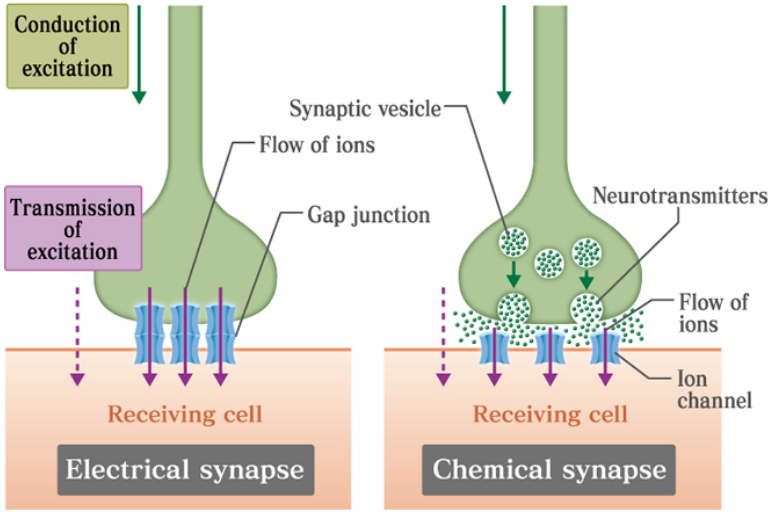
The Nervous System

Synapses - Part II

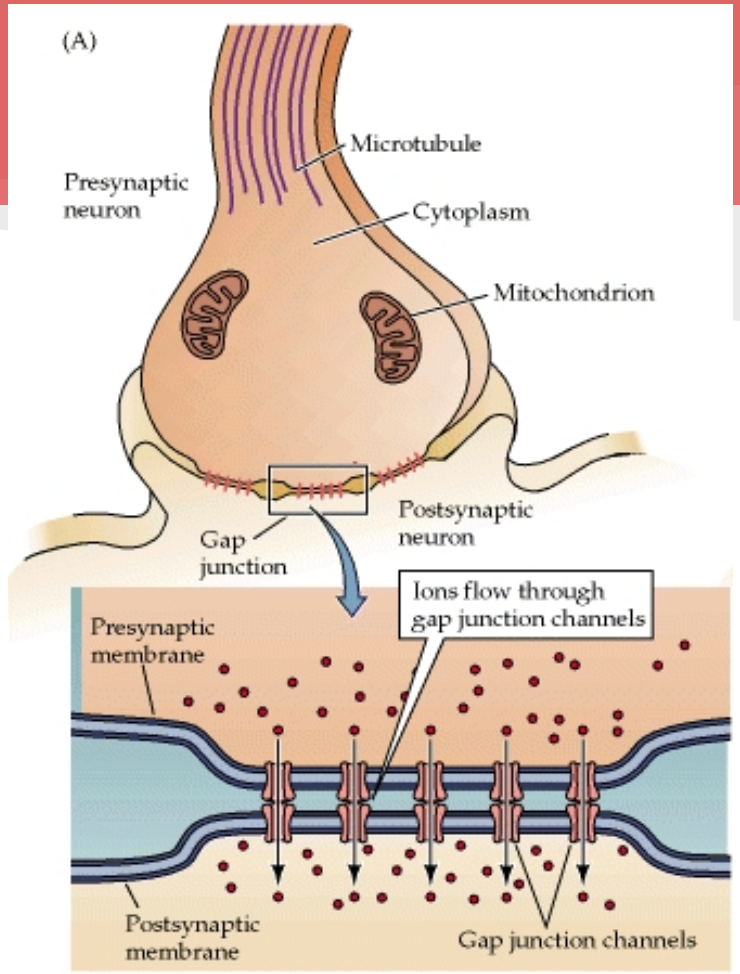
Synapses:

- There are two different kinds of synapses:
  - Electrical
    - cell-to-cell contact
  - Chemical
    - neurotransmitter



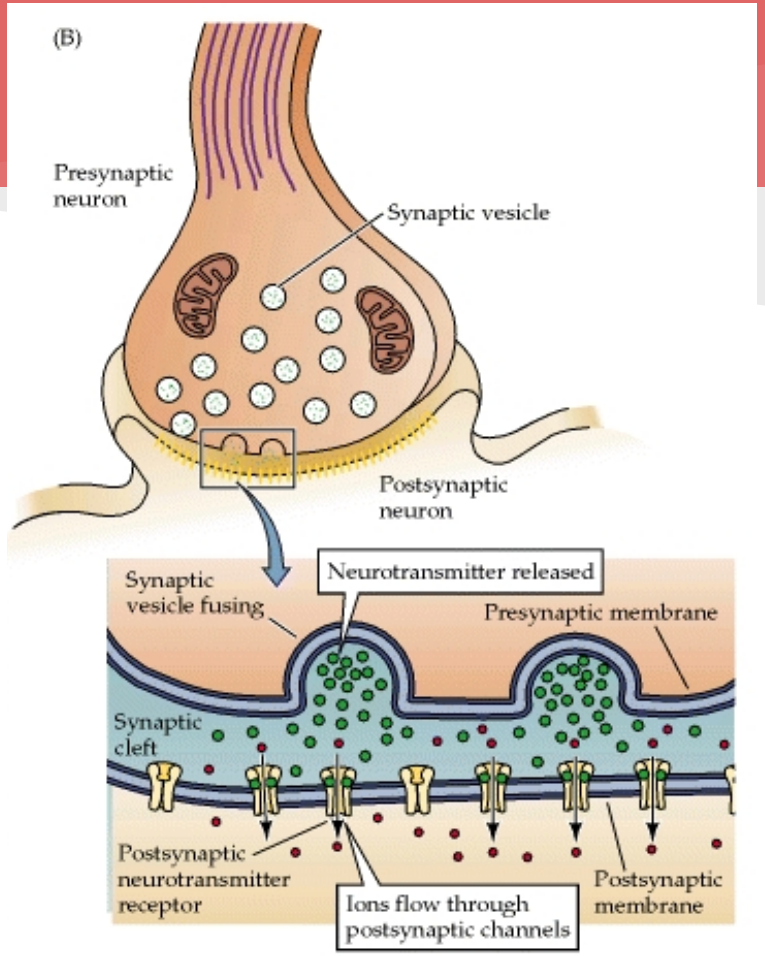
Electrical Synapse

- Presynaptic & postsynaptic membranes are attached by gap junctions
  - Connexons interlock membranes
  - Easy passing off of ions



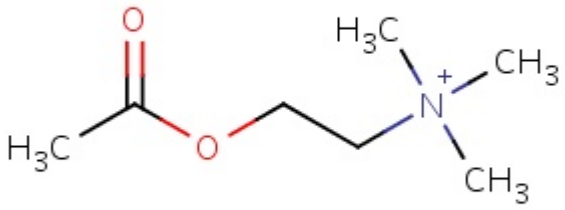
Chemical Synapse

- Neurotransmitter is released as form of communication between cells
- Most abundant type of synapse
- Synaptic activity can be easily adjusted
- Effect of synapse relies on the receptor of the postsynaptic membrane



Cholinergic Synapse

- Chemical synapse that releases acetylcholine (ACh)
  - Most common & well known neurotransmitter



Neurotransmitter vs. Neuromodulator

Neurotransmitter:
chemical signal

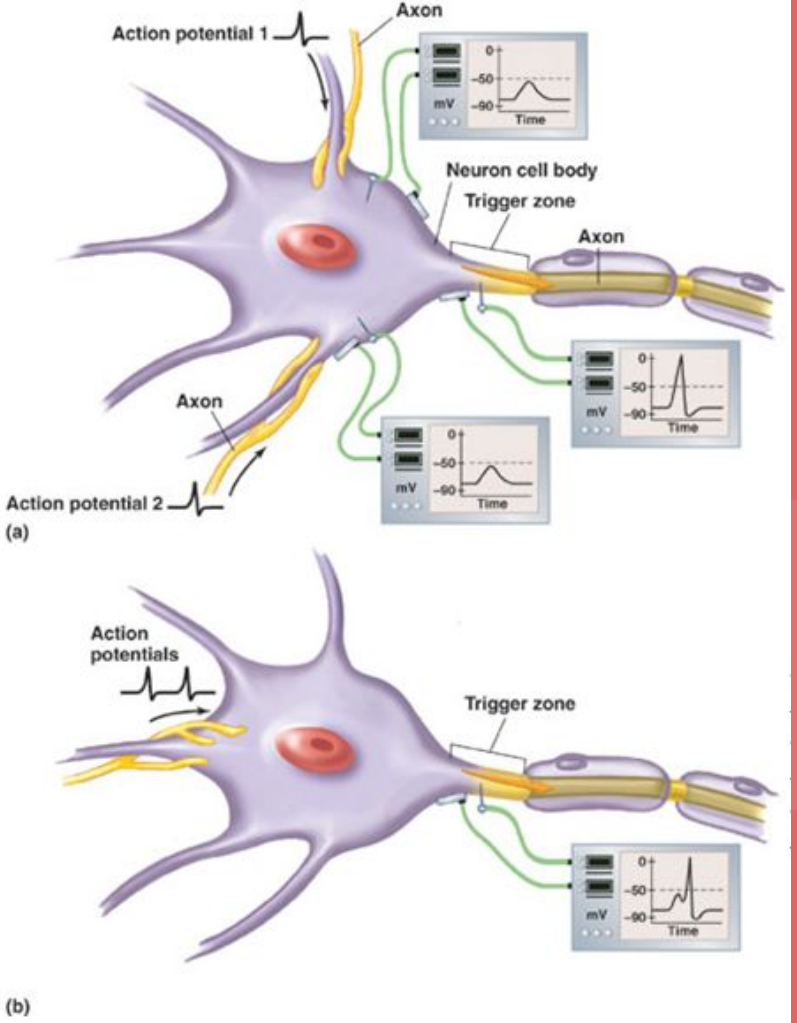
-Norepinephrine
-Dopamine
-Serotonin
-GABA

Neuromodulator:
alter the rate of neurotransmitter release

-Opioids

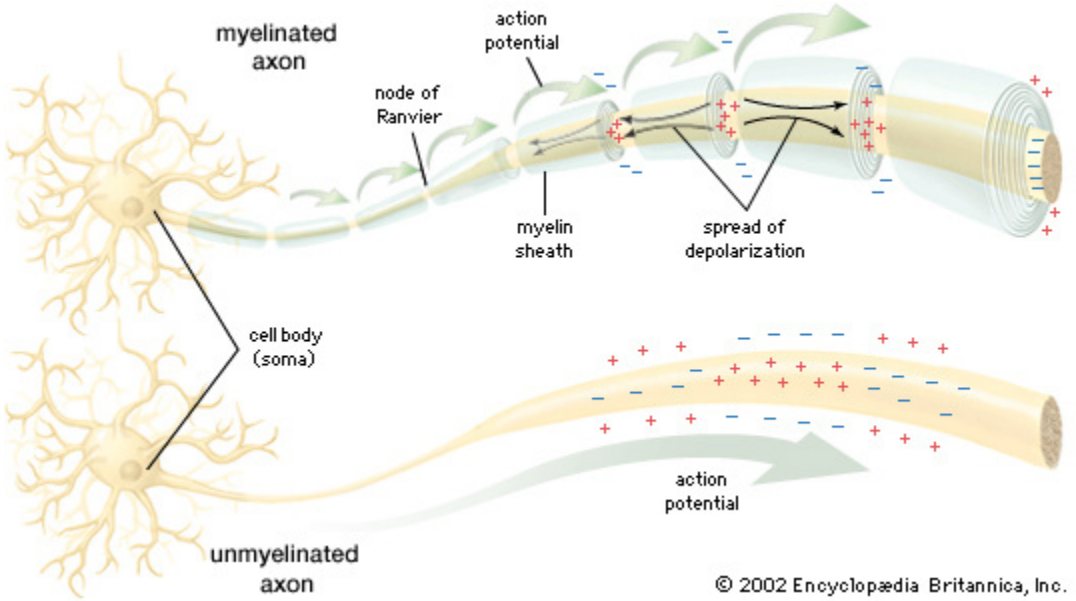
Summation

- The pattern of stimulation that causes an action potential
- Two types of summation:
  - Temporal Summation
    - single synapse that repeats until threshold is met
  - Spatial Summation
    - more than one stimulation at a time


Action potential 1
Axon
0
−50
−90
mV
Time
Neuron cell body
Trigger zone
Axon
Axon
Action potential 2
(a)
Action potentials
Trigger zone
(b)

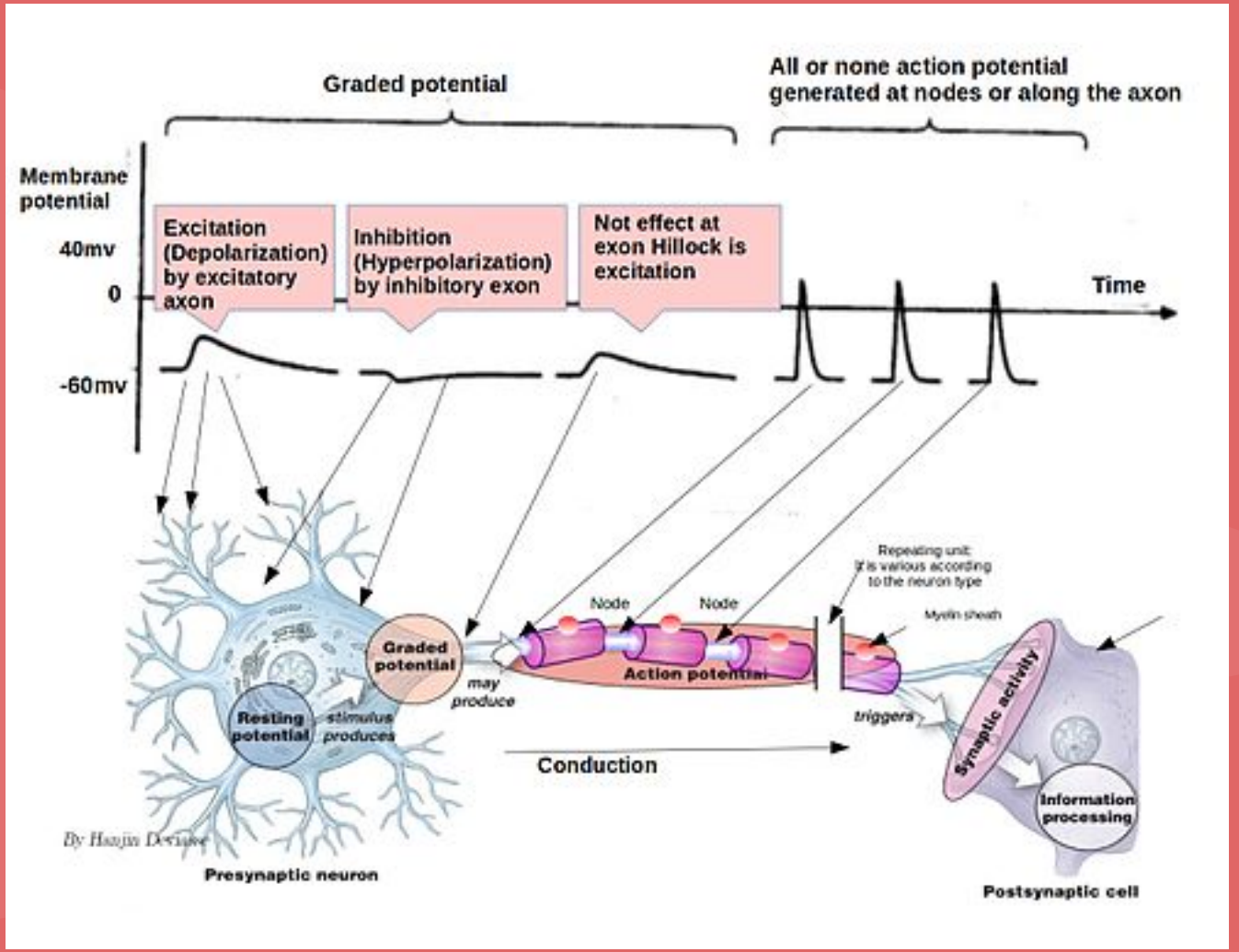
Propagation

- The flow of the action potential in an axon
  - Continuous Propagation
    - unmyelinated axons
  - Saltatory Propagation
    - myelinated axons
    - “node jumping”



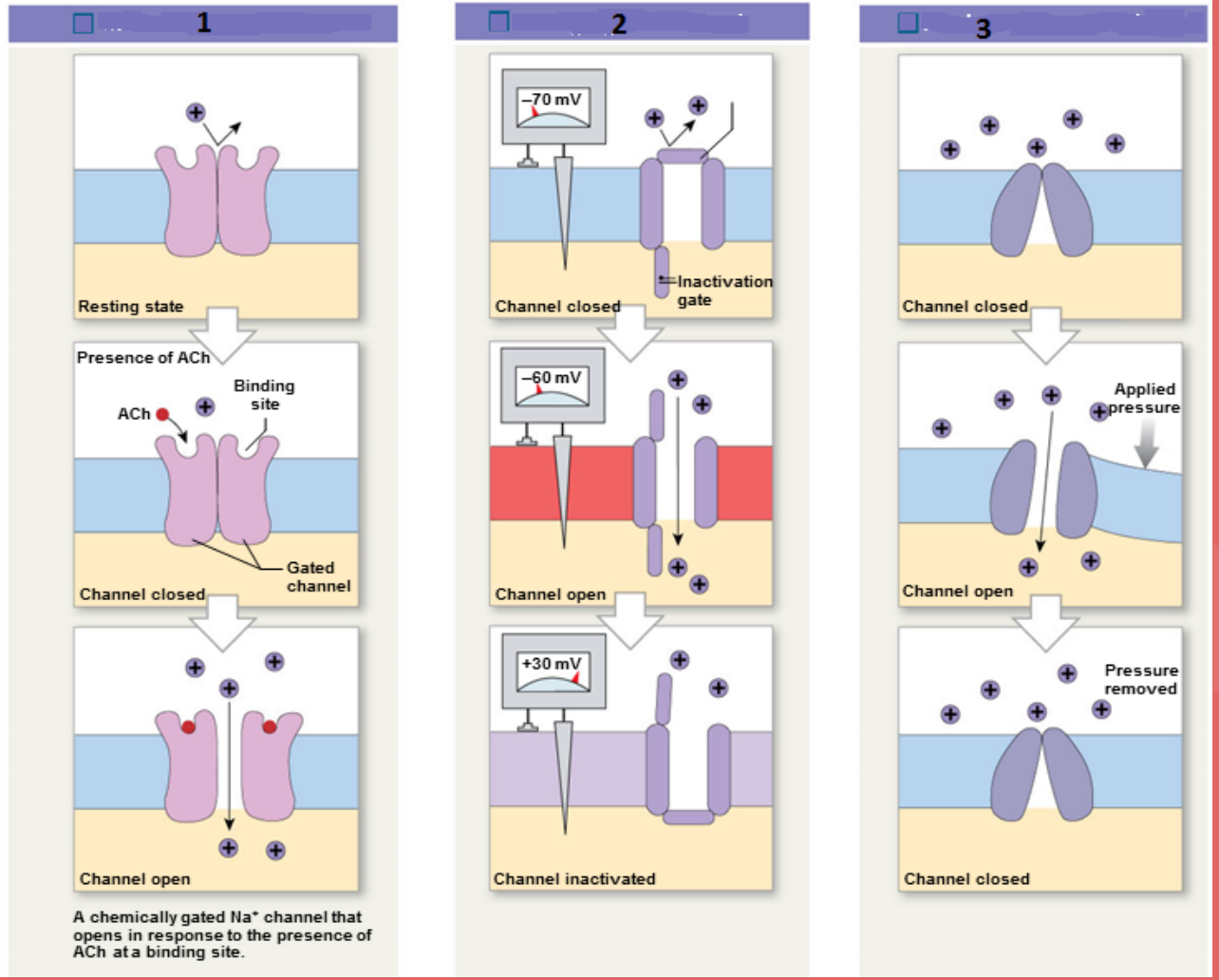
Neural Potentials

- Resting potential - resting cell
- Graded potential - temporary response to stimulus
- Action potential - electrical impulse along axon
- Synaptic activity - release of neurotransmitters
- Information processing - integrate stimuli


Graded potential
All or none action potential generated at nodes or along the axon
Membrane potential
40mv
0
-60mv
Excitation (Depolarization) by excitatory axon
Inhibition (Hyperpolarization) by inhibitory exon
Not effect at exon Hillock is excitation
Time
Repeating unit: it is various according to the neuron type
Node
Node
Myelin sheath
Graded potential
may produce
Action potential
Resting potential
stimulus produces
triggers
Synaptic activity
Conduction
Information processing
By Hanjin Dexter
Presynaptic neuron
Postsynaptic cell

Changes in Membrane

- Gated channels in the membrane open & close in response to stimuli
- Chemical
  - specific chemicals bind
- Voltage
  - capability of generating and conducting an action potential
- Mechanical
  - distortion of the membrane



A chemically gated Na^+ channel that opens in response to the presence of ACh at a binding site.

All-or-None Principle

- A stimulus will either trigger an action potential or it won't
- If the strength of the stimulus exceeds threshold it will not affect the membrane response; it will be the same

PNS Response to Injury

- Schwann Cells
- Wallerian Degeneration
  - axon disintegrates & is phagocytized by nearby macrophages
  - Schwann cells remain cement together
  - Recovering neuron’s axon can grow into the Schwann cells

CNS Response to Injury

- Very limited and more complicated than PNS
  - most likely there will be more axons involved
  - astrocytes are known to produce scar tissue, preventing regrowth
  - astrocytes also release chemicals that prevent axonal regrowth