

# Biological Basis of Psychology

Intro Psychology  
Georgia Tech  
Instructor: Dr. Bruce Walker

## Today

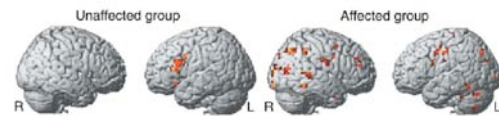
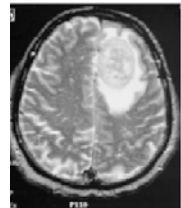
- Structures involved in thinking
- Functioning
- Organization

## Recall the “Machine” Analogy

- The brain is the key to cognition
- So how is the brain structured?
- How does it operate?
- What else do we need to know?

## Seeing Structure and Function

- Structure:
  - Dissection, MRI
- Function:
  - Case studies, ablation, PET, fMRI, EEG



## Recall the Neuron Doctrine

- Neurons do the work
- Actually, **networks** of neurons do the work
- Neurons are connected by synapses
- So we need to know how these “building blocks” work, and how they form “networks”

## Nervous System

- Fissures/Sulci
- Gyri
- Nerves
- Tracts
- Ganglia
- Nuclei



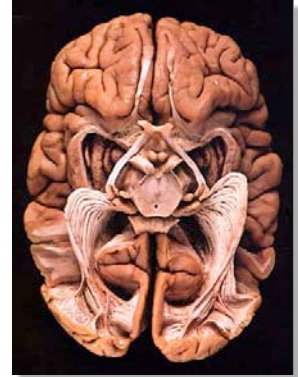
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## Nervous System

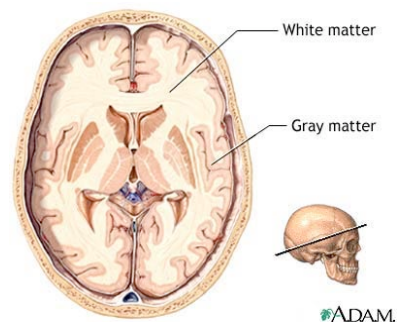
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## Cellular Anatomy of the Nervous System

- Hard to study!
- Billions of cells in NS
  - $\sim 10^{10}$  in brain
- 2 categories
  - Neurons
  - Glial cells
- Neurons are small...
  - Cell body 1-100  $\mu$ m
- Same color
- Complicated connections

## Gray & White Matter



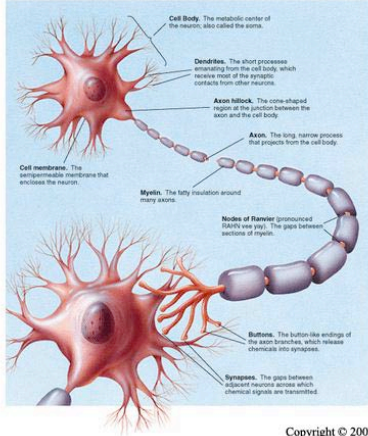
## Myelin

- White – leading to distinction between “white” and “grey” matter
- 2 Basic functions
  - Speeds nerve conduction
    - Neural depolarization occurs at nodes, then jumps to next node
    - Can increase conduction from 30 to 120 ms/sec.

## Glial Cells

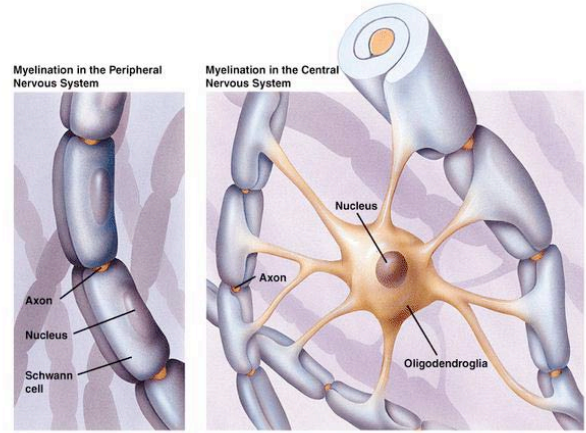
- “Support system” for neurons
- $\sim 50\%$  of cells in brain are glia
- Astrocytes (Astroglia)
  - Physical matrix for neurons
  - Metabolic support
    - Glucose - Lactate
    - Glycogen
  - Phagocytosis

► The Major External Features of a Typical Neuron

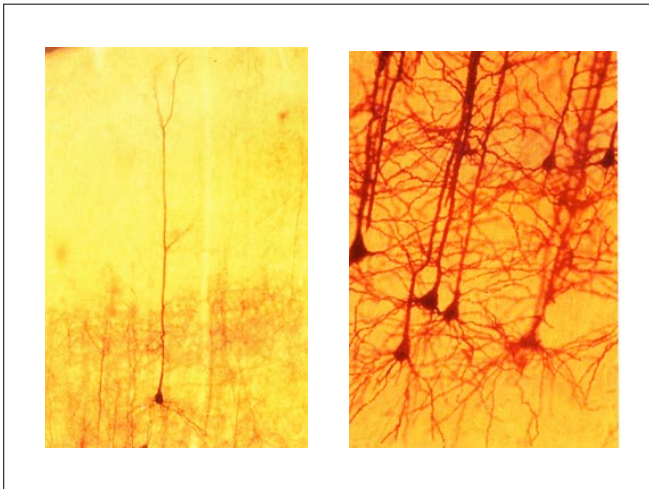


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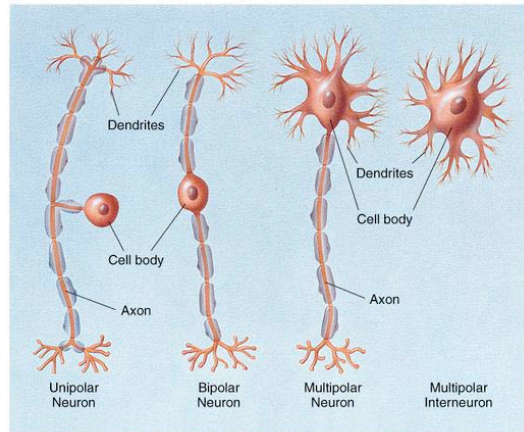
► Myelination of PNS and CNS Axons



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► Types of Neurons

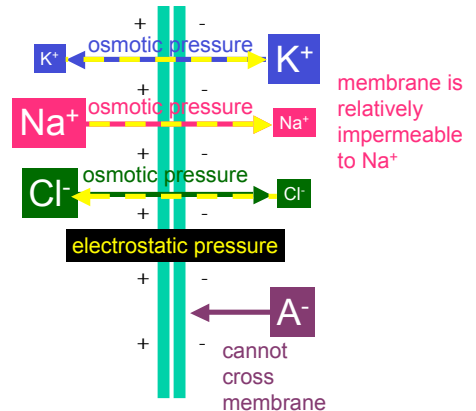


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Cell Membrane

- Lipid bilayer
- Semipermeable
- Membrane potential
- Membrane proteins
  - Pumps
  - Ion channels
    - Leak channels
    - Mechanically gated
    - Voltage gated
    - Chemically gated
    - Many types

OUTSIDE CELL      INSIDE CELL



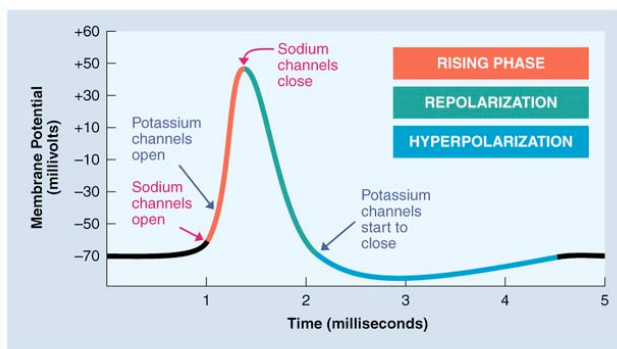
## Firing of a neuron

- Signal of a neuron is carried by an electrical charge that moves from one end of the neuron to the other
- Electrical activity
  - Resting potential
  - Action potential

## Firing of a neuron

- Concept of Threshold
  - All or None – Neurons fire or they don't
  - "Intensity" information carried by frequency of firing
  - Firing may **increase** or **decrease** likelihood of connected neurons firing
    - Neural "Inhibition"

### ► Opening and Closing of Voltage-Activated Sodium and Potassium Channels

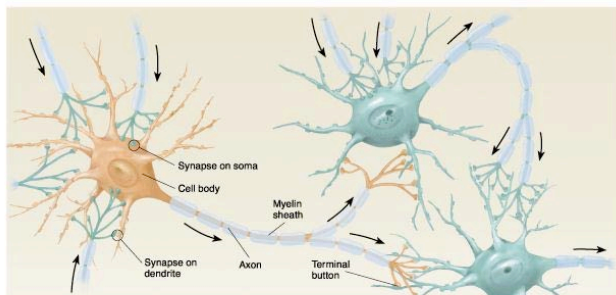


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## Where the action is at

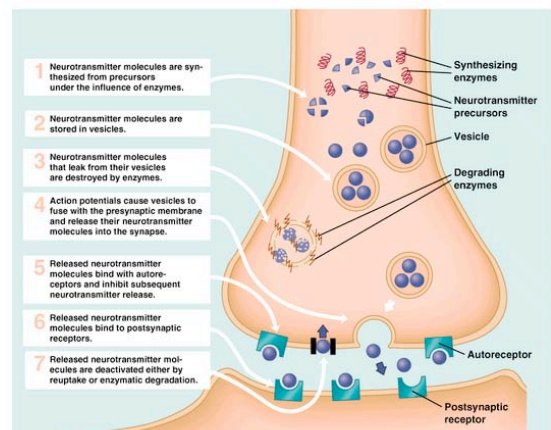
- Synapse
  - Connection point between neurons
  - Electrical activity carrying neural signal along axon is converted into chemical signals to transfer to the next neuron

### ► Synaptic Connections Between Neurons



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### ► Seven Steps in Neurotransmitter Action



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## Neurotransmitters

- Acetylcholine – one of the most common
- Norepinephrine – important to bodily and psychological arousal/alertness – released by amphetamine
- Dopamine – central in schizophrenia, depleted in Parkinson's disease, important in higher cognitive functions
- Endorphins – stimulate certain neurons that disrupt messages from pain centers – placebo effects, acupuncture

## Upcoming

- Brain regions & organization
- Vision as an example of neural computation
- Motivation & learning
- Sensation & perception