PSY 302
Lecture 1-The Neurons
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Functional Classes: Central Nervous System (NS) + Peripheral NS

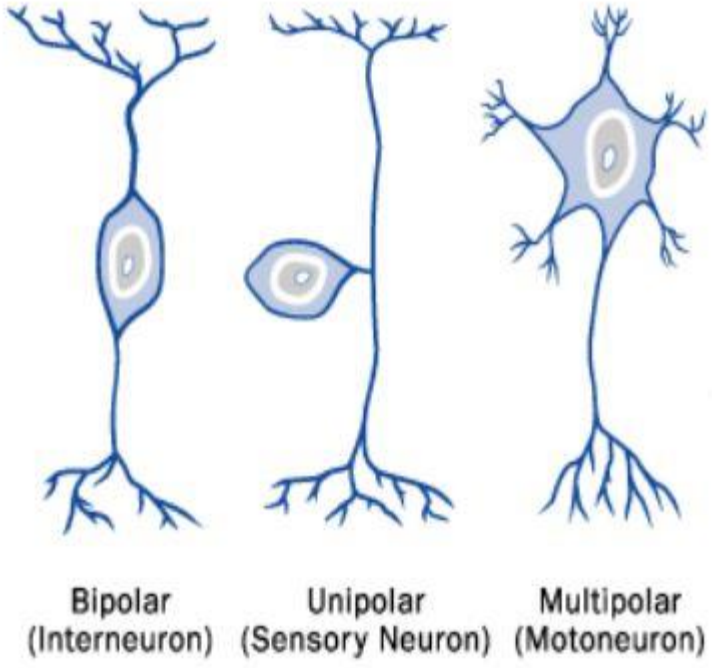
- Sensory neurons-collect internal (stomach) and external (vision, touch, smell) information
- Motor neurons-control muscles
- Other-interneurons

Morphology

- Neurons fall into several morphological classes (shapes)
- The study of neuron shapes called "neuro-anatomy"
- In some cases, the shape of a neuron is indicative of its function

3 Basic Shapes

- How many braches are coming out of the cell body?
- Unipolar Neuron-1 branch (add photos)
- Bipolar Neuron- 2 branches
- Multipolar Neuron-3 branches, most neurons are multipolar



Source: http://humanphysiology.academy/Neurosciences%202015/Chapter%201/P.1.3p%20Neurone%20Micro.html

Multipolar Neuron

- Soma (cell body)
- Dendrites-get information from other neurons, input
- Spines-fine structures coming out of dendrites on some neurons
- Axon (inside myelin sheath)-send information out, output
- Terminal boutons
- Neurotransmitter-chemicals
- Information is summed at the soma, from all the dendrites. It is then sent away on the axon

Flow of Information:

Information --> spines --> dendrites --> soma --> axon--> terminal boutons --> neurotransmitter

Bipolar and Unipolar

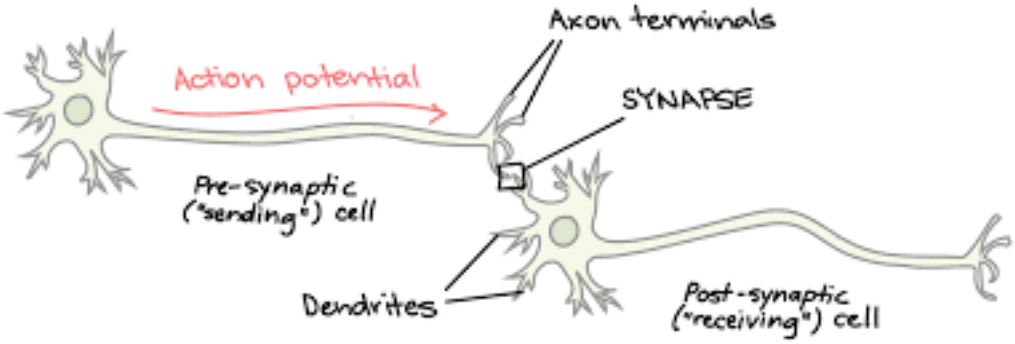
- Bipolar: sensory neurons, have cilia are sensitive to physical stimuli
  - E.g. retina (vision), cochlear nerve (audition)
  - Sensory neurons: external or internal stimuli --> brain
- Unipolar: motor neurons, have dendrites are sensitive to physical stimuli
  - E.g. spinal cord (touch)
  - Motor neurons: brain --> muscles, glands

Nerves=bundles of axons

- Axons covered with myelin sheaths

Synapses

- Neurons talk to each other through synapses
- Pre=before
- Post=after
- Synapse is a place not an object



Source: https://www.khanacademy.org/science/biology/human-biology/neuron-nervous-system/a/the-synapse

Inside a Multipolar Neuron

- Mitochondria-Energy, ATP, symbiosis
- Nucleus-chromosomes, DNA, genes, proteins, enzymes

- Cytoskeleton: ensemble of microtubules and other proteins that together produce the shape of the neuron
- Cytoplasm
- Membrane-lipid bilayer
- Myelin sheath
- Dendrites
- Microtubules-axoplasmic transport

The Neurons

- Neurons support many functions: perception, action, thinking, emotion…
- Neurons need to be taken care of throughout the nervous system
- Glial (glue) cells: support system of the neurons
    - 5 times more than neurons
    - 3 basic types:
        - Astrocytes
        - Oligodendrocytes (CNS), Schwann cells (PNS)
        - Microglia
    - Don't produce information

Astrocytes: Star Cells

- City workers
- Buffers for chemical substances
- Structural support
- Cleanup (phagocytosis)
- Nourishment: e.g. lactate
- Active interface between blood vessels and neurons

Oligodendrocytes: Myelination

- Schwann cell (PNS)
    - Myelination in PNS
    - Myelin sheath wraps around entire cell
- Oligodendroglia (CNS)
    - Myelination in CNS
    - Wraps around branches
- Nodes of Ranvier
- Destroyed in Multiple Sclerosis patients

Microglia

- Smallest of glial cells
- Phagocytes (motile)
- Move to wherever there's damage
- Members of the immune system, in the brain (like macrophages in the blood)
- Are activated during inflammatory reactions due to brain damage (Alzheimer's)

Blood-Brain Barrier

- Gaps that permit the free flow of substances into and out of the blood
- Capillaris in all of body except brain
- Selective permeability
- Active transport (e.g. glucose)
- Area Postrema in the brain: control of vomiting

The Neurons

- Neuro Anatomy: how the neurons look
- Neuro Physiology: how the neurons work
- Neurons are electrical devices
- Electrons vs. Ions
    - Electrons: free floating information, un-usable
    - Ion=atom/molecule + electrons, channeled information

Inside vs. Outside

- Difference of electrical potential between the 'inside' of a neuron (cytoplasm), and the 'outside' (extracellular space)
- Resting membrane potential (-70mV)

The Resting Membrane Potential

- 2 forces
    - Diffusion: from high concentration to low concentration
    - Electrostatic pressure: same charges repel

Keep the Sodium Out

- Sodium-Potassium Pump
- Keeps sodium out
- Gets Potassium in

Membrane Potential: departure from rest

- Hyperpolarization: membrane potential goes more negative
- Depolarization: membrane potential goes more positive

Action Potential

- Study membrane potential change: need to stimulate

Voltage-Dependent Ion Channels

- Fact 1: Ions move in/out of the cell through ion channels
- Fact 2: Ion channels open when the membrane depolarizes enough
- Fact 3: K+ channels are a bit slower than Na+ channels

Ion Flow during an AP:

1. Na+ channels open, Na+ begins to enter cell

2. K+ channels open, K+ begins to leave cell
3. Na+ channels become refractory, no more Na+ enters cell
4. K+ continues to leave cell, causes membrane potential to return to resting level
5. K+ channels close, Na+ channels reset
6. Extra K+ outside diffuses away

Na+ in --> depolarize
K+ out --> hyperpolarize