

Module 10 LO6

Synapse

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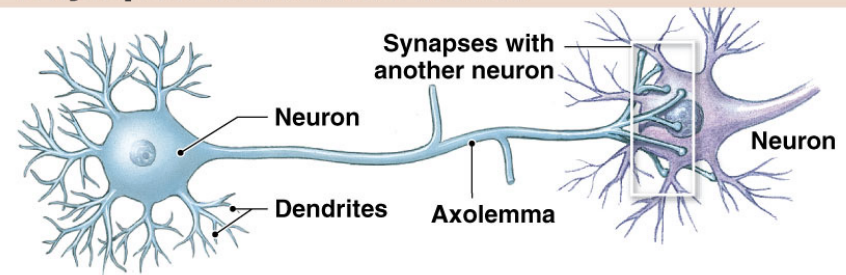
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[Video Recording Link](#)

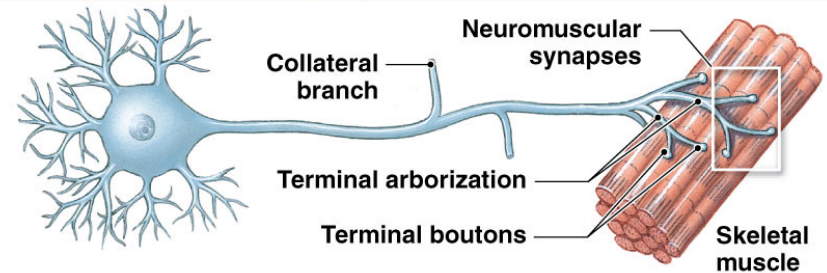
6. Synapse

- Communication between:
 - 2 neurons
 - Neuron and effector cell
 - Muscle
 - Gland
- Importance:
 - Homeostasis
 - Disease treatments

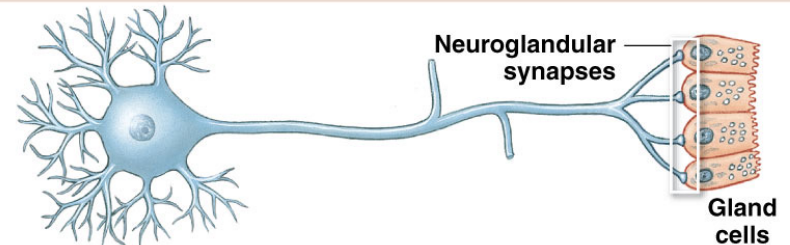
1. Synapses with another neuron



2. Neuromuscular synapses

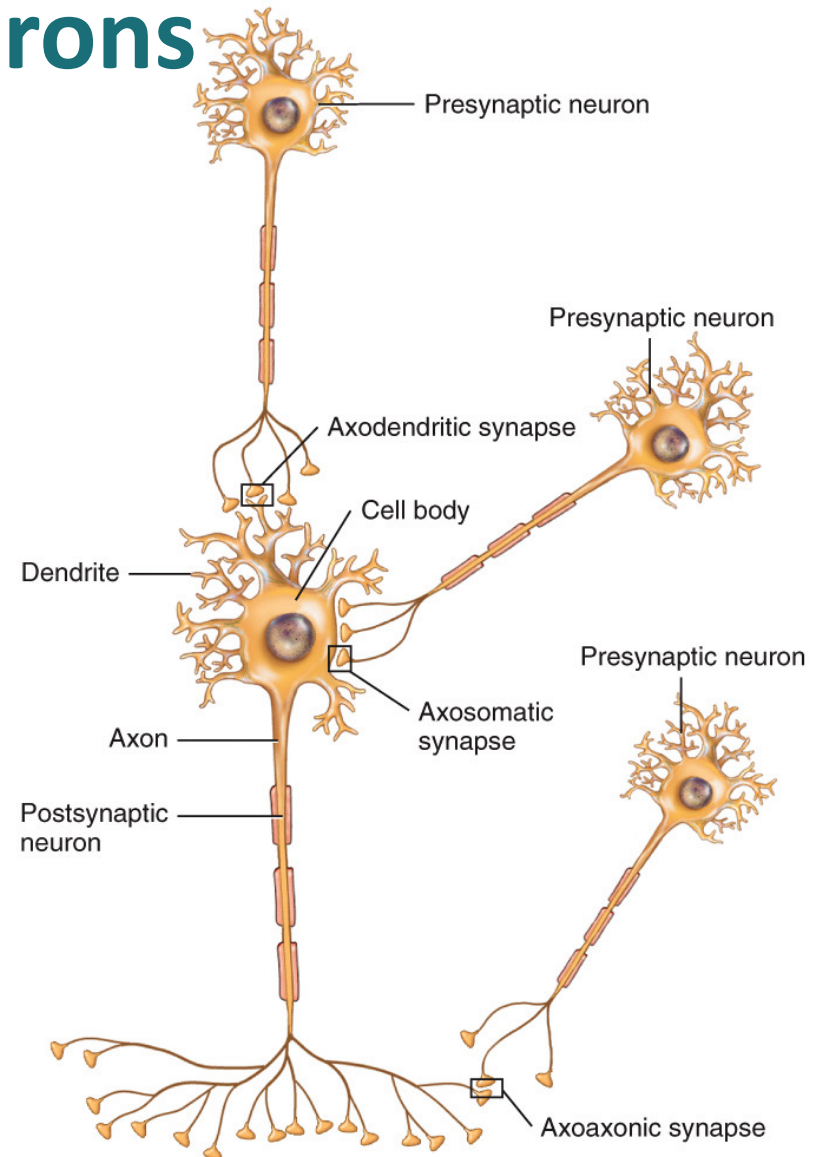


3. Neuroglandular synapses



Synapse Between Neurons

- Presynaptic neuron
 - Sending signal
- Postsynaptic neuron
 - Receiving signal
- Neural synapses can be:
 - Axodendritic
 - from axon to dendrite
 - Axosomatic
 - from axon to cell body
 - Axoaxonic
 - from axon to axon

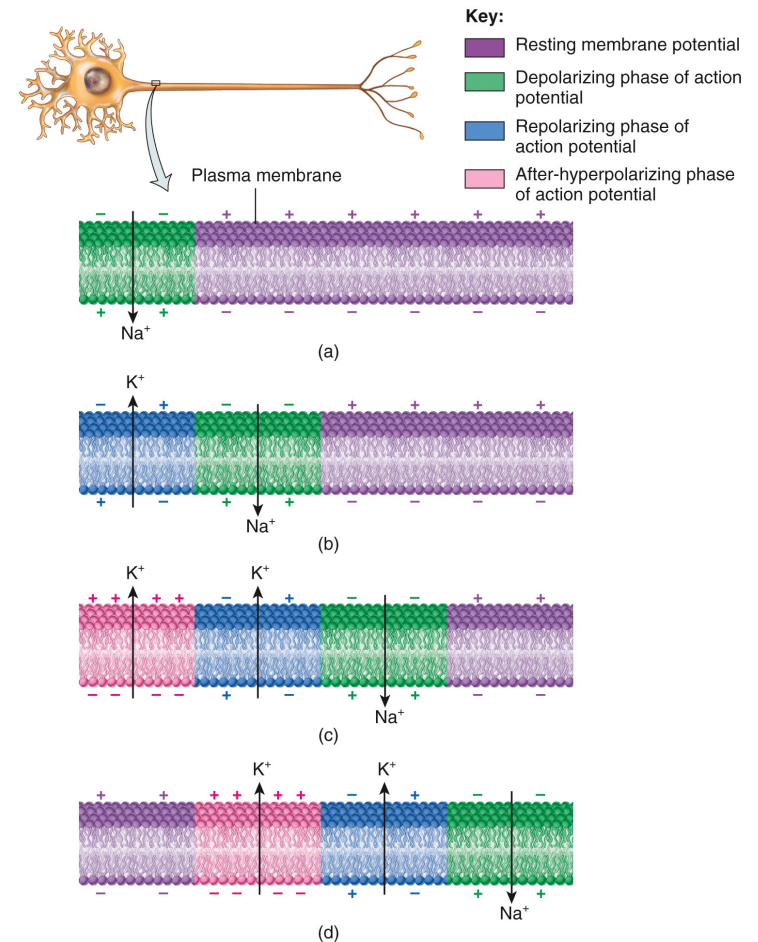


Types of Synapses

- Electrical synapse
 - Involves channels that allow ions to flow from one cell to another
- Chemical synapse
 - Involves release of neurotransmitter into synaptic cleft
 - About 100 substances are either known or suspected neurotransmitters
 - acetylcholine (ACh), glutamate, aspartate, gamma aminobutyric acid (GABA), norepinephrine (NE), dopamine (DA), serotonin, endorphins, and nitric oxide (NO)

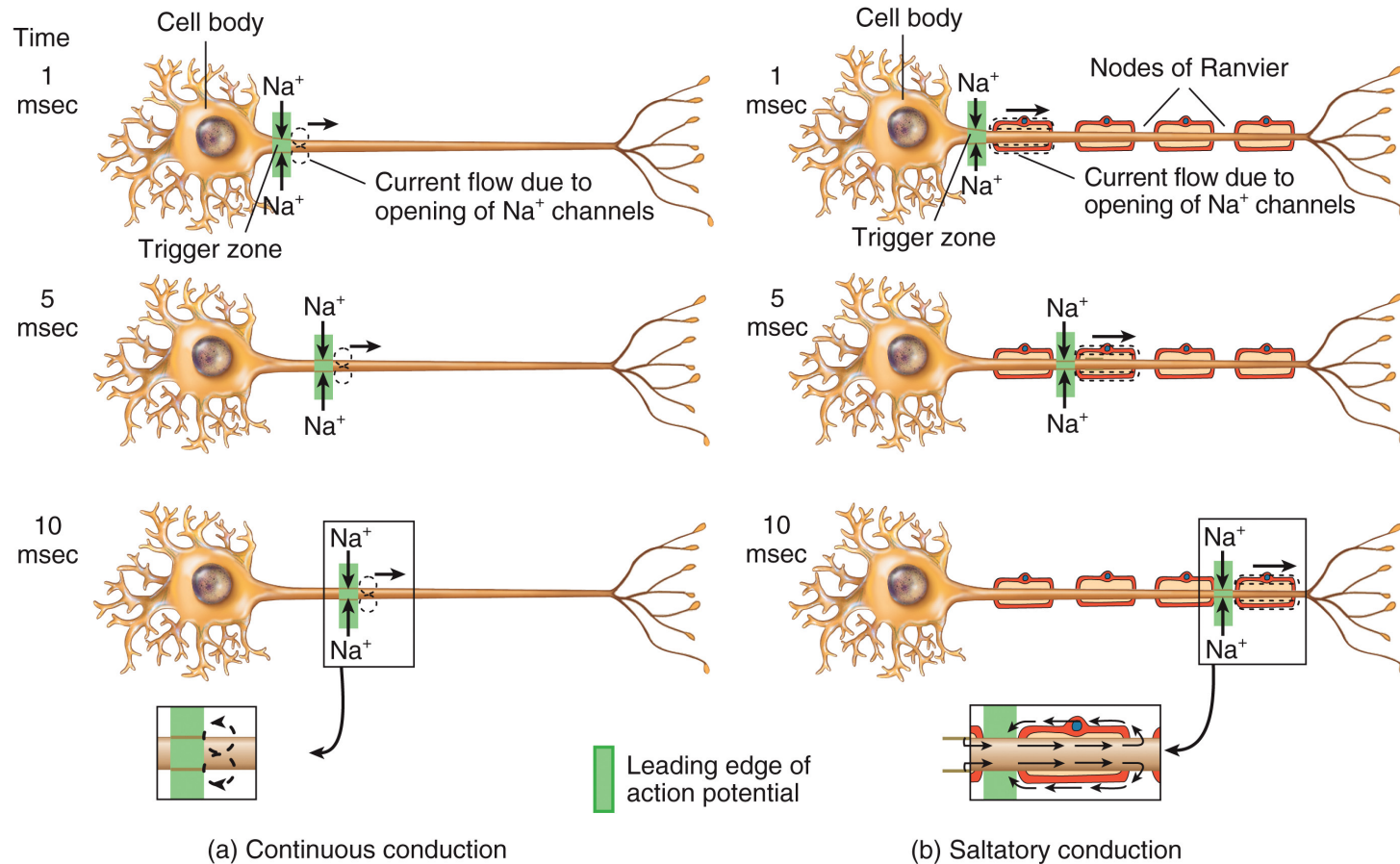
Action Potentials Undergo Propagation

- Each phase of AP sequentially regenerates along the axon of a neuron from trigger zone (axon hillock) to axon terminals.

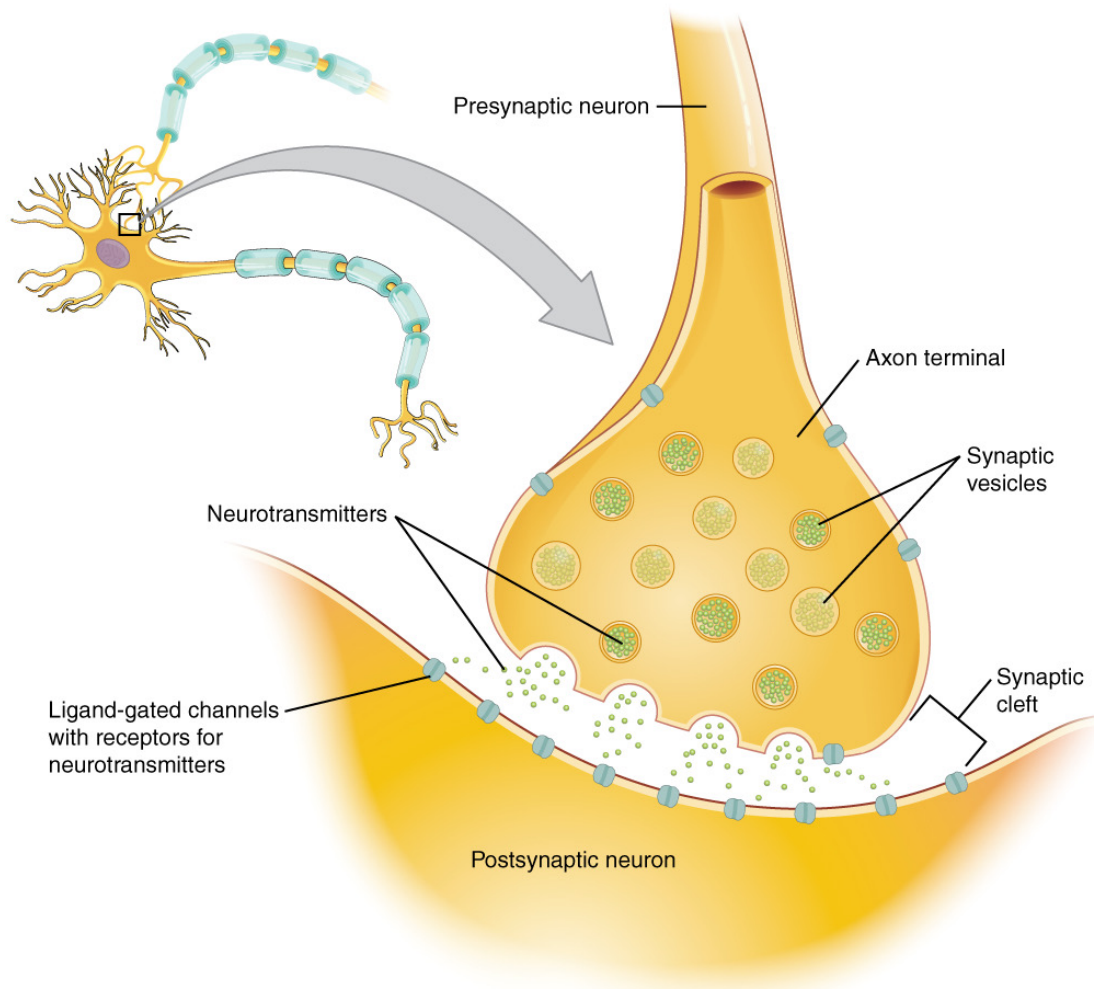


Conduction velocity

Unmyelinated axons exhibit continuous conduction; myelinated axons exhibit saltatory conduction.



Synapse Between Neurons



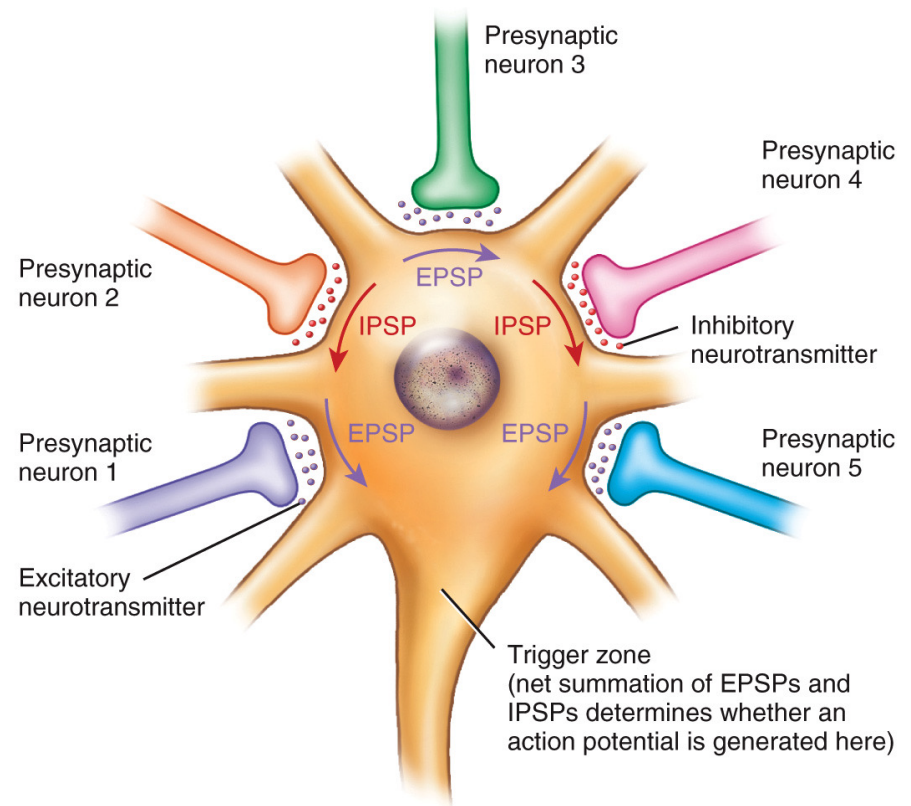
At a chemical synapse, a presynaptic neuron converts an electrical signal (action potential) into a chemical signal (neurotransmitter release). The postsynaptic neuron then converts the chemical signal back into an electrical signal (postsynaptic potential).

Responses at Postsynaptic Cell

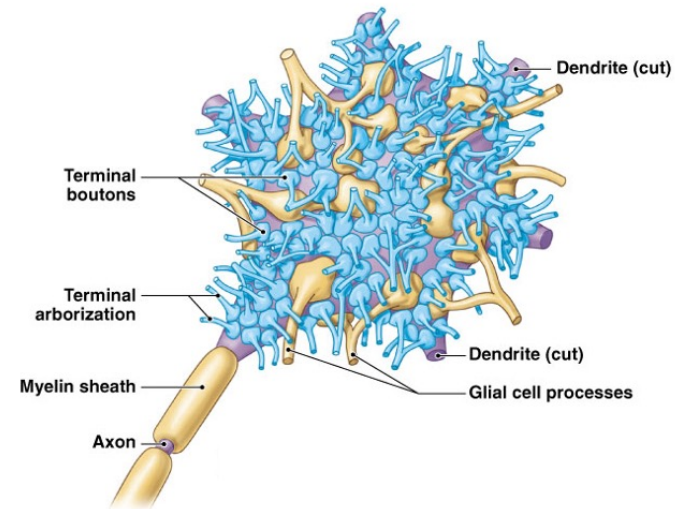
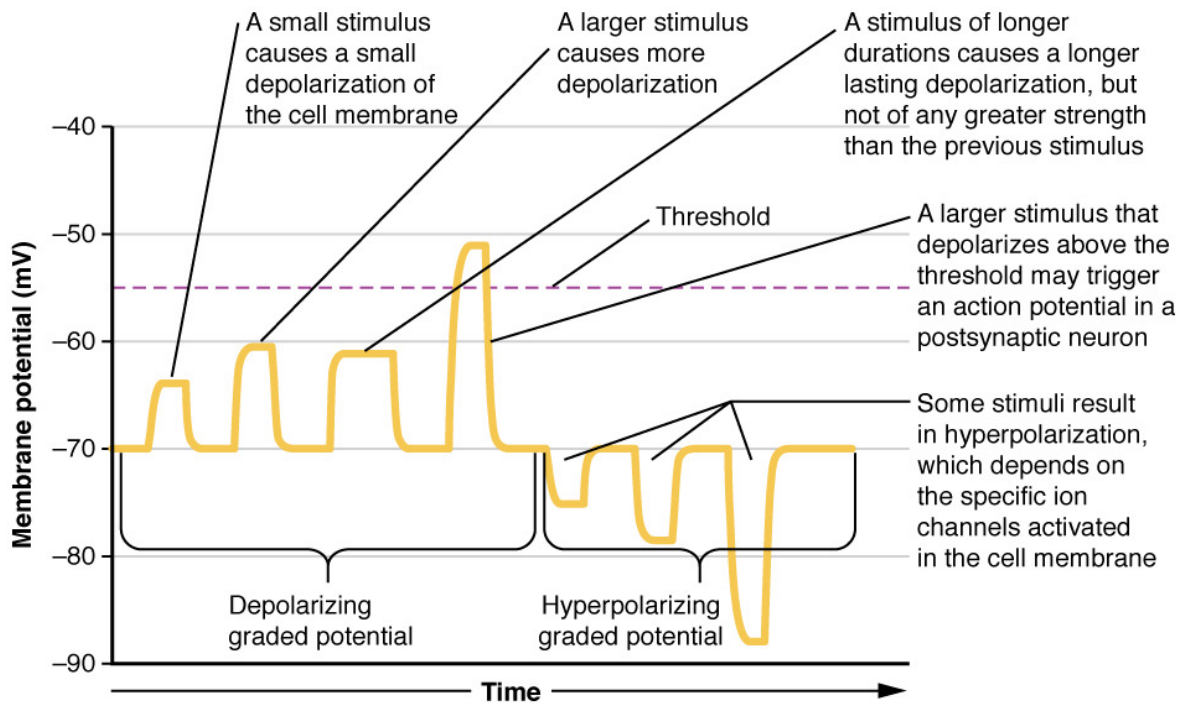
- Excitatory post-synaptic potential (EPSP)
 - Neurotransmitter release results in a depolarization of the post-synaptic membrane
 - Examples: Acetylcholine, glutamate
- Inhibitory post-synaptic potential (IPSP)
 - Neurotransmitter release results in a hyperpolarization of the post-synaptic membrane
 - Examples: glycine, GABA
- Some may cause both (depending on the specific receptor: serotonin, dopamine, norepinephrine)

Summation of IPSP and EPSP

- If the net summation of EPSPs and IPSPs is a depolarization that reaches threshold, then an action potential occurs at the trigger zone of the postsynaptic neuron.

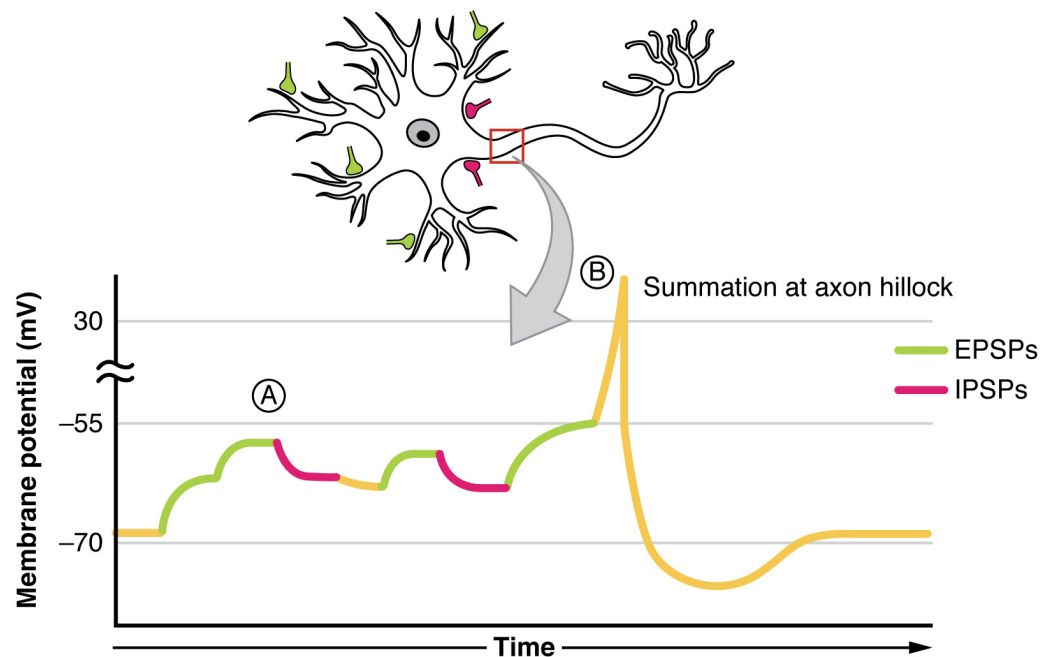


Graded Potentials



Summation

- Spatial summation – several weak signals from different locations are converted into a single larger one
- Temporal summation – converts a rapid series of weak pulses from a single source into one large signal



Graded Potentials X Action Potentials

Characteristic	Graded Potentials	Action Potentials
Origin	Arise mainly in dendrites and cell body.	Arise at trigger zone and propagate along axon.
Types of channels	Ligand-gated or mechanically-gated ion channels.	Voltage-gated channels for Na^+ and K^+ .
Conduction	Decremental (not propagated); permit communication over short distances.	Propagate and thus permit communication over longer distances.
Amplitude (size)	Depending on stimulus strength, varies from less than 1 mV to more than 50 mV.	All or none; typically about 100 mV.
Duration	Typically longer, ranging from several msec to several min.	Shorter, ranging from 1–2 msec.
Polarity	May be hyperpolarizing (inhibitory to generation of an action potential) or depolarizing (excitatory to generation of an action potential).	Always consists of depolarizing phase followed by repolarizing phase and return to resting membrane potential.
Refractory period	Not present; thus summation can occur.	Present; thus summation cannot occur.