The Neurons:

- **Functional Classes: Central Nervous System + Peripheral**
  - Sensory neurons
  - Motor Neurons
  - Other (interneurons)

- **Morphology**
  - Neurons fall into several morphological classes (shapes)
  - The study of neuron shapes is called Neuro-anatomy
  - In some cases, the shape of the neuron will tell you what it does

- **How Many Branches come out of cell body?**
  - Unipolar Neuron: 1 branch
  - Bipolar Neuron: 2 branches
  - Multipolar Neuron: Many branches

- **Multipolar Neuron:**
  - Information is ‘summed’ at the soma, from all the dendrites. It is then sent away on the axon.
  - Information travels from Spines to the Dendrites, to the Soma, to the axon, then to the terminal boutons.

- **Bipolar and Unipolar**
  - Sensory neurons: External or internal stimuli $\rightarrow$ Brain
  - Motor neurons: Brain $\rightarrow$ muscles, glands

- **Nerve = Bundles of axons**

- **Synapses**
  - Neurons ‘talk’ to each other through synapses
    - Postsynaptic (‘post’ = after)
    - Presynaptic (‘pre’ = before)
  - The synapse is a ‘place’ … not an ‘object’

Circuit Diagram: A $\rightarrow$ B $\rightarrow$ C

- **Inside a multipolar neuron**
  - Energy, ATP *symbiosis*
  - Chromosomes, DNA, genes, proteins, enzymes
- The Neurons
  - Neurons support many functions: Perception, action, thinking, emotion…
  - Neurons needs to be ‘taken care of’ throughout the nervous system.
  - The Glial (glue) cells: 5 times more than neurons
    - 3 basic types:
      - astrocytes, oligodendrocytes, and microglia cells

- 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
  - Destroyed in Multiple Sclerosis Patients
  - Schwann cell (PNS)
  - Oligodendroglia (CNS)

- Microglia
  - Smallest of glial cells
  - Phagocytes (motile)
  - Part 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
  - Has gaps that permit the free floe of substances into and out of the blood
  - Capillary in all of body except the brain
  - Selective permeability
  - Active Transport (e.g. glucose)
  - Area Postrema in the brain: control of vomiting
• The Neurons
  o NeuroAnatomy: How the neurons ‘look’
  o NeuroPhysiology: How the neurons ‘work’
  o Neurons are electrical devices
  o Electrons vs. Ions
    - Electron: ‘free flowing’ information (un-usable)
    - Ion: Atom/Molecule + Electrons

• Inside vs. Outside
  o Differences of electrical potential between the ‘inside’ of a neuron (cytoplasm),
    and the ‘outside’ (extracellular space)

• The Resting Membrane Potential
  o 2 Forces:
    - Diffusion: from high concentration .... To low concentration.
    - Electrostatic pressure: same charges repel.

• Keep The Sodium Out
  o Sodium-Potassium Pump (a.k.a. transport)
  o Keeps Sodium out, and gets potassium in
  o 3 sodium ions pumped out; 2 potassium ions pumped in

• Membrane Potential: Departure from rest
  o Hyperpolarization: Membrane potential goes more negative.
  o Depolarization: Membrane potential goes more positive

• Action Potential
  o Study membrane potential change: Need to stimulate

• Voltage-dependent Ion Channels
  o Fact 1: Ions move in/out of the cell through ion channels.
  o Fact 2: The ion channels open when the membrane depolarizes enough.
  o Fact 3: Potassium (K+) channels are a bit slower than the sodium (Na+) channels.

• Conduction of a Depolarization
  o In dendrites: ‘Passive Propagation’. The signal is regenerated. No attenuation.
  o All-or-none conduction Law

• Saltatory Conduction in Axon
  o Up to 260 miles/hour
  o Decremental conduction under myelin sheath
  o Action potential is regenerated at nodes of Ranvier

• Rate Law
  o The greater the stimulus, the greater the number of action potentials (per second)
• Sodium ions are more numerous outside of the cell, and depolarize the neurons when they enter T/F
• There are 5 times more neurons than glial cells T/F
• In a multipolar neuron, information arrives at the _**DENDRITES**_, is summed at the _**SOMA**_, and is sent out on the _**AXON**_.