# Module 5: Methods of Communication in the Brain

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# Methods of Communication

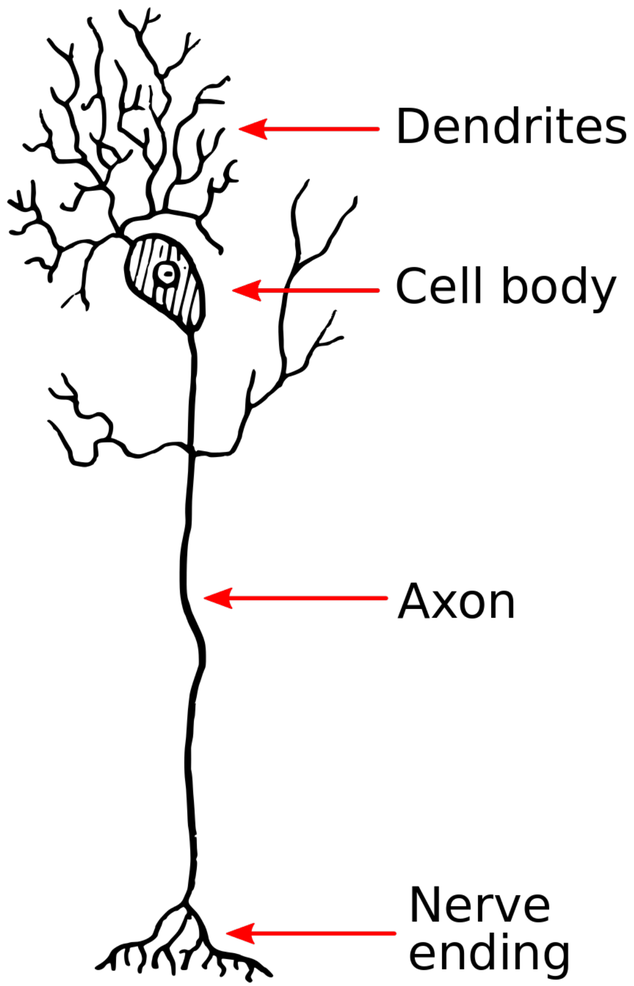
Neurons form the fundamental processing unit of the brain

Reticular theory (Golgi):

- Neurons form a continuous reticular net and are continuously connected.

Neuron doctrine (Cajal):

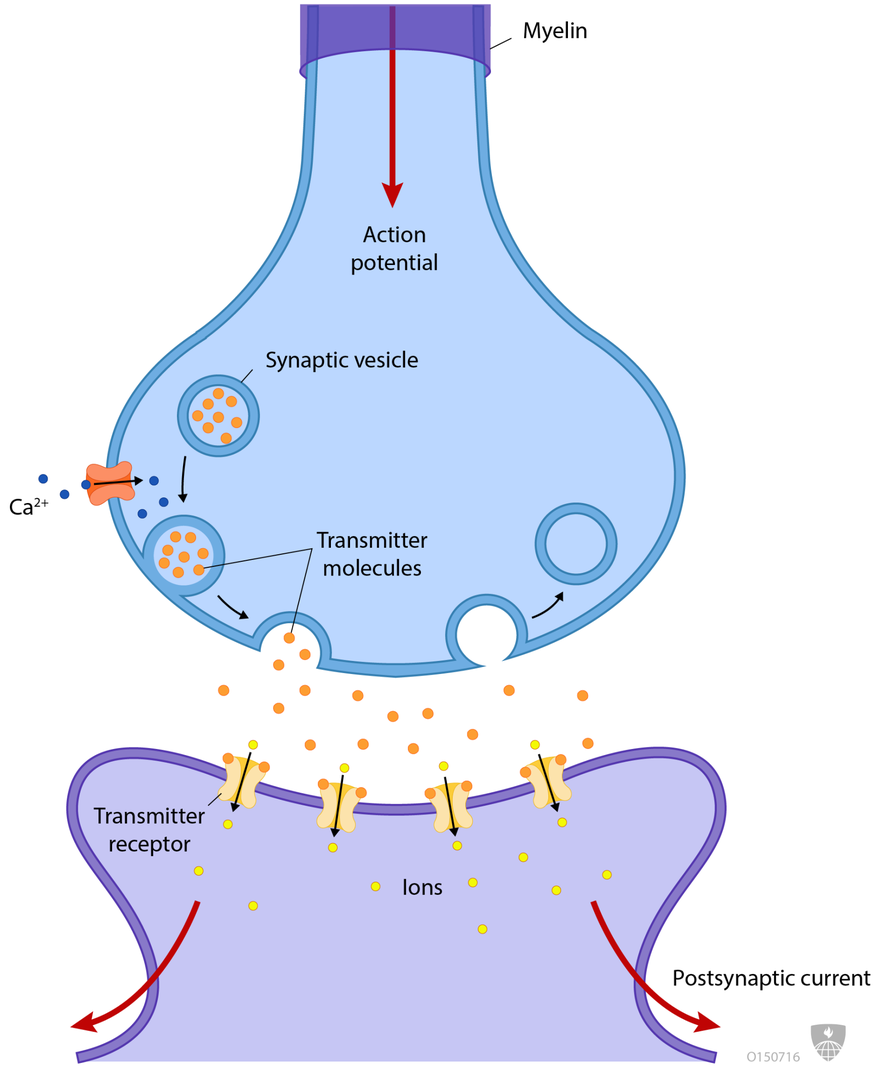
- Neurons are structurally independent units that interact by contiguity and not by continuity



# Methods of Communication

Neurons:

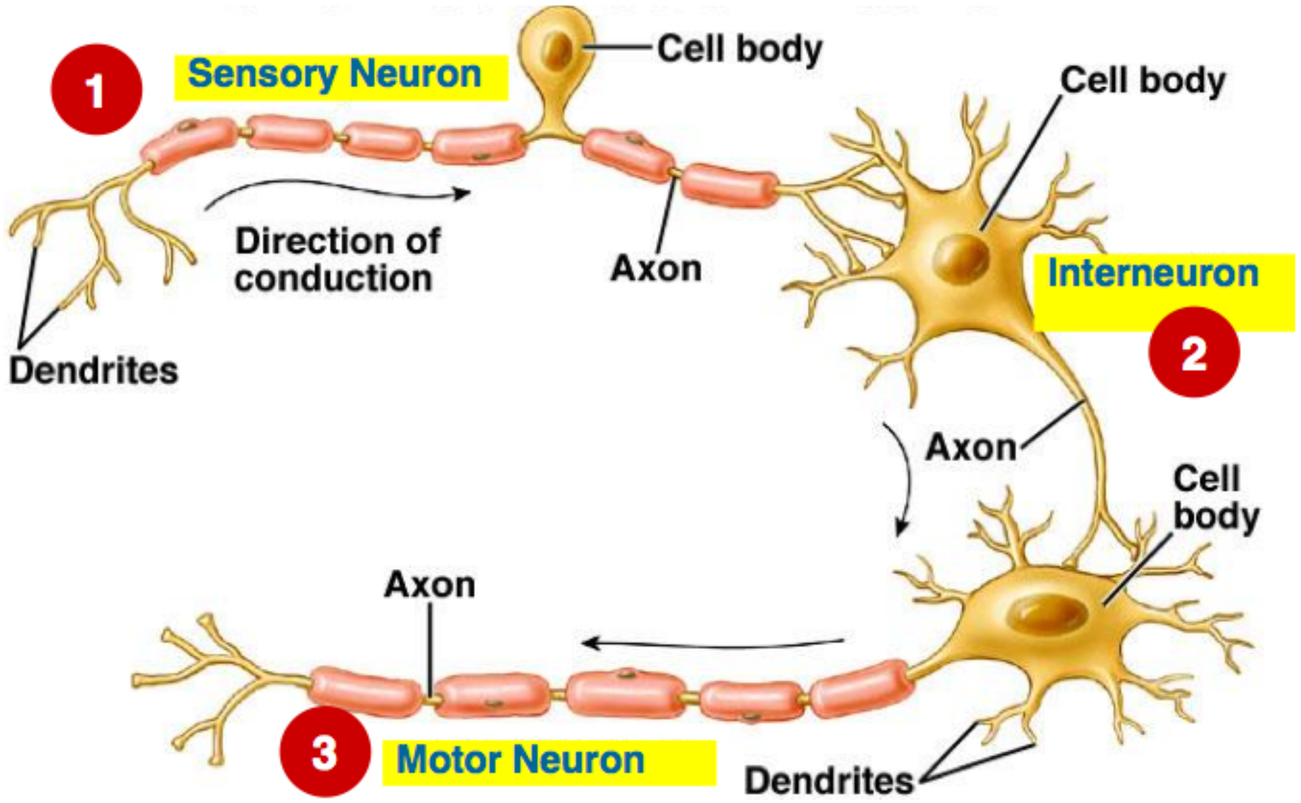
- Receive, process information
- Transmits information both chemically and electrically
- Pass information to downstream neurons
- Form neural networks that collectively support brain function



# Methods of Communication

Three types of neurons:

- Sensory neuron - convert external stimuli into electrical signals
- Interneuron - process and relay information
- Motor neuron - convert electrical signals into muscle or gland movement



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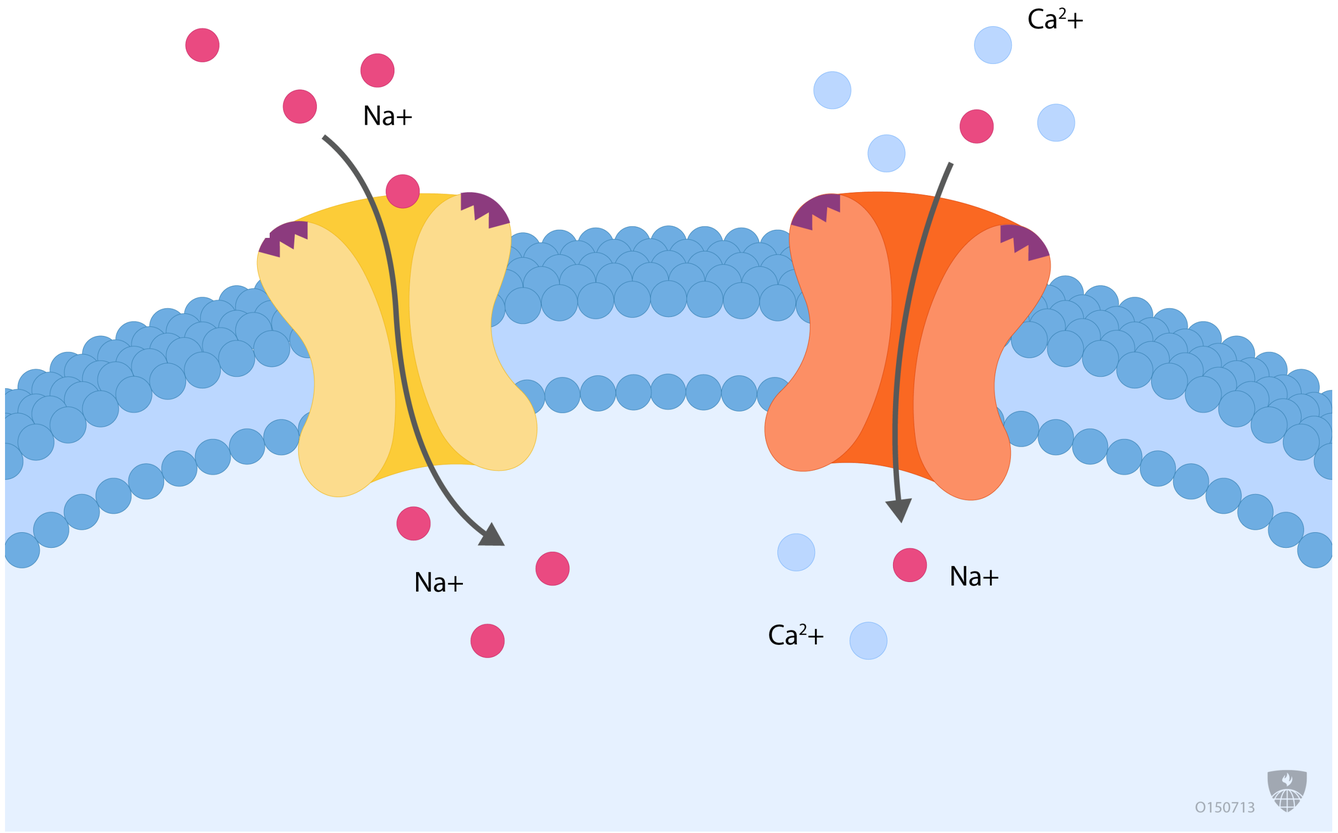
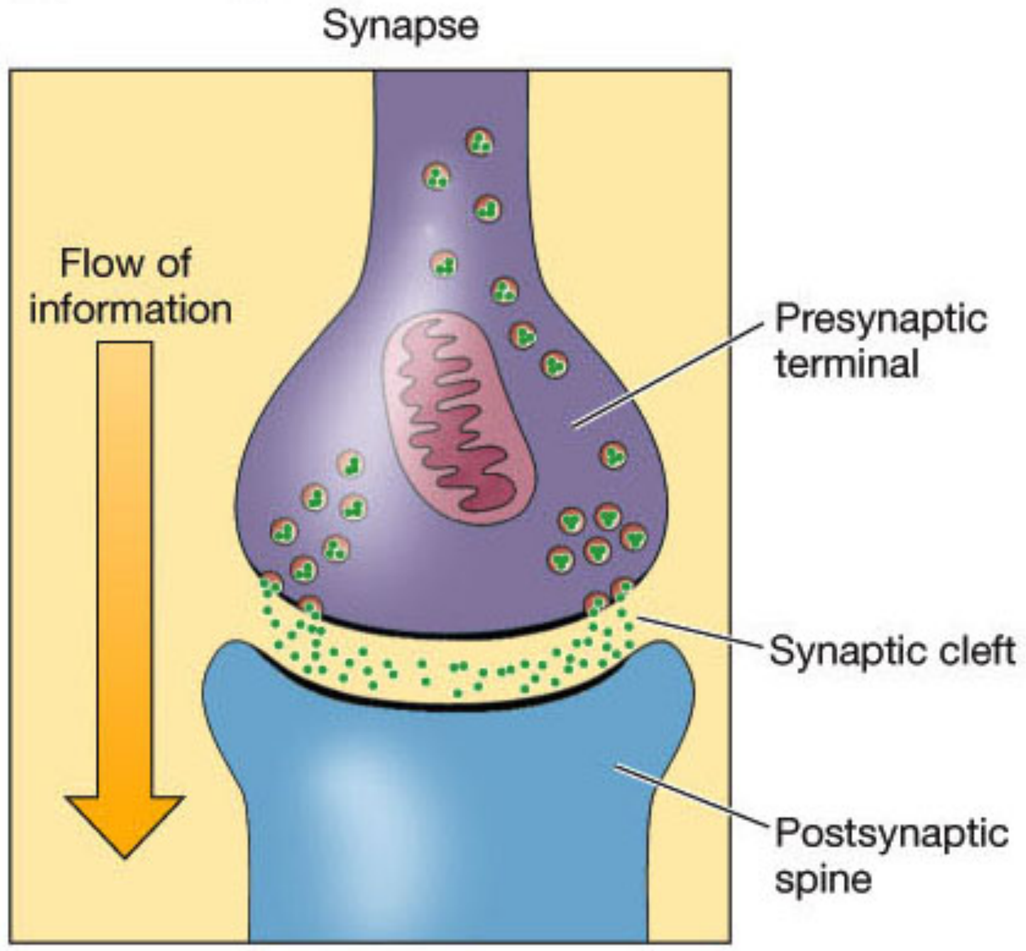
- Ion channels and ion pumps establish a difference in concentration of sodium, potassium, chloride and calcium within the cell versus outside the cell
- This establishes an electrical charge or a resting state potential in the neuron



# Methods of Communication

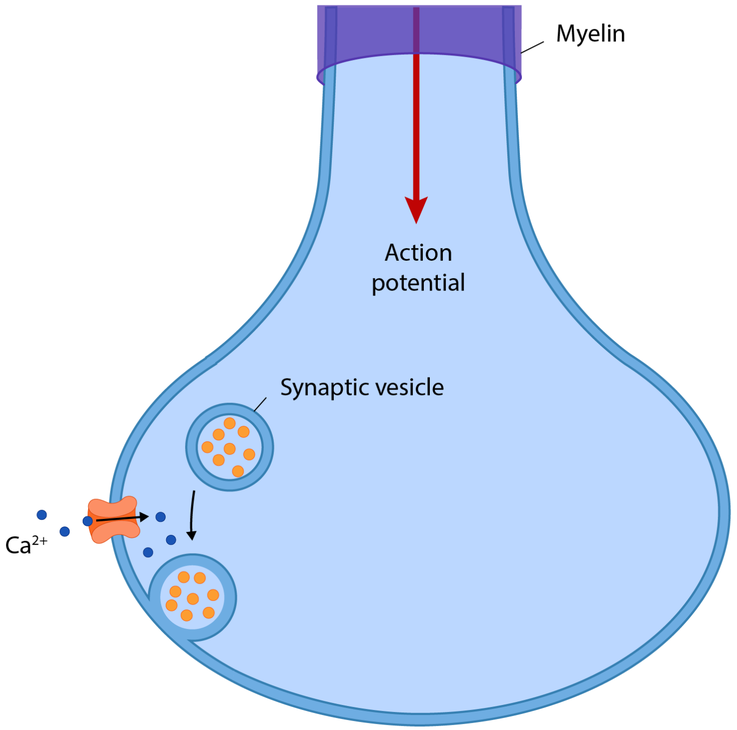
- Axonal nerve endings form synapses with dendrites of adjoining neurons.
- The synapse forms the site where an electrical or chemical signal is transferred from one neuron to another.
- Synapses form the primary site of interneuronal communication

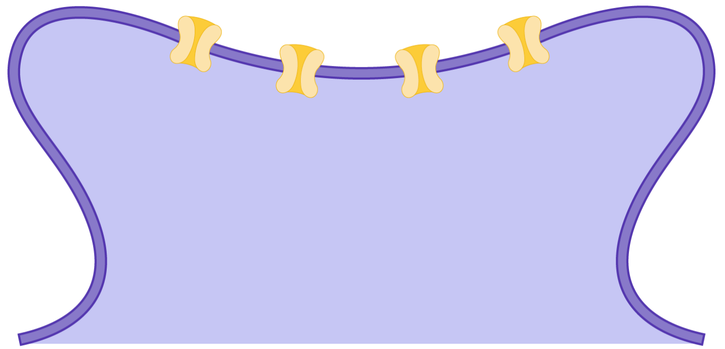


# Methods of Communication

Synaptic transmission:

1. An influx of calcium through ion channels causes available synaptic vesicles to fuse with the pre-synaptic membrane

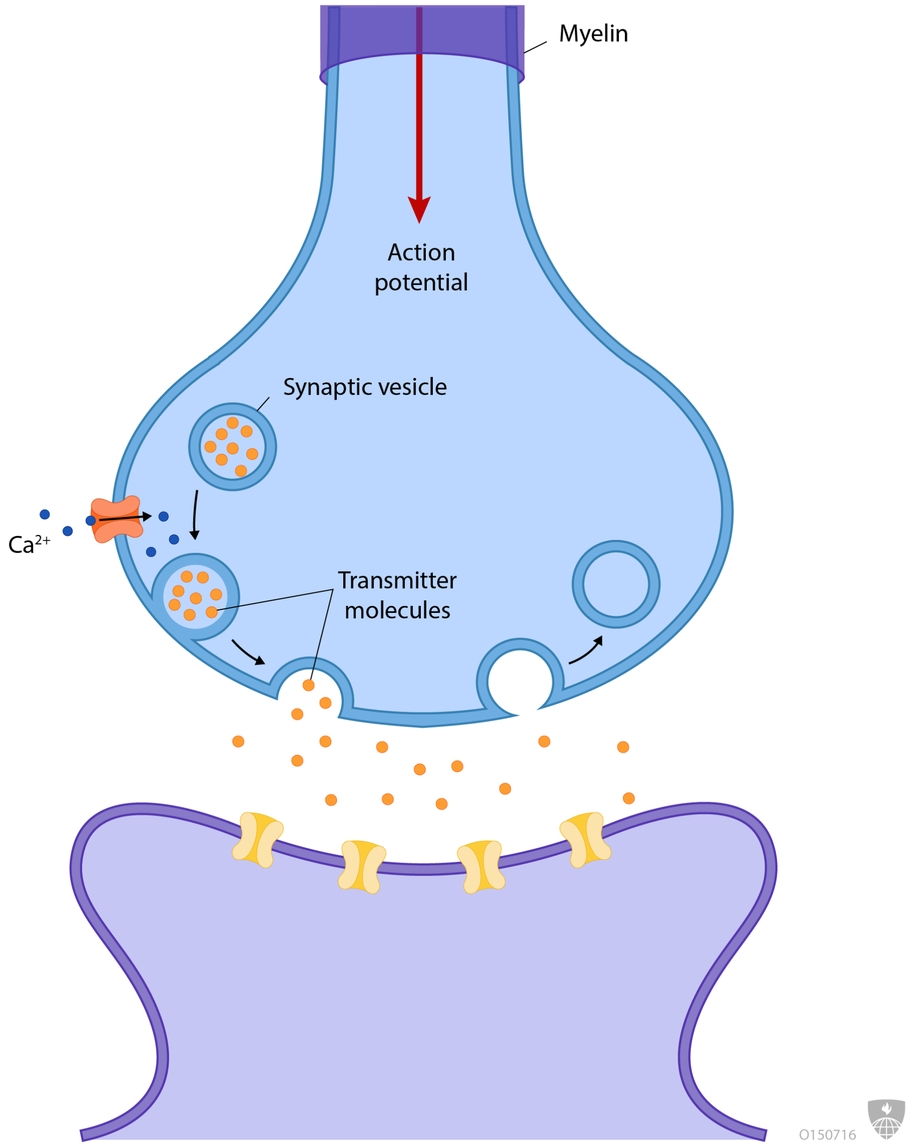


# Methods of Communication

Synaptic transmission:

2. Transmitter is released into the synaptic cleft

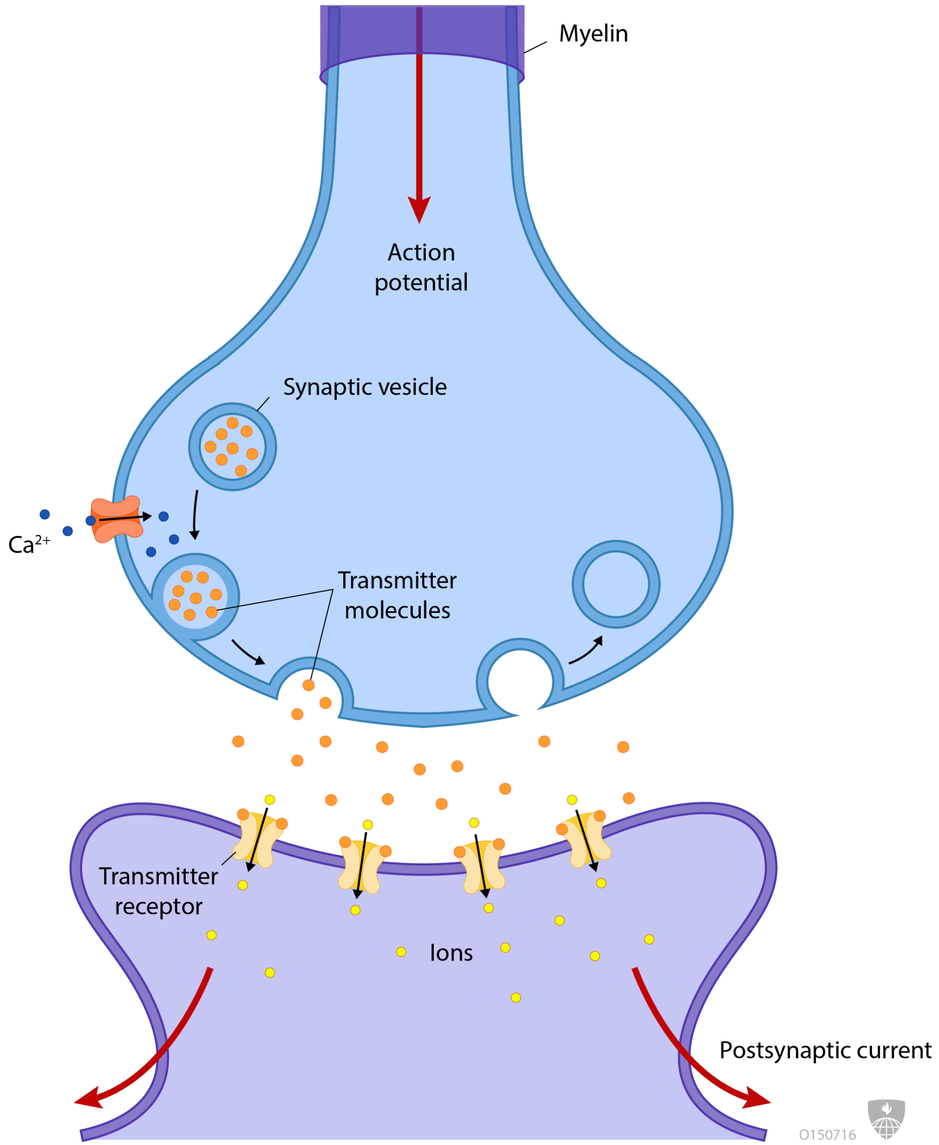


# Methods of Communication

Synaptic transmission:

3. Transmitter binds receptor molecules on the post-synaptic membrane

4. Post-synaptic channels either open or close based on this binding

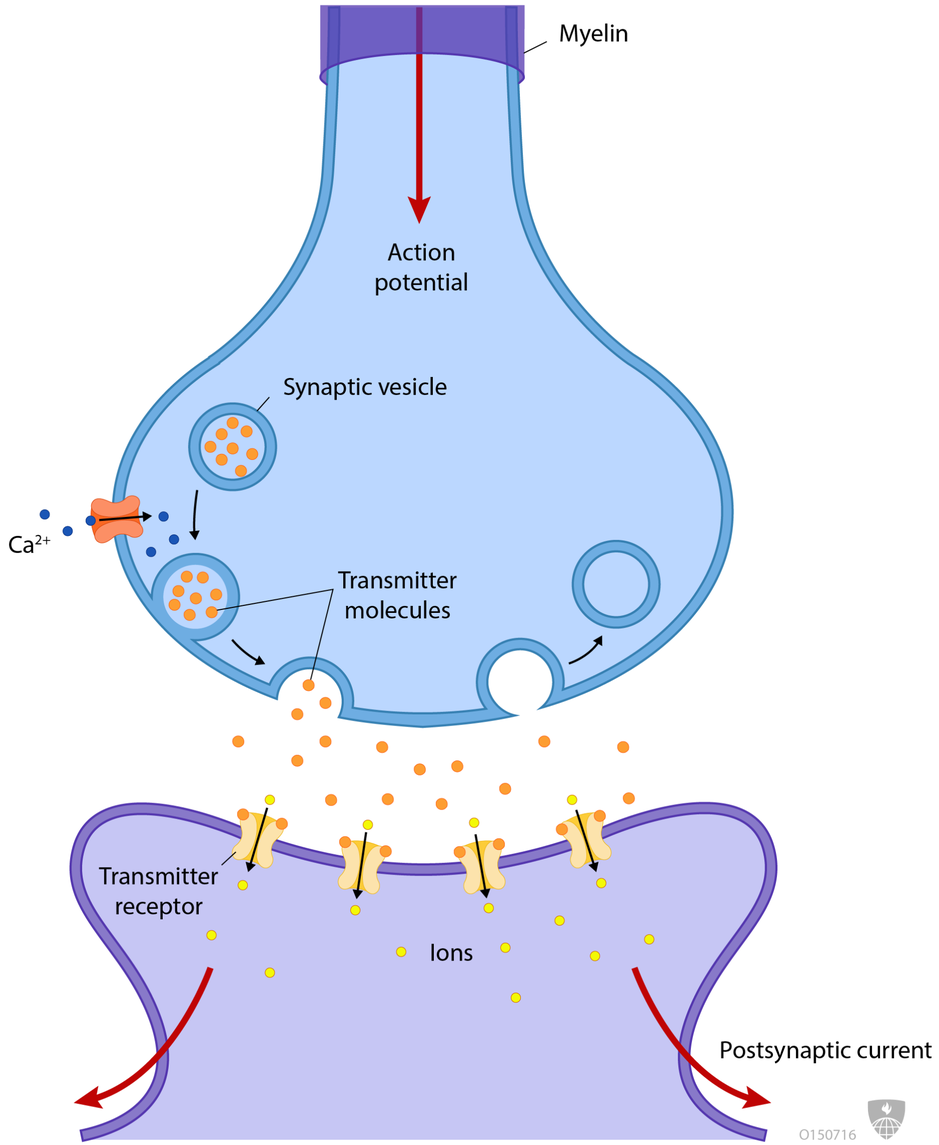


# Methods of Communication

Synaptic transmission:

5. The opening of ion channels causes either an influx of ions in to the post-synaptic neuron

6. Change in balance of post-synaptic ions causes the post-synaptic to depolarize or hyper polarize

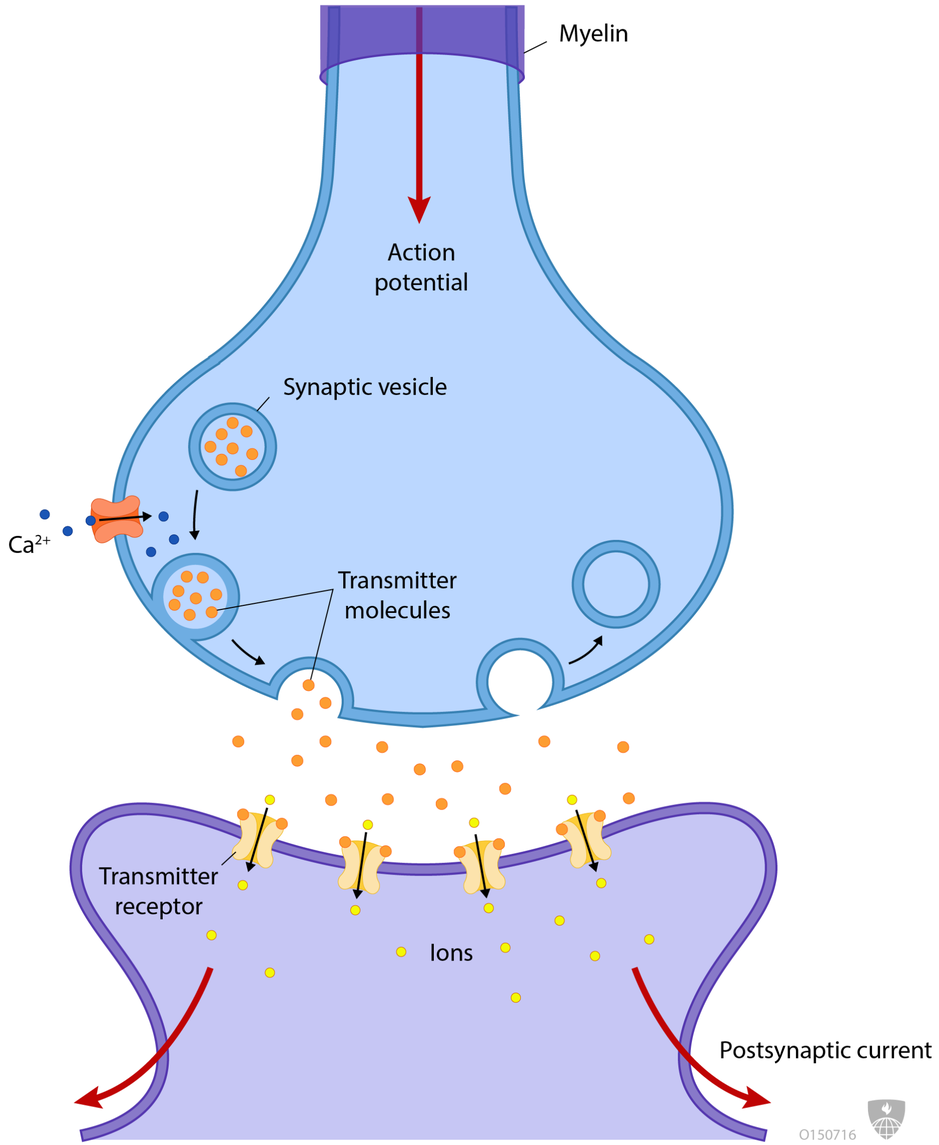


# Methods of Communication

Synaptic transmission:

7. If the post-synaptic voltage changes are large enough an electrochemical pulse is generated called an action potential

8. The electrical action potential travels rapidly along the axon where it can activate synaptic vesicle release in synapses with other neurons



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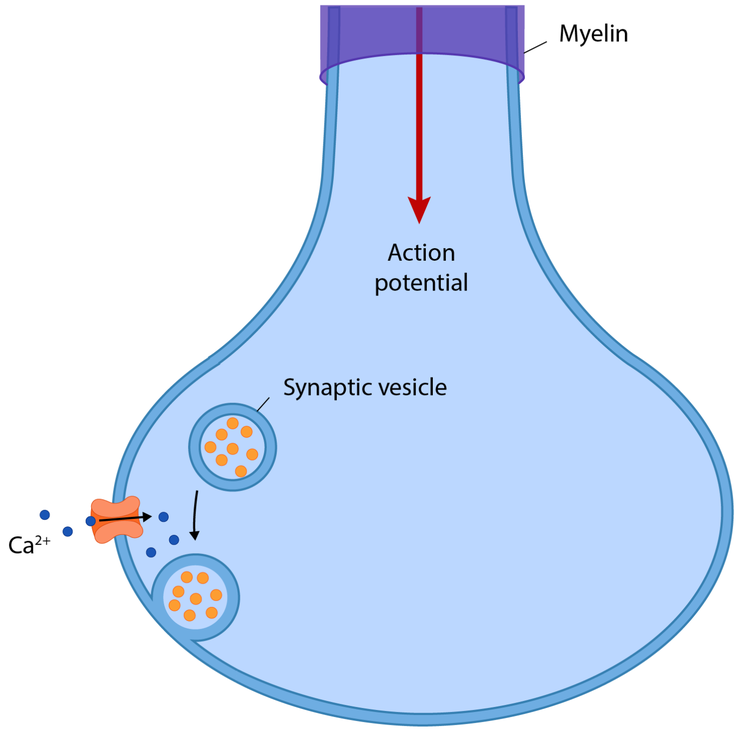
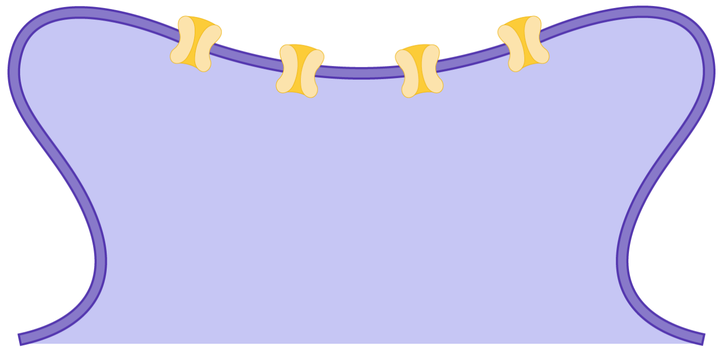
Synaptic transmission:

9. Simultaneously the used synaptic vesicle is retrieved from the membrane and recycled

10. New transmitter is synthesized by the cell's metabolic apparatus and stored in vesicles for future synaptic transmission

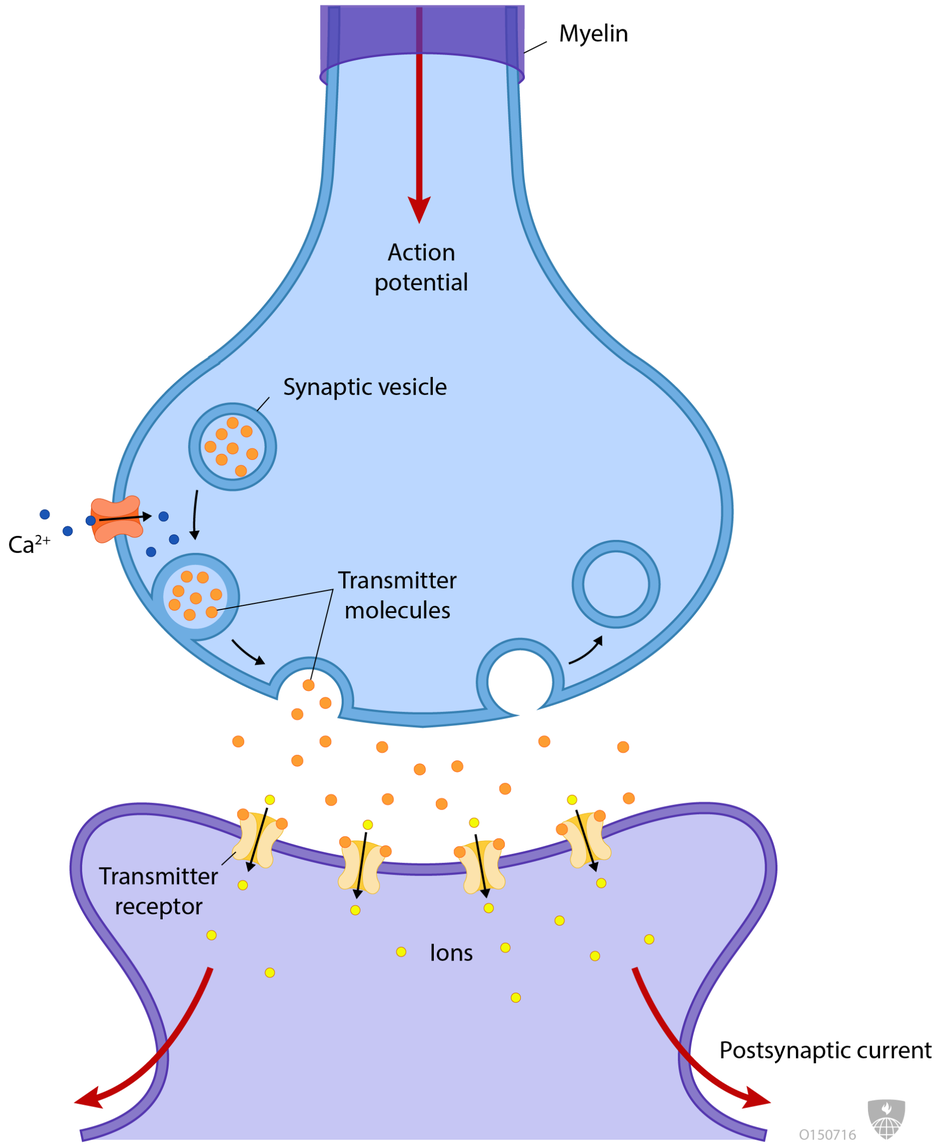


# Methods of Communication

Post-synaptic stimulation changes the excitability of the post-synaptic cell:

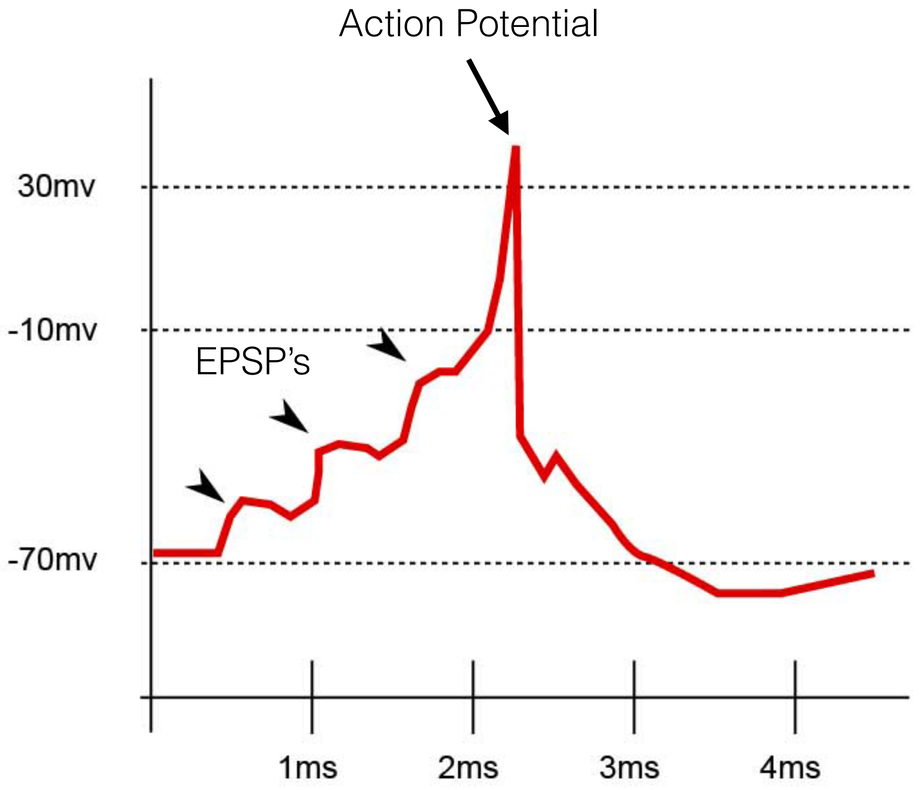
- Excitatory - depolarizes the membrane potential and making it easier to reach action potential threshold
- Inhibitory - hyper polarizes the membrane potential and making it harder to reach the action potential threshold



# Methods of Communication

Excitatory post-synaptic potential (EPSP):

- Single EPSPs do not always cause a post-synaptic action potential
- Neurons form many synapses with adjoining cells
- Summation of EPSP's is often necessary to generate an action potential



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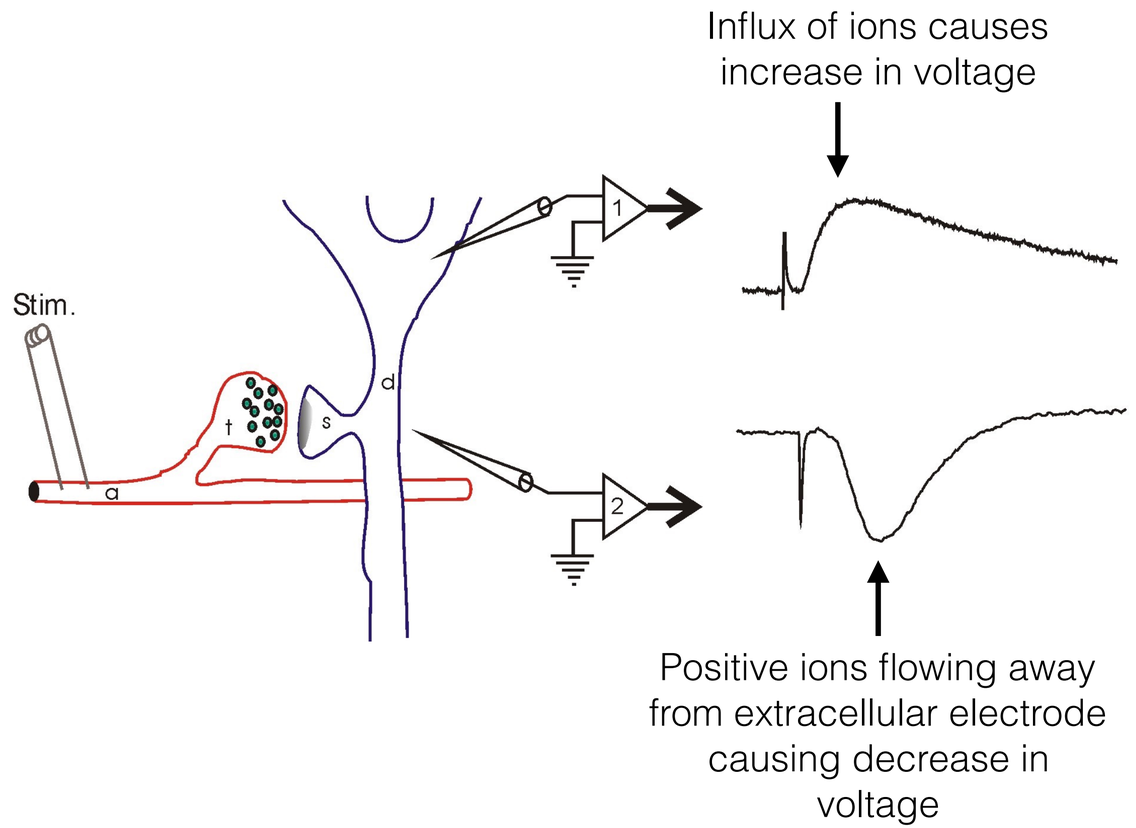
Excitatory post-synaptic potential (EPSP):

- Can be recorded by placement of electrode:
    1. Inside neuron
    2. Outside neuron



# Methods of Communication

Local Field Potential (LFP):

- Neurons are densely packages and highly interconnected
- Extracellular electrode cannot assess which neuron is causing voltage change
- Extracellular recordings thus measure activity of local neuronal environment