

## Action Potentials

-Threshold potential (TP) (*Figure 6-21*)

- $V_m$  required to activate  $Na^+$  channels
- Stimulus then generated by  $Na^+$  influx
- Weak depolarizations = subthreshold potentials

-AP amplitude (aka size), if occur:

- Independent of stimulus
  - o The amplitude will always be the same and doesn't depend on how strong or weak the signal is
    - The bullet in a gun will *always* go the same distance no matter how hard or weak you pull the trigger
- No change in size (not equal to GP)

-Practical application?

- Local anesthetics: many block  $Na^+$  channels

-Propagation down axon (*Figure 6-23*)

- Adjacent sections of plasma membrane (PM)
  - o Has action potential but *CANNOT move*
  - o One starts the next one
  - o Action potential height will *ALWAYS* be the same height/ size
    - As distance increases -> no change in size
    - So no signal changed
    - No distance problem!
    - Each action potentials takes 1-2 milliseconds
  - o Unidirectional
    - Not going to trigger backwards
    - Necessary for speed
    - Due to:

### 1. Hyperpolarization

- Going to need a bigger stimulus to reach the threshold (backward); whereas going to need a smaller/not as big stimulus to reach the threshold (forward); so it's easier to go/keep going forward than go backwards

### 2. Na<sup>+</sup> channel blocked

#### -Propagation down axon (*Figure 6-24*)

- Myelin: insulator
  - Aids graded potentials (GP)
    - Usually has a big "drop-off" and decreases quickly, but with myelin the "drop-off" is not as large and doesn't decrease as quickly
  - Blocks action potentials (AP)
    - Increases conduction velocity
    - Myelin covers some of the section of plasma membrane and makes the action potential move VERY fast. Action potentials are triggered and then moves over their graded potentials and continues to trigger the next action potentials
- Saltatory conduction
  - Action potentials (AP) only at nodes of Ranvier
  - Jump to next node via graded potentials (GP) under myelin
    - Has to be a graded potential when traveling through myelin, cannot be action potential because there is so much influx

#### **Back to Chemical Synapses**

#### -Postsynaptic neuron (*Figure 6-31*)

- Inputs from multiple presynaptics can occur
  - Excitatory (stimulatory) = depolarizing
    - Makes it more likely
  - Inhibitory = hyperpolarizing
    - Makes it less likely
- Temporal summations = same, close together
  - One is not enough to reach the threshold

- o Can send a signal and the receptor ignores and returns to steady state; can send two signals back to back and the second will build in strength off of the first one and will be harder to return to steady state -> *bigger result in the postsynaptic, closer stimuli in time, and postsynaptic cannot return to resting potential before the next one is hit*
  - o One child trying to get her attention by tapping her over and over again
  - Spatial summations = different, close together
    - o Both of her kids "sending signals"/trying to get her attention at the same time
    - o Happens at the same time
- Synapses can change information -> more = higher complex
- When there are 4 synapses there are more chances to make her reach threshold than just if there were 2 synapses.
  - Can change and make multiple different ways for her to get to the threshold

### **Synapse Strength** (*Figure 6-33 -> chemical synapse*)

#### -Presynaptic factors

- Availability of neurotransmitter
  - o Did it make enough neurotransmitters to "talk" to the other cell? Need the *chemicals* for *chemical* synapse
- Ca<sup>+2</sup> availability
  - o Not enough calcium, then we won't have enough calcium to perform the exocytosis
    - Calcium is very important for bones, but even more important for synapse!
- Receptor availability
  - o Most presynaptics are also postsynaptics and they have a message from *their receptors*, so they have receptors to receive messages
- Membrane potential
  - o Message comes down axon as action potential.
  - o Change axon potential? Impacts ability to change action potentials and reaching of the threshold potential
  - o Hyperpolarize? Makes it harder for message to get through