

Alexa
8/29/17

8/29/17- Class Notes

- Very beginning of axon is called “Axon Hillock”
- Conduction of a Depolarization
 - In dendrites: “Passive propagation”. There is attenuation of signal transmission
 - Loses its strength as it travels on from point of stimulation
- Conduction of the Action pOtentiaL
 - In axons: “ Active Propagation: The signal is regenerated. No attenuation
 - Either you have an action potential or you don’t
 - Called “All or none conduction Law”
 - No such thing as half an action potential no matter where you measure
- Saltatory Conduction in an Axon
 - Generate action potential in the beginning, then in the small amount of distance between, the action potential decreases slightly, once you hit Node of Ranvier, action potential regenerates
 - Figure 2.21 in textbook
 - This sort of regeneration of action potential at Node of Ranvier is called Saltatory Conduction
- Rate Law
 - The greater the stimulus, the greater the number of action potentials (per second)
 - The more you excite or stimulate the neurons, the more action potentials you get
 - Figure 2.20 in textbook
- What if we had a quiz?
 - Sodium ions are more numerous outside the cell, and depolarize the neurons when they enter.
 - True
 - There are 5 times more neurons than glial cells.
 - False
 - In a multipolar neuron, information arrives at the ____, is summed at the ____ and is sent out on the ____.
 - Dendrites or spines, Soma, Axon
- Synapses
 - Neurons are simple computing devices
 - Brain functions (including cognitive functions) rely on the activity of networks of interacting neurons
 - interactions= synapses
 - Synaptic Morphology
 - Pre/Post synaptic sites
 - Types of synapses
 - Synaptic vesicles

- Neurotransmitter
- Axonal Transport
 - Stuff moves along the axon microtubules (axoplasmic transport)
 - Generally moves from soma to boutons
 - What is stuff?
 - Where does it go exactly?
- Synapse: The parts
 - Synaptic vesicles are filled with neurotransmitter molecules
 - Synapse does not touch the neuron
 - Synaptic cleft= what's in between
 - Look at figure 2.23 in textbook
 - Vesicles contain neurotransmitters
- 3 kinds of synapse locations
 - Axo-dendrites
 - Axon contacts the dendrites or spines
 - Axo-Somatic
 - Axon goes directly on soma, bypassing dendrites
 - Axon-Axonic
 - Axon goes directly on the other axon
- The synapses
 - Synaptic Physiology
 - The synapse is the place where 2 neurons talk to each other
 - How does this work?
- Neurotransmitter Release
 - Need action potential for synapse to work
 - Once action potential arrive, vesicles stick to membrane, then open up on membrane (called fusion)
 - During this process, they release molecules they held inside called neurotransmitters
 - Received by neurotransmitter-dependent ion channels (aka receptors)
 - Very quick process
- Ionotropic Receptors
 - Molecule that sits in membrane that waits for neurotransmitters
 - They fit together like a lock and key
 - Once they fit together, the ion channel opens up
 - Ion channels closed unless neurotransmitter is bound to it
 - Very fast and very local
- Metabotropic Receptor
 - Neurotransmitter binds to it
 - Sends second messengers: molecules that link receptors to ion channels
 - Mediate the influence of hormones and drug, state-dependent information processing...
 - Transmitter binds→ activates receptors→ activates Second Messengers which opens ion channels and intracellular effects

- Slow and more diffuse since it has a couple steps
- IPSPs and EPSPs
 - Excitatory/Inhibitory Postsynaptic Potential
 - Look at figure 2.27 in textbook
 - One given neuron releases the same neurotransmitter at all of its synapses
 - Basic law
- Regulation of Release: Re-uptake
 - Reuptake of neurotransmitter molecules
 - Need to clean up the neurotransmitter back to where they came from
 - This is like a little tube that sends them back up called transporter
 - Recycling of molecules
 - Help with fast, efficient neurotransmission (low signal-to-noise)
- Regulation of Release: Autoreceptors, Enzymatic Deactivation
 - Autoreceptors
 - On the presynaptic membrane (aka presynaptic receptors)
 - Regulate synthesis and release of neurotransmitter (no ion flow)
 - Mostly metabotropic
 - Enzymatic Deactivation
 - Acetylcholine (ACh) vs. Acetylcholine esterase (AChE)
- Regulation of Release: Axo-axonic Synapse
 - Presynaptic inhibition/facilitation
 - Neuron B is trying to talk to neuron C
 - The AB synapse helps (or interferes with) the BC synapse
 - The AB synapse exerts a presynaptic facilitation (or inhibition) of the BC synapse
 - Figure 2.30
- Nonsynaptic Communication
 - Fun Fact 1
 - Some neurotransmitters are released diffusely (leak-out): Neuromodulators
 - They have slow and diffuse actions (peptides). Influence many postsynaptic targets
 - Involved in attention, emotions, pain sensitivity
 - Fun Fact 2
 - Most hormones are produced by endocrine glands in the body (adrenal glands, stomach, liver)
 - Some neurons produce hormones rather than neurotransmitters
 - Some neurons have hormone receptors (target cells)
 - Communication between nervous system and body
 - ex= sex hormones and aggression, stress
- Spatial Summation
 - Post synaptic potentials from different synapses sum up at the soma
 - If both go up=then bigger up
 - If both go down=than bigger down
 - If one up and one down=they cancel out

- Temporal Summation
 - Postsynaptic potentials from the same synapse (but different action potentials) sum up
 - If both up= then bigger up
 - If both down=the bigger down
- Preview...When Synaptic transmission goes wrong
 - Not enough neurotransmitter binding: Acetylcholine and Myasthenia gravis treated by inhibition of enzymatic deactivation
 - Not enough neurotransmitter binding: Depression and Selective Serotonin Reuptake Inhibitors
 - Weakness of postsynaptic receptors: Dopamine and drug addiction
 - Too much binding: Dopamine and Schizophrenia
 - Death of presynaptic neurons that produce a specific neurotransmitter: Dopamine and Parkinson's disease
 - Change in number/sensitivity of postsynaptic receptors: Glutamate and learning and memory