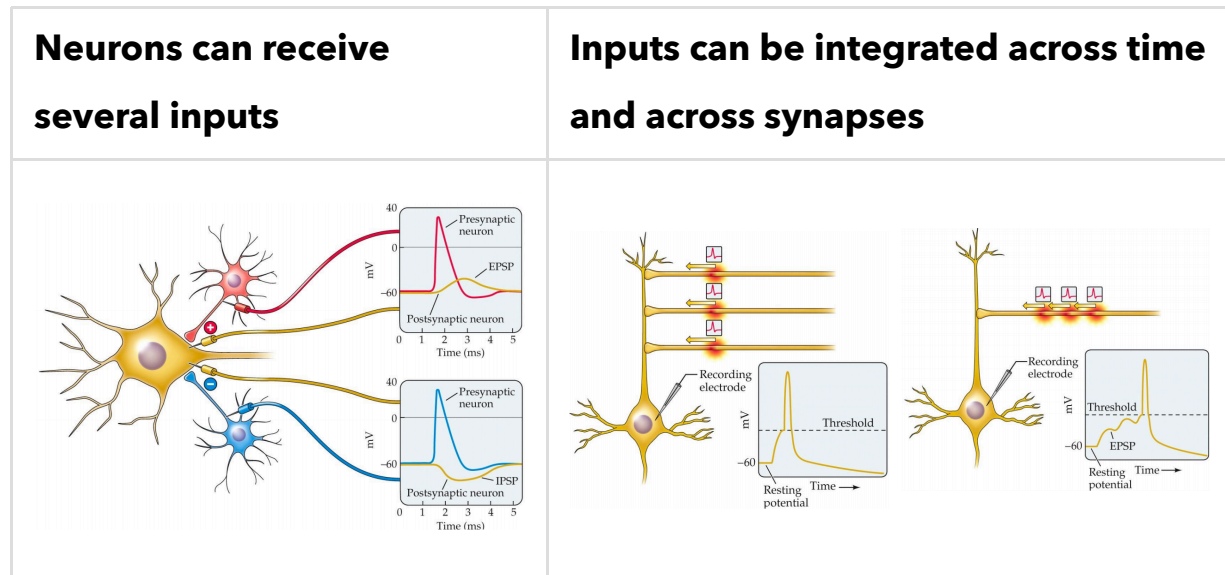


Lecture 5

Integrating Electrical Signals



Neurotransmission

Chemical vs Electrical Synapses

Varieties of Synapses

- Synapses vary widely, each type is specialized in
 - Location
 - Structure
 - Function

- Target
- Through connections to the dendrites, cell body, or axon of a neuron, transmitters can control the actions of the neuron in different ways
 1. **Dendrodendritic**: Dendrites to dendrites
 2. **Axodendritic**: Axon terminal to dendrites
 3. **Axoextracellular**: Axon terminal to extracellular fluid
 4. **Axosomatic**: Axon terminal to cell body
 5. **Axosynaptic**: Axon terminal to another terminal
 6. **Axoaxonic**: Axon terminal to another axon
 7. **Axosecretory**: Axon terminal to capillaries (directly into blood)

Structure of Chemical Synapses

- Chemical Synapse
 - Junction where messenger molecules (neurotransmitters) are released from one neuron to excite/inhibit the next neuron
 - Majority of synapses in the mammalian nervous system are chemical
- Neurotransmitter
 - Chemical released by a neuron onto a target with an excitatory or inhibitory effect
 - Outside the CNS, many of these chemicals circulate in the blood stream as hormones (distant targets, slower action than neurotransmitters)
- Experiment: Otto Loewi (1921)
 - Frog heart experiment

- Role of the vagus nerve and the neurotransmitter acetylcholine (ACh) in slowing heart rate
- Acetylcholine
 - First neurotransmitter discovered in the PNS and CNS
 - Activates skeletal muscles in the somatic nervous system
 - May excite/inhibit internal organs in the autonomic nervous system

Structure of Electrical Synapses

- Gap junction
 - Fused presynaptic and postsynaptic membrane
 - Allows ions (electrical messages) to pass directly from one neuron to the next
 - Electrical Synapses are fast
 - These types of synapses are less common
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Steps in Synaptic Transmission

1. Synthesis

- Some neurotransmitters are transported from the cell nucleus to the terminal button
- Others, made from building blocks imported into the terminal, are packaged into vesicles there

2. Release

- In response to an action potential, the transmitter is released across the membrane by exocytosis

3. Receptor action

- Transmitter cross the synaptic cleft and binds to receptor

4. Inactivation

- Transmitter is either taken back into the terminal or inactivated in the synaptic cleft

Excess Neurotransmitter

- Accomplished in at least four ways
 - Diffusion away from synaptic cleft
 - Degradation by enzymes in synaptic cleft
 - Reabsorption into presynaptic neuron for subsequent reuse
 - Taken up by neighboring glial cells