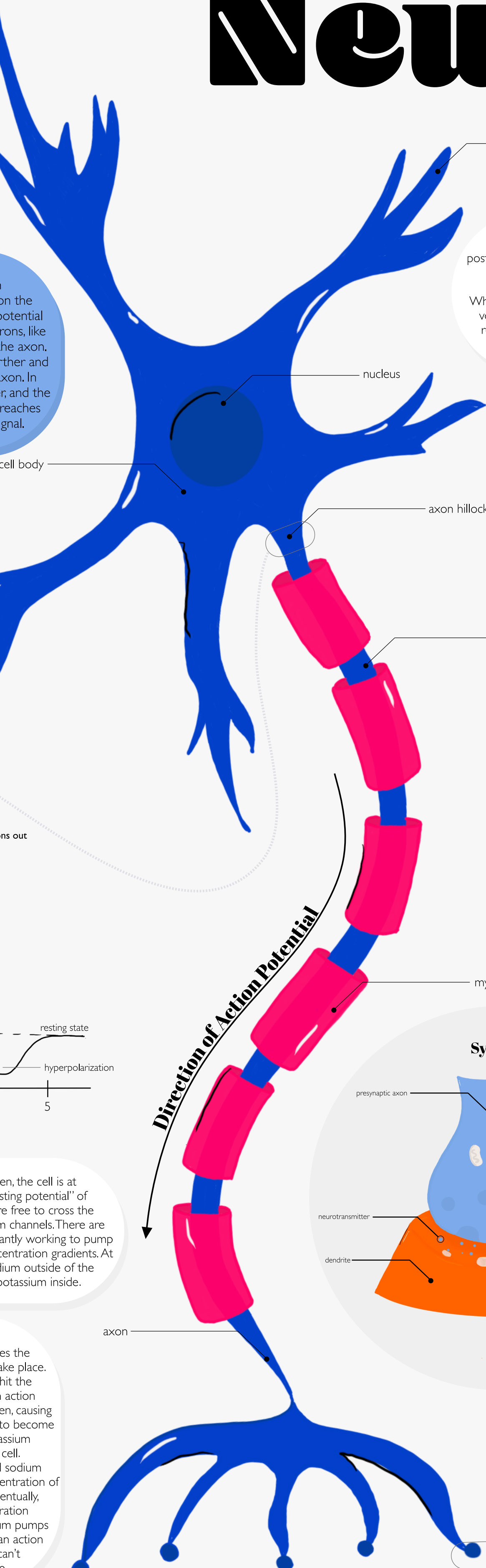
Neurons

This is an illustration of a neuron. The neuron receives signals through its dendrites. Depending on the signal, it may trigger an action potential. This action potential propagates down the axon of the neuron. Some neurons, like this one, have myelin sheaths, which help to insulate the axon. Myelin sheaths help the action potential propagate farther and faster by increasing the cross sectional area of the axon. In between the myelin sheaths are the Nodes of Ranvier, and the potential jumps from node to node and eventually reaches the axon terminal, where it can trigger another signal.



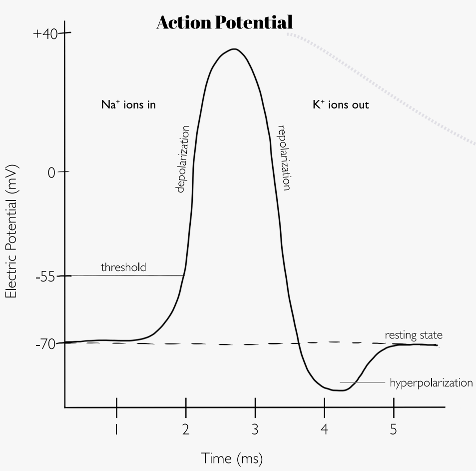
A synapse is where a postsynaptic neuron releases neurotransmitters (a type of chemical signal to act on the postsynaptic target cells). Most of the signals between neurons are chemical, but they can also be electric.

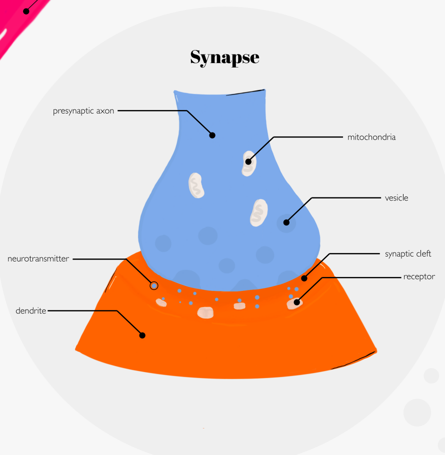
When the action potential arrives at the axon terminal, this opens voltage-gated Ca^{2+} channels. The concentration of Ca^{2+} is kept relatively low inside the cell, so when the channels open, Ca^{2+} rushes inside and causes a fusion of the vesicles to the membrane.

The vesicles fuse with the membrane through the SNARE complexes and cause the release of the neurotransmitters into the synaptic cleft. Those chemical signals then bind to the receptors on the postsynaptic membrane.

If the binding of the neurotransmitter causes depolarization, meaning the postsynaptic neuron becomes less negative inside, then it is an excitatory synapse. If the postsynaptic neuron becomes more negative inside and the chemical signal causes hyperpolarization, it is an inhibitory synapse.

The v-snares (vesicle snares) associate with the t-snares (target snares) in the membrane. Once the vesicles have formed a stable interaction, the vesicle fuses with the membrane and releases its contents into the synaptic cleft.





When an action potential is not happen, the cell is at rest, and so the cell membrane has a "resting potential" of around -70mV. At rest, potassium ions are free to cross the membrane through the non-gated potassium channels. There are also sodium-potassium pumps that are constantly working to pump sodium and potassium ions against their concentration gradients. At rest there is a higher concentration of sodium outside of the neuron and a higher concentration of potassium inside.

During an action potential, there is a spike or an impulse that depolarizes the membrane. If it depolarizes the neuron enough (~-55mV), then an action potential will take place. If the spike doesn't depolarize the neuron enough to hit the threshold, then no action potential will occur. When an action potential happens, first the gated sodium channels will open, causing sodium ions to flood into the cell. This causes the neuron to become even more depolarized. A little bit after, the gated potassium channels open, letting potassium ions go out of the cell. This allows for repolarization of the cell, while the gated sodium channels close. There is an overshoot, caused by a low concentration of potassium inside the cell, causing a hyperpolarization. Eventually, after the gated potassium channels close, the concentration goes back to normal with the help of the sodium potassium pumps and the non-gated potassium channels. However, after an action potential, the cell has a refractory period, where it can't have another action potential for a period of time.