Lecture 9, Feb 9, 2023

Activation of Postsynaptic Cell

- Presynaptic axon terminals are the synaptic inputs, which are near the cell body of the postsynaptic neuron
- EPSP: Excitatory PostSynaptic Potential
- IPSP: Inhibitory PostSynaptic Potential
- Glutamate is predominately excitatory; GABA is always inhibitory (but could change based on cellular concentration of ions); glycine is inhibitory
- Norepinephrine and epinephrine depends on the receptors
- Acetylcholine is always excitatory
- Two types of summation for activation:
  - *Temporal summation*: when stimuli are near each other in time, the depolarization caused by them would add on top of each other, and with enough of them the action potential would fire
    - One axon firing fast enough
  - *Spacial summation*: when multiple types of stimuli are present at the same time, the depolarization caused by them adds together
    - Two axons firing at the same time, with some distance in between
- *Inhibitory synapses*: when these fire, the membrane hyperpolarizes; this would cancel out any excitatory synapse signals
- *Presynaptic inhibition*: inhibitory synapses can attach to excitatory synapses (instead of to the postsynaptic neuron body); when these fire, they would inhibit the excitatory synapse from firing at all
  - Inhibitors only affect the synapse they attach to

Central Nervous System

- From the brain, the nerves travel down the spine and branch out
  - Cervical, thoracic, lumbar and sacral in order
  - On the face is the trigeminal nerves
  - Some nerves come directly out of the brain
- Tracts are neurons grouped in certain regions of the spinal cord
  - Ascending tracts are sensory pathways that start in the periphery regions (e.g. fingertips) that go to the brain
    - Different senses go to different regions of the brain (somatosensory homunculus); more space is allocated to more sensitive regions
  - Descending tracts are motor pathways that start in the brain and go down the spine to muscles
  - Note neurons are unidirectional
- Spinal cord structure:
  - Dorsal side is the back, ventral side is the front
  - Thicker neurons are typically motor neurons since signals travel faster
  - Mnemonic: SAME (Sensory - Afferent, Motor - Efferent), DAVE (Dorsal - Afferent, Ventral - Efferent)
  - Sensory/afferent neurons go through the dorsal side
  - A group of axons get bundled into *fascicles* to become a nerve (typically inside a fascicle, all the neurons are either all sensory or all motor)

Reflex Arcs

- Can be monosynaptic or polysynaptic
- Classical example of tapping the patellar tendon with a hammer
  - Cells measure how much the tendon is stretched, which gets sent to the spinal cord
  - Without needing to go into the brain, the synapse activity happens right at the spinal cord and goes back to a muscle group, causing movement of the leg

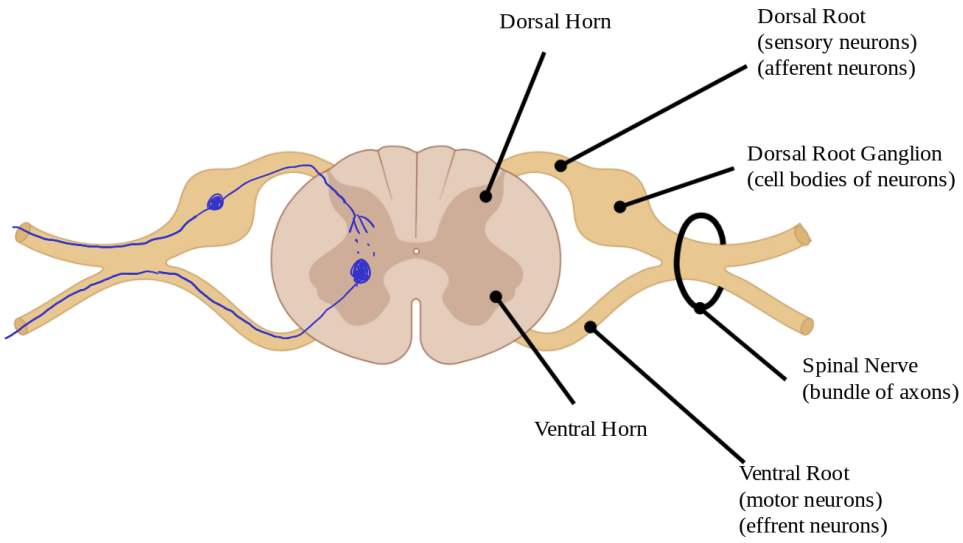

Figure 1: Spinal cord structure, with typical reflex arc in blue

- A monosynaptic reflex only has one synapse, which has to go all the way to the spinal cord and back, so there is a delay
- A polysynaptic reflex (e.g. withdraw reflex) takes the same path, but excite multiple interneurons in the spinal cord that can excite and inhibit motor neurons for different parts of the body
  - e.g. exciting the biceps and inciting the triceps to withdraw your hand when you touch a hot object