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 branches 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