFACE AREA
  - HUMAN BRAIN HAS MORE FOLDS THAN OTHER ANIMALS
- 

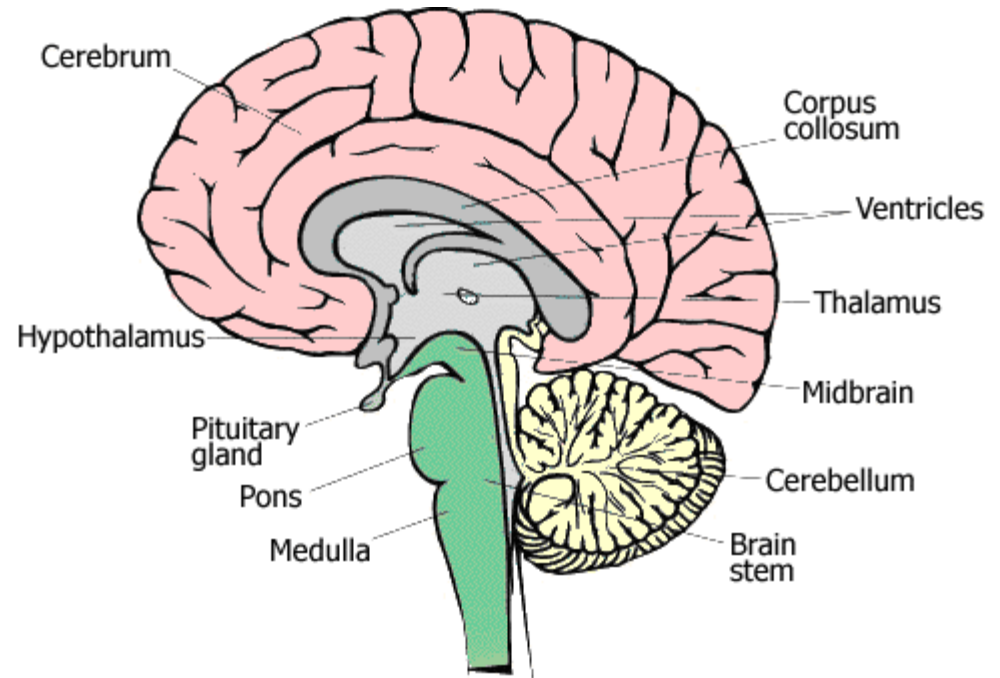
# The Diencephalon

- MIDDLE of the head
  - Very protected
- TRANSIT CENTER
  - Between brain and body
    - Hormonal
    - Emotional responses
    - Memory



# The Brainstem

- Pathway between brain and spinal cord
- Nerves that control basic body functions
  - Breathing
  - Heart rate
  - Blood pressure

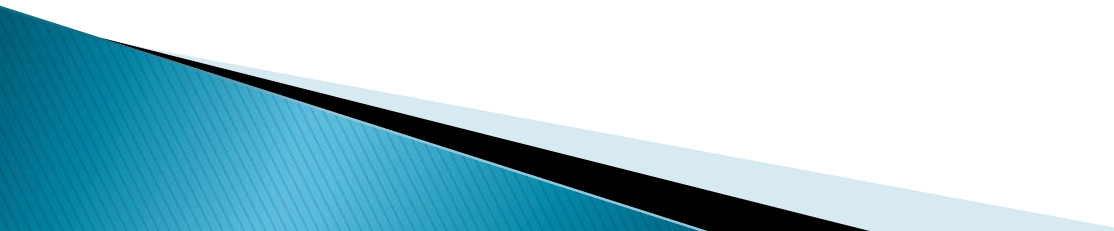




# Cerebellum

- Located:
  - Under cerebrum
  - Dorsal to pons and medulla
- Controls and maintains:
  - Voluntary muscle movements
  - Posture
  - Coordination
  - Balance

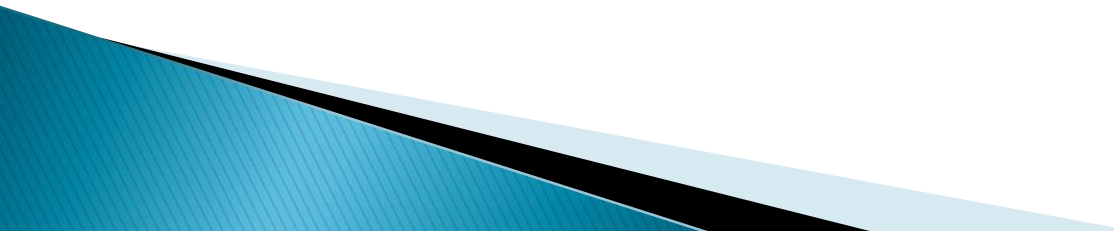
# VOCABULARY

1. Stimuli
  2. Central nervous system
  3. Peripheral nervous system
  4. Sensory nerves
  5. Motor nerves
  6. Cerebral cortex
  7. Cerebellum
  8. Diencephalon
  9. Brain stem
- 

# Day three Jan 17 –absent

- ▶ Article – How we learn
- ▶ TED talk

# Day Four January 19

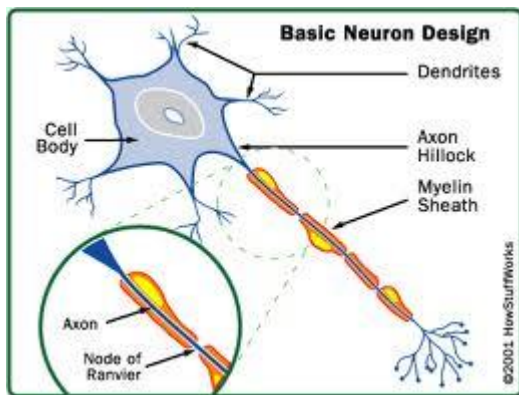
- ▶ Course offerings for next year
  - ▶ Discuss article/TED – how we learn
  - ▶ Notes 3 – Neuron structure and function
  - ▶ Playdoh neurons
  - ▶ Jigsaw on neurotransmitters
- 

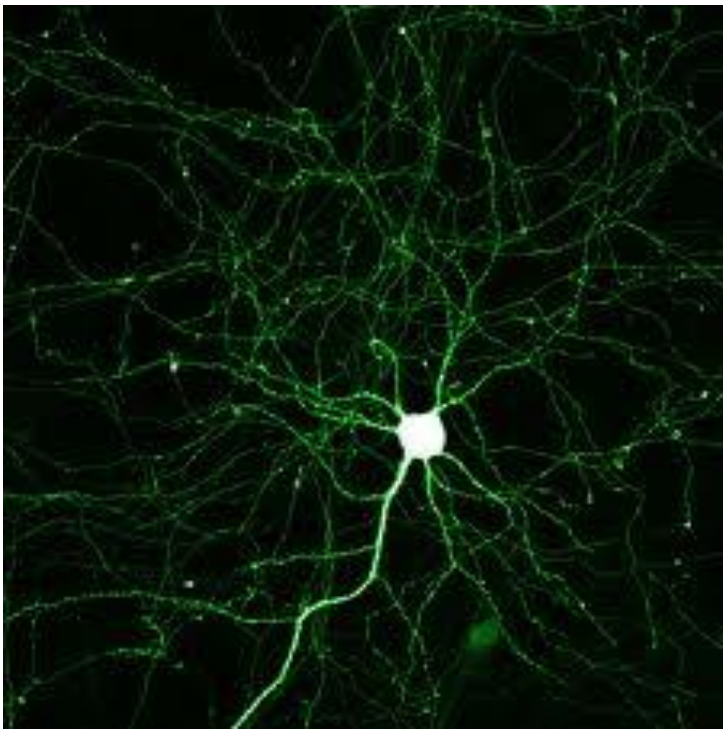
# 2 TYPES OF NS CELLS

- ▶ Nerve cells or Neurons
  - Send electrochemical signals
- ▶ Glial Cells or Support Cells
  - DO NOT send signals
  - Helper cells
  - Ex:
    - make ATP/energy
    - Provide insulation
    - Protection/immune functions

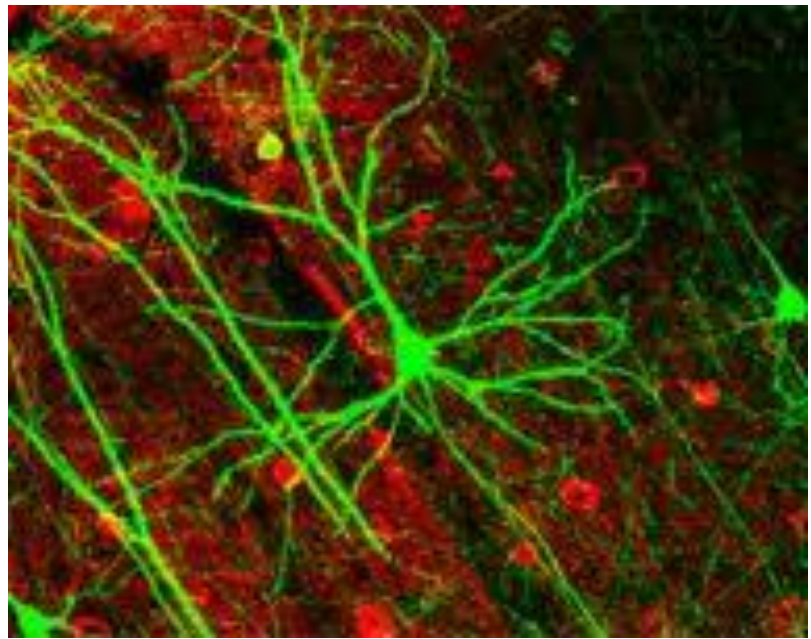
# THE STAR: NEURONS

- ▶ Neuron is the type of nerve cell that sends the signals to the rest of your body
- ▶ It uses electricity and chemicals to do this → electrochemical

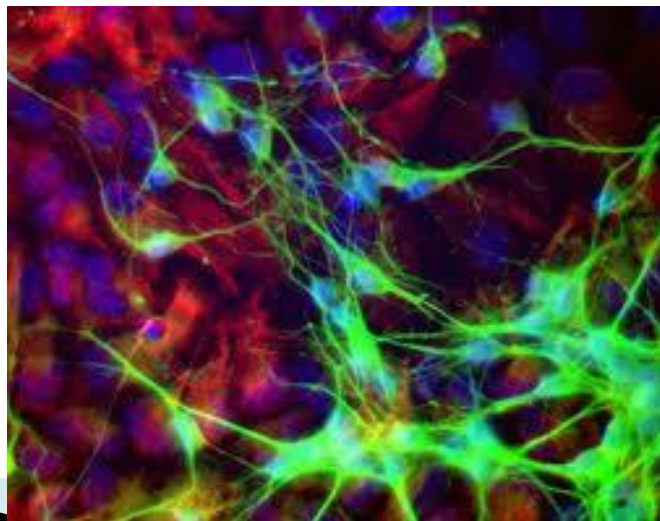




▶ Neuron



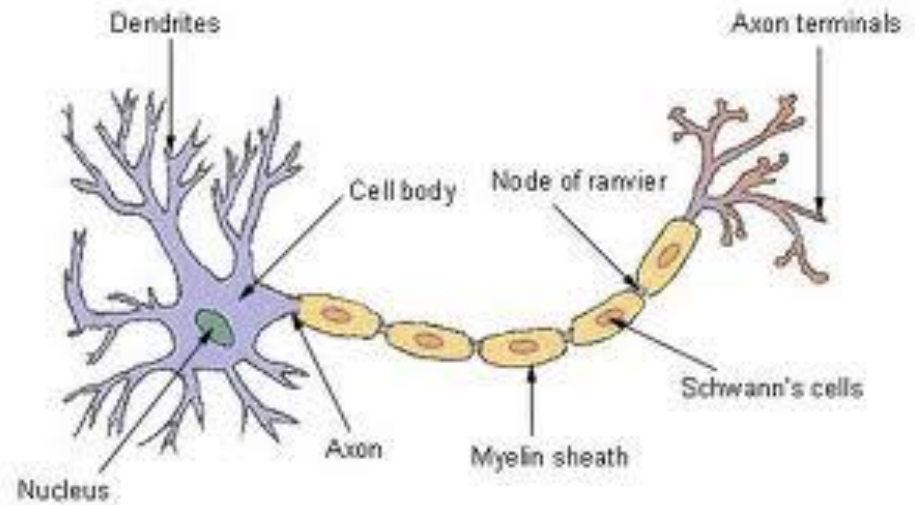
Neuromuscular junction



Neuron with  
support cells

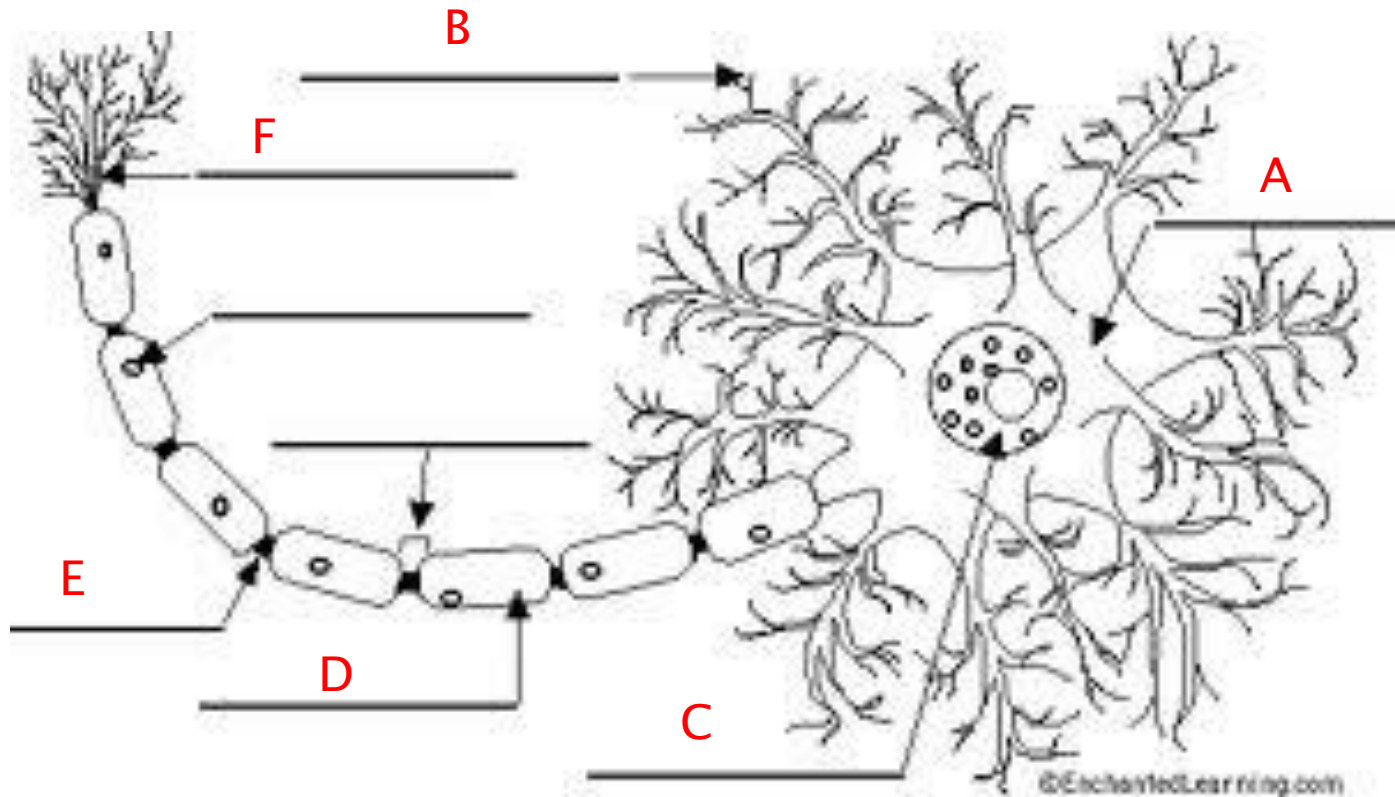
# STRUCTURE OF A NEURON

- ▶ **CELL BODY**
  - Main cell functions
- ▶ **NUCLEUS**
  - Stores the DNA
- ▶ **DENDRITES**
  - Take in messages
- ▶ **AXON**
  - Sends messages
- ▶ **AXON TERMINALS**
  - Transfers messages to new cell
- ▶ **MYELIN SHEATH – Support Cell**
  - insulates





# Review of Neuron Structure & Function



# DIFFERENT NEURON STRUCTURES\*\*

## ▶ MULTIPOLAR

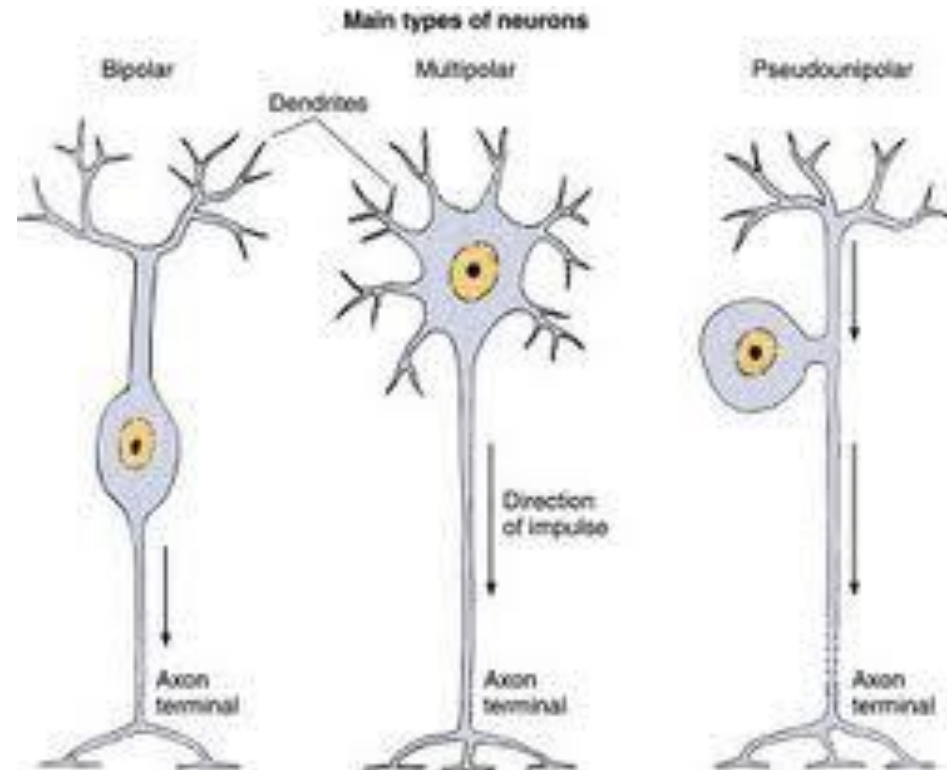
- Most neurons are multipolar
- They have many dendrites connected to the cell body and many axon terminals at the other end

## ▶ BIPOLAR

- One main dendrite and one axon

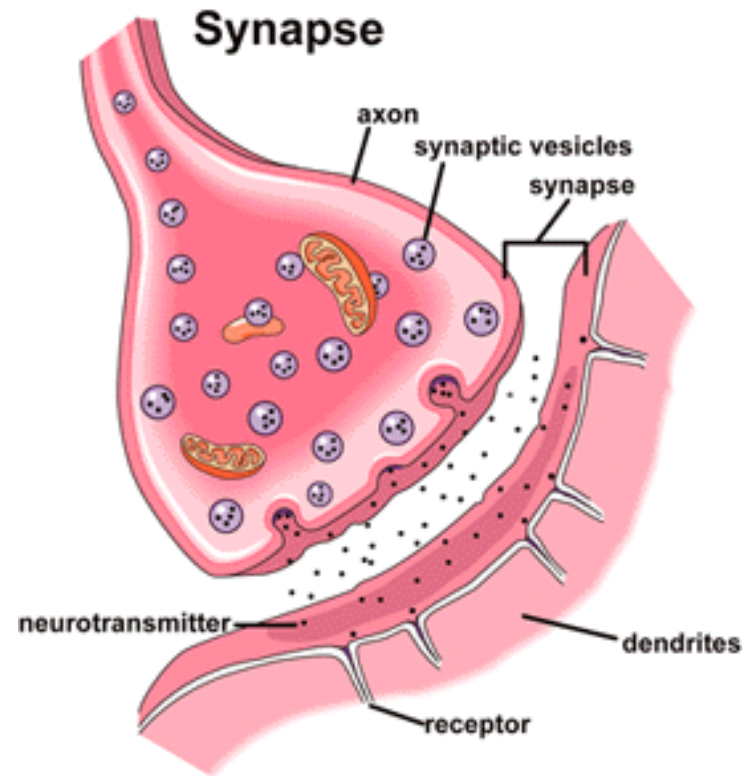
## ▶ UNIPOLAR

- one short branch off the cell body and then an axon only coming off of it



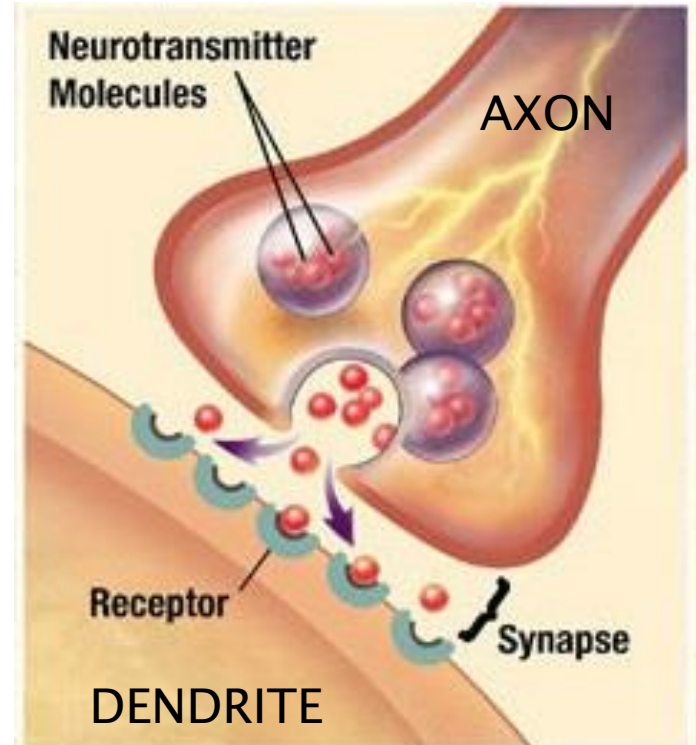
# SYNAPSE

- ▶ Space between neurons.
- ▶ Chemicals (called neurotransmitters) send signal **BETWEEN** cells



# SYNAPSE

- ▶ Neurotransmitters are released into GAP
- ▶ Receptors (on next cell) respond to them
- ▶ NEUROTRANSMITTERS DO NOT GO INTO THE NEXT CELL

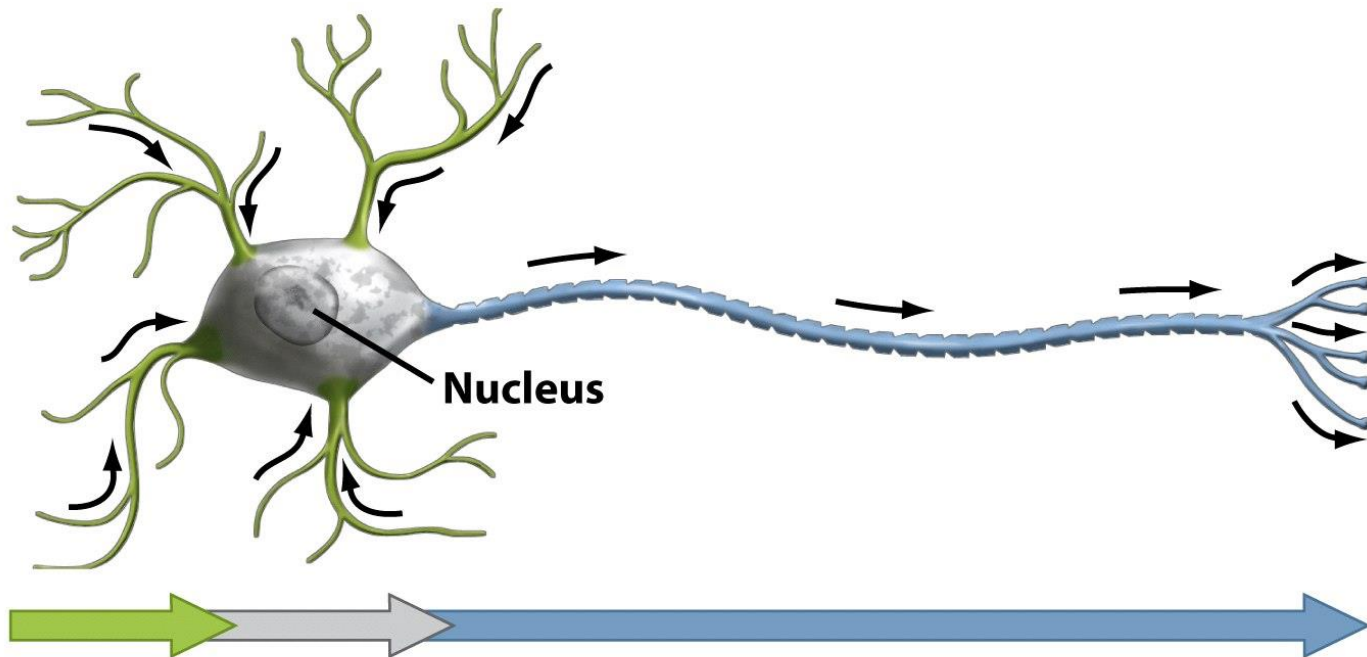


# What floats across the cleft?

## NEUROTRANSMITTERS

- ▶ **DOPAMINE**
  - Motivation
  - Arousal
  - Hallucinogens are thought to act on dopamine
- ▶ **ADRENALINE/EPINIPHRINE**
  - Excitatory
  - Mood elevator
- ▶ **GLUTAMATE**
  - Excitatory
- **SEROTONIN**
  - “feel good”
  - Effects mood and anxiety
- **ACETYLCHOLINE**
  - Muscle movement
- **GABA**
  - Sedation or inhibition
- **ENDORPHINS**
  - Pain relief, reduce stress, depress functions (lower breathing rate, heart rate)

# Information flow through neurons



## **Dendrites**

**Collect  
electrical  
signals**

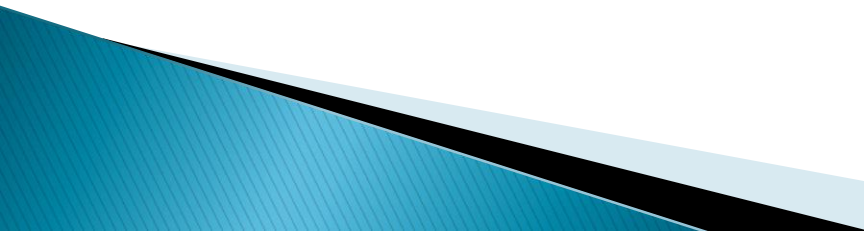
## **Cell body**

**Integrates incoming  
signals and generates  
outgoing signal to  
axon**

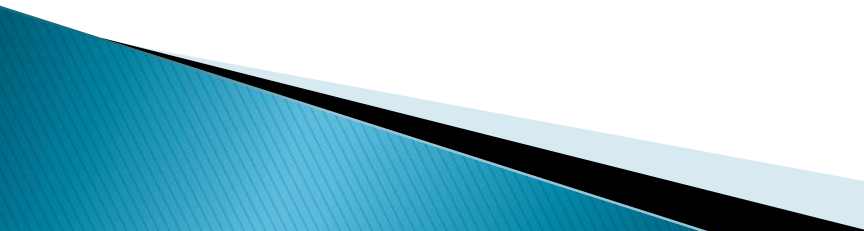
## **Axon**

**Passes electrical signals  
to dendrites of another  
cell or to an effector cell**

# WHAT STARTS A MESSAGE?

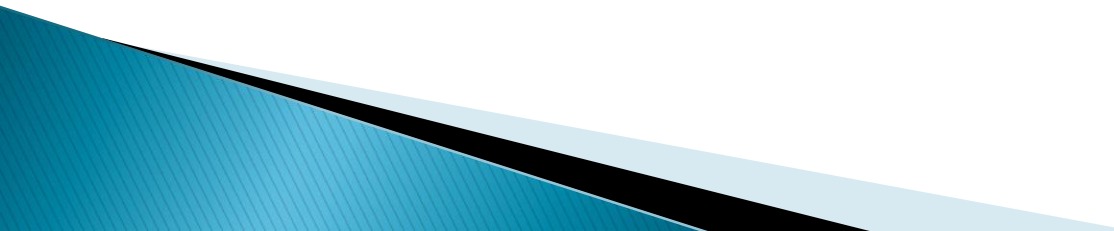
- ▶ Your body needs to communicate something
  - ▶ Stimuli
    - Pain, cold, pressure (remember the skin receptors?)
  - ▶ Neurotransmitter
    - Continuation of a message
    - Final step of message (EX: tells a muscle to contract)
- 

# HOW NEURONS SEND MESSAGES

- ▶ Electrical signal – within a neuron
    - Called an **ACTION POTENTIAL**
    - This is the **excitability or irritability** of the cell
  
  - ▶ Chemical signal – between neurons
    - **NEUROTRANSMITTERS**
    - This is the **conductivity** of the cell
- 



# VOCAB

- ▶ Dendrite
  - ▶ Cell body
  - ▶ Axon
  - ▶ Axon terminal
  - ▶ Neurotransmitters – chemical signal
  - ▶ Electrical signal
  - ▶ Stimuli
- 

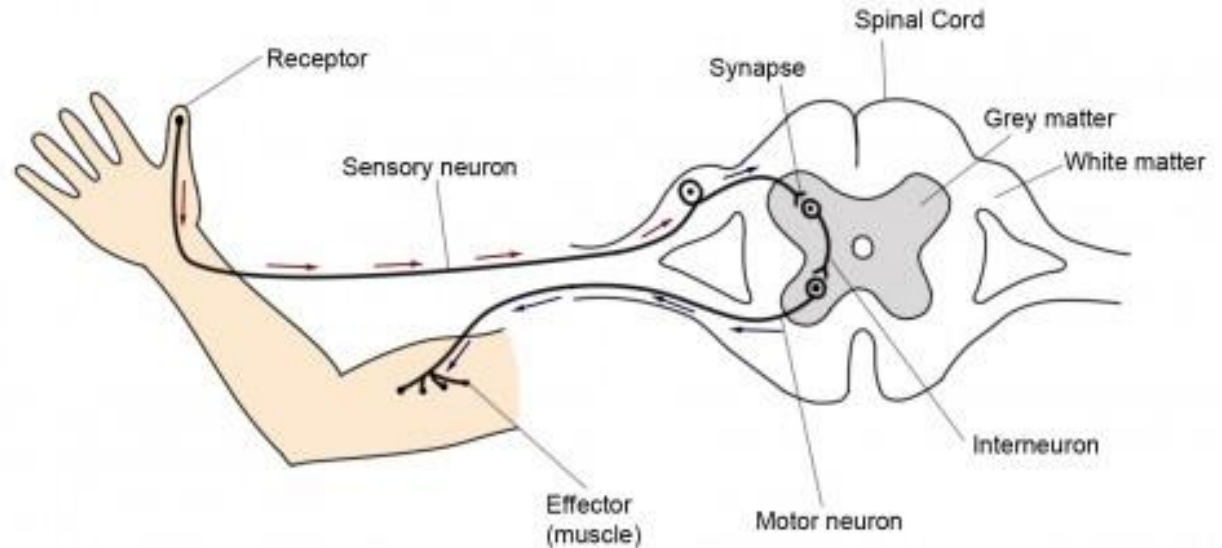
# Day Five January 23

- ▶ Neuromuscular junction posters

# Day Six January 25

- ▶ Notes 4 – Reflex arc
  - ▶ Reaction time activity
- 

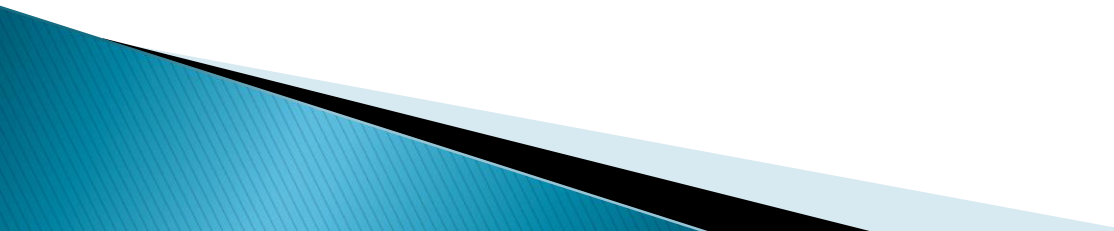
# REFLEX ARC



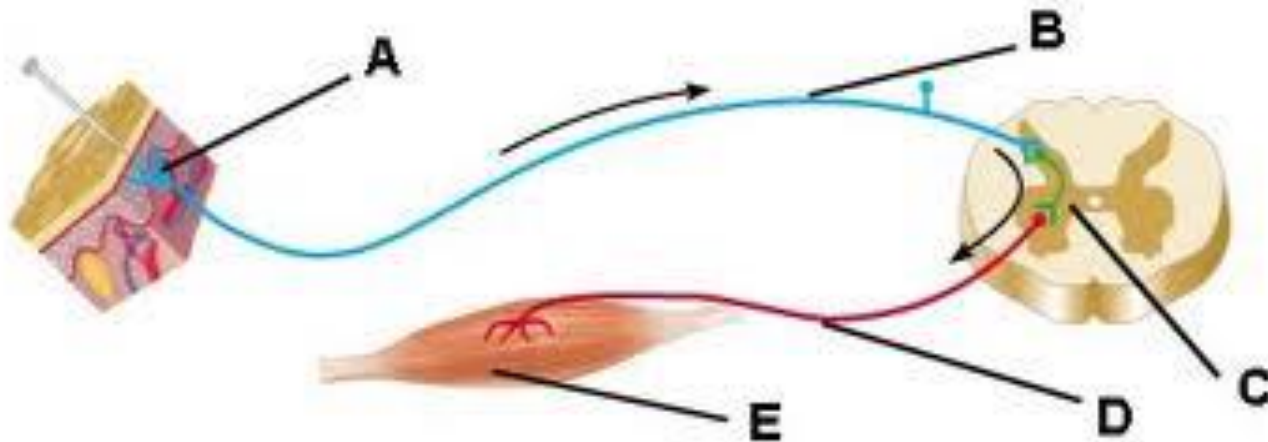
## THREE STEPS

1. Sensory nerve receives stimuli
2. Integration occurs in spinal cord
3. Motor nerve sends response message to muscle

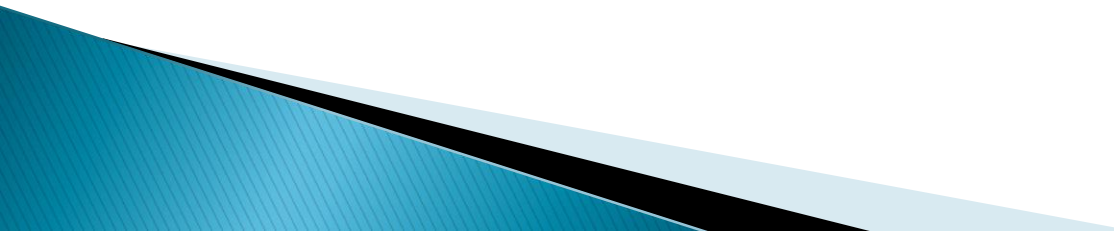
# Reflex arc

- ▶ When the body needs to respond ASAP
  - ▶ Reflex arcs occur without ever sending information to the brain, only to the spinal cord
  - ▶ There are internal and muscular reflex arcs – we will focus on the muscular ones.
- 

# Name those parts



# VOCABULARY

- ▶ Stimuli
  - ▶ Sensory nerves
  - ▶ Motor nerves
  - ▶ Integration
  - ▶ Reflex arc
- 

# Day Seven Jan 27

- ▶ Notes 5 - Protection
- ▶ Long term head injuries article



# PROTECTING THE NERVOUS SYSTEM

- ▶ Four protections
  1. Bone
  2. Meninges
  3. Cerebral spinal fluid
  4. Blood Brain Barrier

# Protection 1

- ▶ BONES
  - Skull
  - Vertebrae

# Protection 2

- ▶ MENINGES
  - MEMBRANES
  - COVER THE BRAIN AND SPINAL CORD

# PROTECTION 3

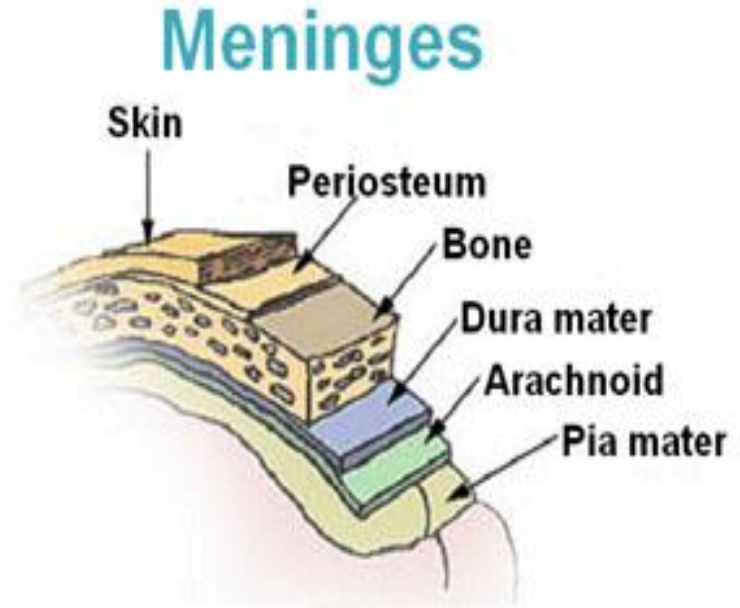
- ▶ Cerebral Spinal Fluid
  - Acts as a cushion
  - Similar to blood plasma

# Protection 4

- ▶ Blood brain barrier
  - Extra filter that all blood going to the brain passes through
  - Keeps toxins and waste out
  - Keeps bacteria and viruses out
  - Not as good with fat soluble things (some drugs, including alcohol)

# Meninges

- Set of three protective layers covering brain and spinal cord
  - Dura mater
    - Outermost layer
  - Arachnoid
    - Middle layer
  - Pia mater
    - Thin, vascular inner layer
    - Attached directly to brain and spinal cord tissue



**Dura mater -- outer layer lining skull**  
**Arachnoid (mater) -- contains blood vessels**  
**Subarachnoid space -- filled with CSF**  
**Pia mater -- covers brain**

# The Spinal Cord

- Extends from medulla oblongata to between 1<sup>st</sup> and 2<sup>nd</sup> lumbar vertebrae
- Consists of:
  - Gray matter (made of cell bodies)
    - Central area surrounded by white matter
  - White matter (made of axons)
    - Contains tracts for impulses

# CONCUSSIONS

- ▶ OCCUR WHEN THE HEAD IS HIT HARD
- ▶ CAUSE SWELLING IN THE BRAIN
- ▶ SYMPTOMS OF A CONCUSSION
  - CONFUSION
  - BLURRED VISION
  - NAUSEA
  - FLASHING LIGHTS
  - UNEVEN PUPILS



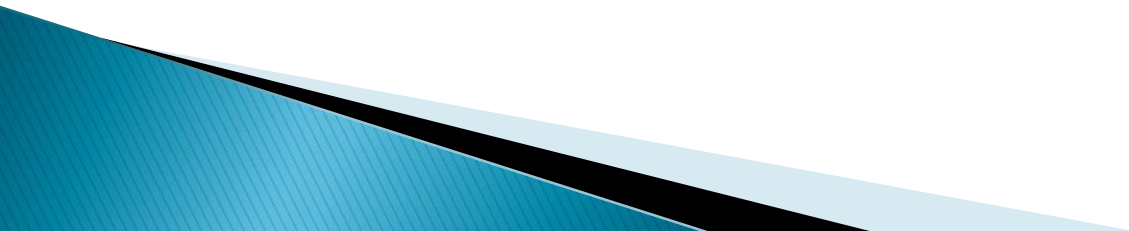
# Day Eight

- ▶ Project time
- ▶ Read teenage brain article


# Day Nine

- ▶ Article Discussion
- ▶ More project time

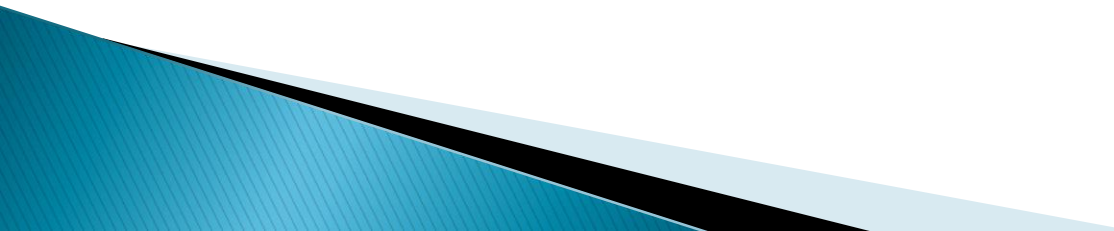
# Slides we aren't using



# WHAT CAUSES AN ACTION POTENTIAL?

- ▶ **STIMULI OR NEUROTRANSMITTERS!!!!!!**
  - ▶ These are the chemical signals in the brain
  - ▶ There are many different types of neurotransmitters and they all have different effects on the brain and body
  - ▶ Examples include: serotonin, acetylcholine, dopamine we are going to save that story for another day
- 

# A few more spots in the brain

- ▶ Broca's area – language, usually in the left hemisphere, at the junction of all the sensory lobes (parietal, occipital, temporal)
  - ▶ Language processing happens in the front of the frontal cortex
- 

# DRUGS AND THE BRAIN

## ▶ STIMULANTS

- CAFFEINE, NICOTINE, AMPHETAMINES
- INCREASE DOPAMINE AND ADRENALIN

## ▶ DEPRESSANTS

- ALCOHOL, BENZODIAZEPINS (AKA VALIUM), SLEEPING PILLS, AND BARBITUATES
- INCREASE OR CHANGE GABA PRODUCTION

## ▶ OTHER

- MARIJUANA/THC,
- ALTER ANANDAMIDE PRODUCTION,
  - CEREBELLUM – COORDINATION
  - BRAIN STEM – SHORT TERM MEMORY

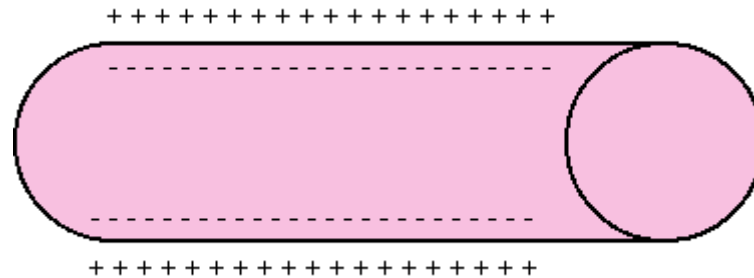
# Day 8 January 27 and 28

- ▶ Test
- ▶ Course offerings next year

# ACTION POTENTIAL 1 \*\*\*

## REST (Not sending a signal)

- ▶ Axon is **POLARIZED** or charged
- ▶ Unequal number of + and - charges.
  - (++ outside the neuron, -- inside the neuron)

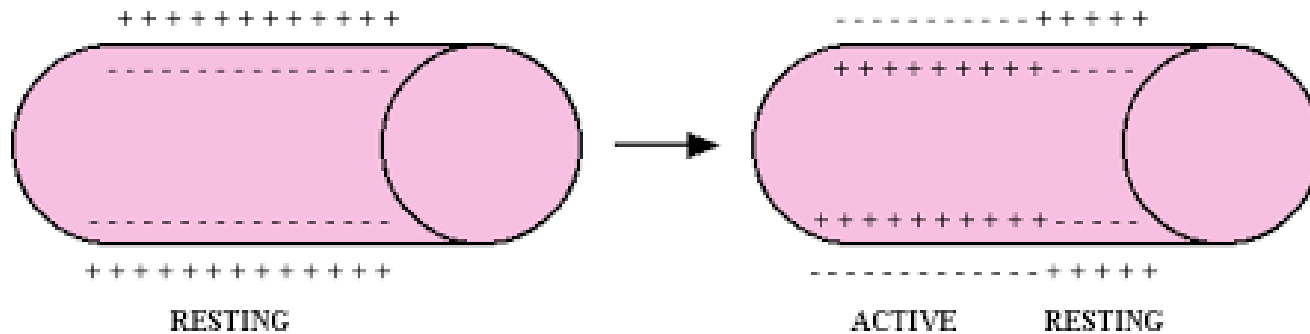




# ACTION POTENTIAL 2

## DEPOLARIZATION \*\*\*

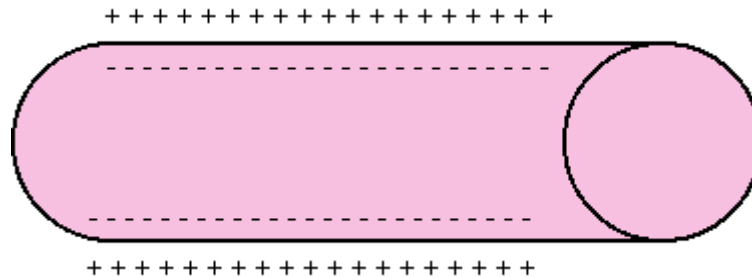
- ▶ ++ ions rush into the neuron
- ▶ Charges move into axon, this is an impulse



# ACTION POTENTIAL 3

## ▶ REPOLARIZATION

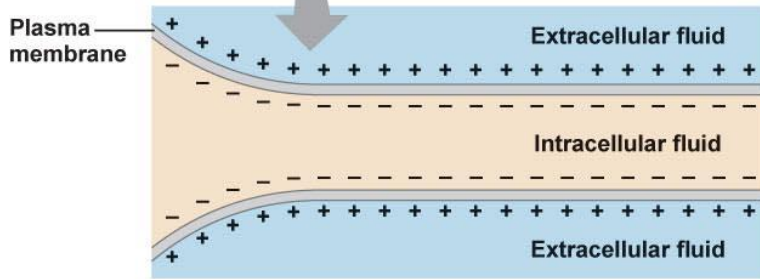
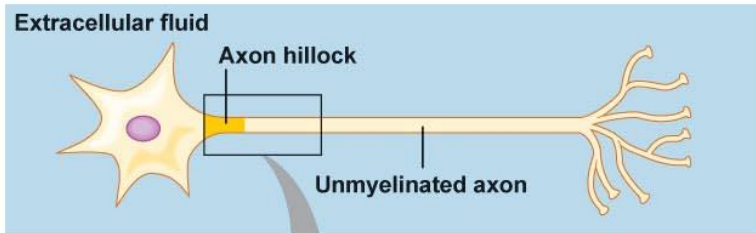
- Charges go back to rest
- Normally happens quickly
- Drugs can change this speed



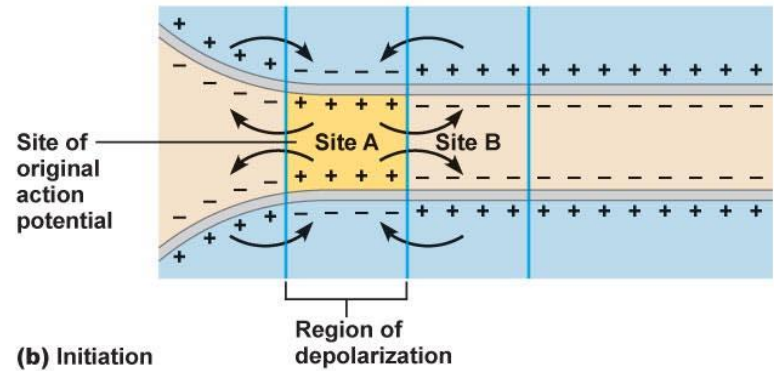
# ACTION POTENTIAL 4

## ▶ ENERGY REQUIREMENTS

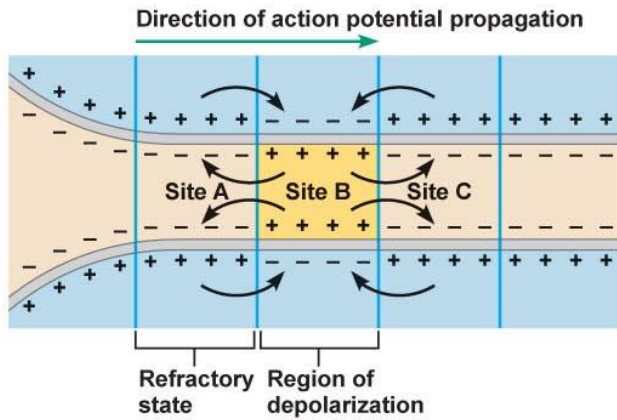
- No energy needed for action potential
  
- Energy (ATP) needed to get cell back to resting potential.



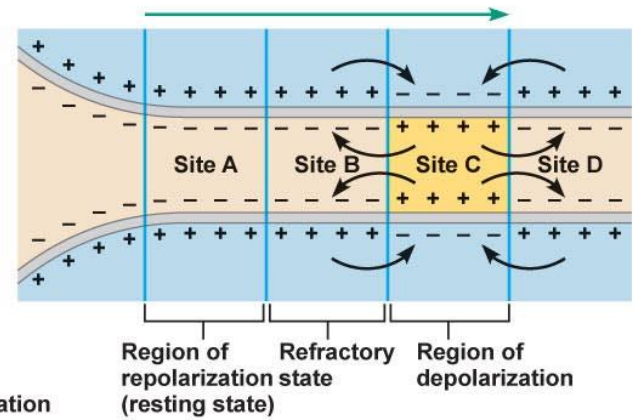
(a) Resting



(b) Initiation



(c) Propagation



(d) Propagation continues

# WHAT CAUSES AN ACTION POTENTIAL?

- ▶ **THE NEED TO SEND A MESSAGE**
  - ▶ **STIMULI**
  - ▶ **NEUROTRANSMITTERS**
- 

# TYPES OF SUPPORT CELLS

## ▶ Neuroglia

- Insulate, protect, nourish the nerve cells in the CENTRAL NERVOUS SYSTEM (CNS)

## ▶ Myelin Sheath

- Insulate and help in speedy transmission of PERIPHERAL NERVOUS SYSTEM (PNS)
- Made by Schwann cells