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 VESICLES that store: NEUROTRANSMITTERS

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