

Notes for Wednesday and Friday September 18 & 20, 2002

Outline

- Structure of Neuron
- Neurophysiology:
- Resting membrane potential
- Action potential (AP)
- Propagation of AP

Nervous tissue

- Neuron = nerve cell; generates electrical signals.
- Neuroglia = “nerve glue”; support & protect

Neuron

- Long lifetime
- Cannot undergo mitosis
- High metabolic rate

Neuron structure

- Cell body
 - Nuclei = located in CNS
 - Ganglia = located in PNS

Nerve Processes

- Dendrites: receive information & conduct to cell body
- Axon: conveys information away from cell body

Axon

- Tip = axon terminal
- Synaptic end bulbs that contain:
- SYNAPTIC VESSICLES that store: NEUROTRASMITTERS

Myelin Sheath

- Lipid & protein covering produced by Schwann cells
- Insulate & protect the axon & increase speed of nerve impulse
- Typically long &/or thick axons
- Neurilemma
- Segmented
- Node of Ranvier

Gray & White Matter

- Gray: Unmyelinated axons; nuclei & ganglia; dendrites
- White: Myelinated axons

Classification of Neurons - by Structure

- Multipolar
- Bipolar
- Unipolar

By Function

- Sensory = afferent neurons
 - in PNS; convey to CNS; typically bipolar
- Motor = efferent neurons
 - in PNS; convey from CNS; typically multi polar
- Interneurons
 - located in CNS; transmit from neuron to neuron; typically multipolar

Neuron functions

- Excitability = irritability
- Conductivity

Neurons are able to respond to stimuli, convert information into a nerve impulse and transmit nerve impulses to other neurons, muscles or glands.

- Potassium = K^+
- Sodium = Na^+

Resting membrane potential

- Chemical composition is different on either side of the plasma membrane
- Leakage channels - always open
- Ion specific gated channels: K^+ & Na^+ both closed
- More K^+ inside
- More Na^+ outside
- More -tively charged large proteins inside
- More K^+ leaks out compared to Na^+ leaking in
- Na/K PUMP: 3 Na^+ out/2 K^+ in
- Inside of the cell is -tively charged compared to ECF
- Resting membrane potential = -70 mV
- Membrane is POLARIZED

Transfer of information

- Stimulus = change in environment that alters the resting membrane potential
- Graded potential
- Action potential

Graded potential

- Varies in amplitude depending on strength of stimulus
- Small deviation from resting membrane potential
- Mainly at dendrites & in cell body
- Localized - short distances

Action potential

- = Nerve impulse (NI)
- Only along axon from hillock to axon terminal
- Stimulus must reach threshold level = -55 mV
- All-or-none response
- Gated Na⁺ channels open
- Na⁺ rushes into the cell
- (Gated K⁺ channels open BUT K⁺ moves in SLOWLY)
- Membrane potential DEPOLARIZES +30 mV
- Release of energy
- Action potential is generated = electric current
- Gated Na⁺ channels CLOSE
- Gated K⁺ channels still open
- Movement of K⁺ increased
- REPOLARIZATION of membrane potential
- Plasma membrane returns to POLARIZED state
- Gated K⁺ CLOSE
- Na/K pump maintains resting potential

Refractory period

- = between depolarization & polarization
- No AP can occur during this time

Propagation of AP/NI

- Depolarization creates local current which depolarizes adjacent membrane and new AP is generated
- AP always moves away from stimulus

- Self propagating

Continuous conduction

- Unmyelinated axons
- Slow
- Similar to firecracker

Saltatory conduction

- Myelinated axons
- Myelin is poor conductor of electrical impulse
- AP occurs at Nodes of Ranvier
- Leaping effect = fast