Neurotransmitters

by Sophia

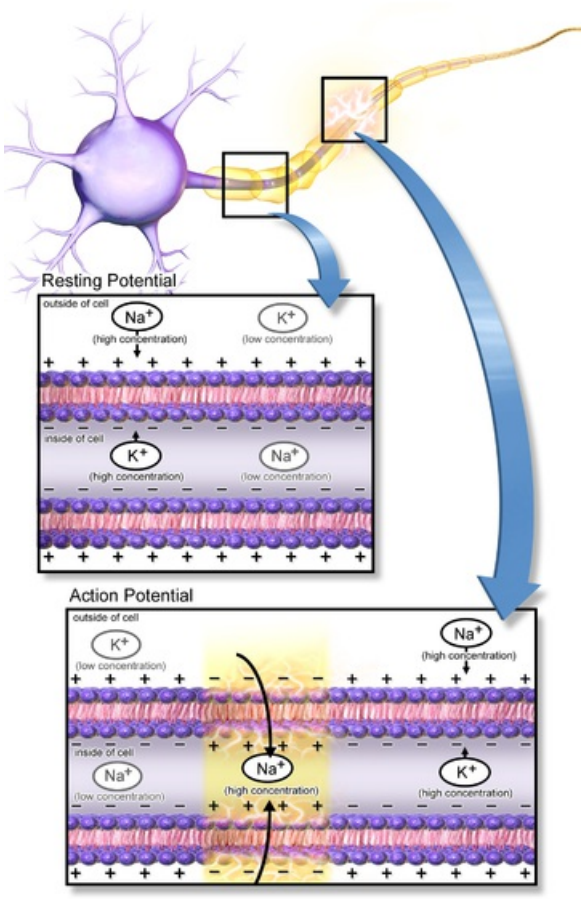
WHAT'S COVERED

In this lesson, you will learn about the role of neurotransmitters in relaying signals throughout the nervous system. Specifically, this lesson will cover:

1. How Neurons Communicate

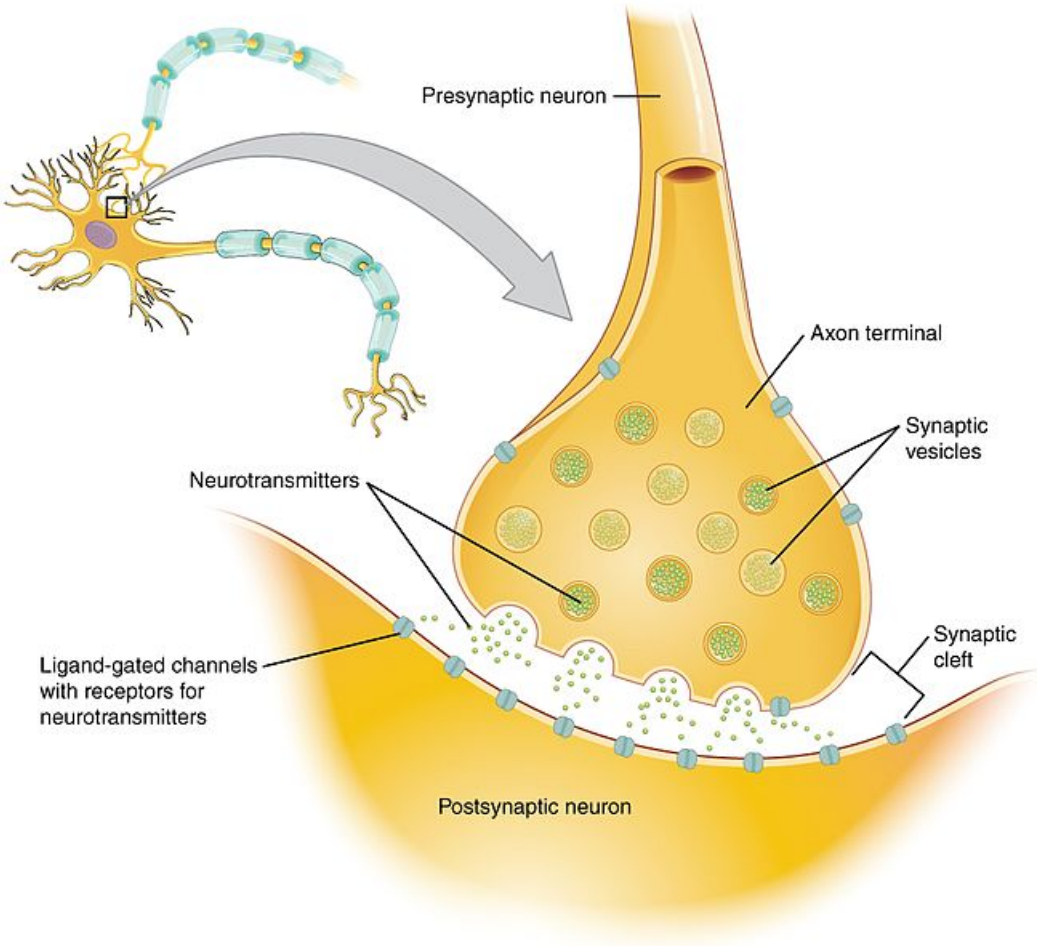
Neurons communicate with other neurons, muscle fibers and glands, and they communicate with all these different tissues in pretty much the same way. Let's take a motor neuron communicating with a muscle fiber as an example.

Neurons are long and communication among them has to be fast; think about how quickly you go from the decision to raise your hand to the action itself. What's the fastest way to send a signal along the long nerve cell? Electricity. (This is about how fast a light bulb glows after you flip the switch.)



An **action potential** is the electrical impulse that travels along a neuron. Cells maintain an electrochemical gradient inside the cell membrane. They have a slight negative charge (voltage potential) inside, so positive charge hovers just outside the plasma membrane because it is attracted to what's on the other side of that selectively permeable barrier. When the neuron needs to relay a signal, channels embedded in the plasma membrane open, and the charges are reversed within a short section of the cell. Now there's a negative charge outside the cell that flows along the cell's length.

The action potential reaches the ends of the neuron; in the motor neuron example, that's the neuromuscular junction (a neuromuscular junction is the area where a neuron and a muscle fiber come close to one another). The neurotransmitters will then diffuse across a gap known as a synapse.



Remember, the **neurotransmitters** are the chemical form of whatever signal is being carried. These neurotransmitters are stored in vesicles inside the **presynaptic cell** (the cell before the synapse that stores neurotransmitters for release)—in our example, the motor neuron. When the action potential reaches these vesicles, they fuse with the plasma membrane, are secreted outside the cell, and diffuse across the **synapse** (the gap between the presynaptic and postsynaptic cells). When the neurotransmitters reach the **postsynaptic cell** (in this example, the muscle fiber), they will bind to receptors (special proteins in the plasma membrane that act as locks to a specific neurotransmitter "key"). These receptors will then convey the signal within the postsynaptic cell.

TERMS TO KNOW

Action Potential

A nerve impulse.

Neurotransmitter

The chemical form of a signal that is sent between neurons and muscle cells, gland cells or other neurons.

Presynaptic Cell

The cell at a synapse that stores a neurotransmitter for release.

Synapse

The gap between a neuron and a gland cell, muscle cell, and another neuron.

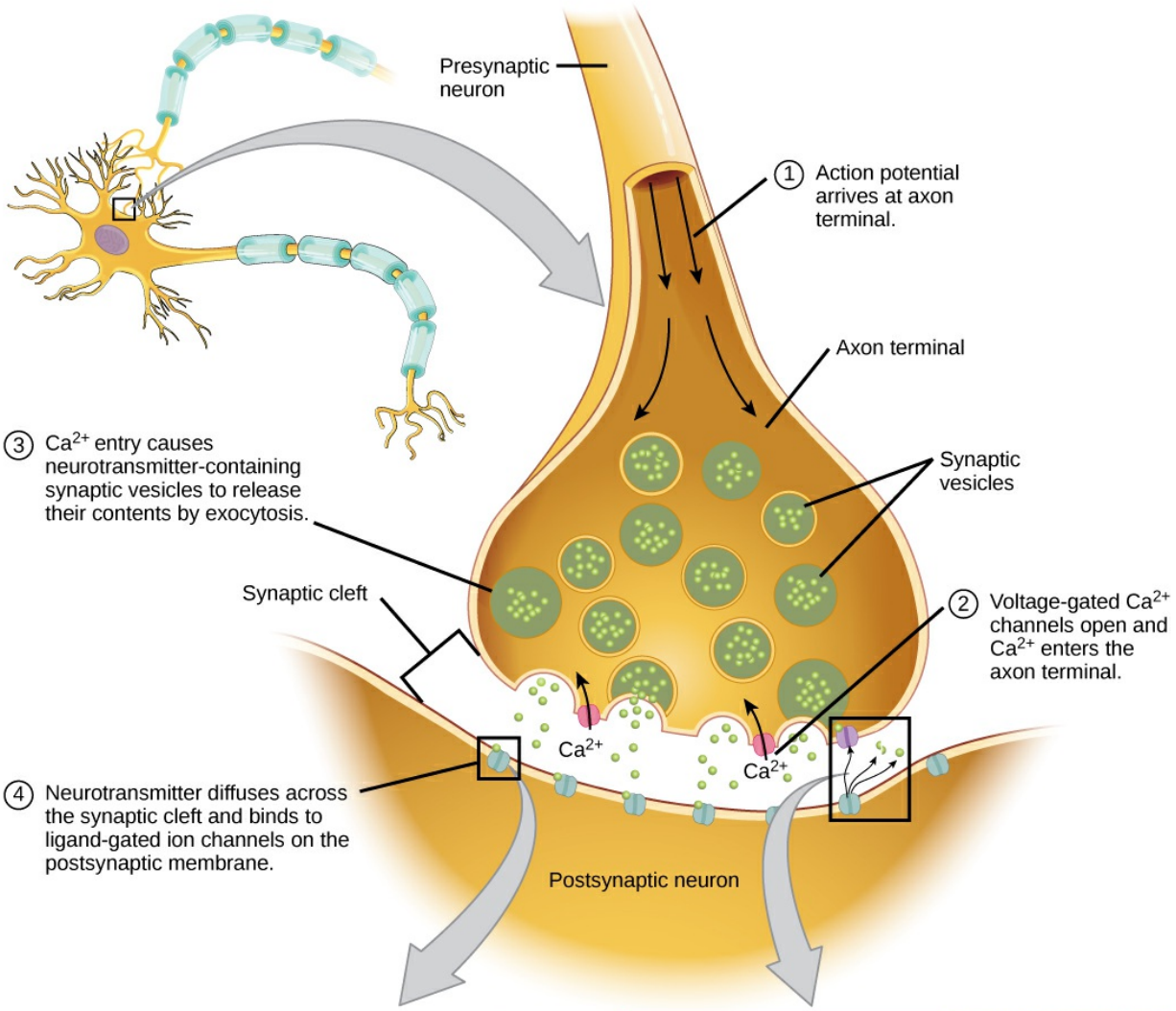
Postsynaptic Cell

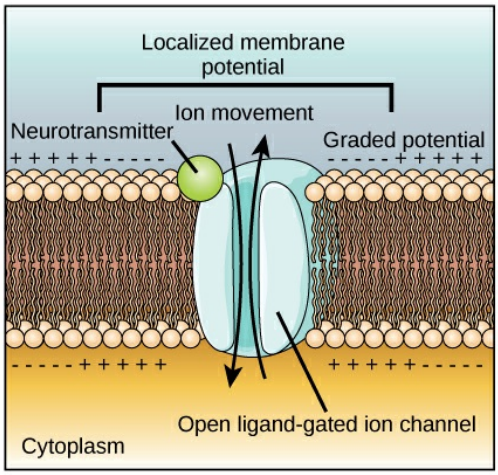
The cell at a synapse to which the neurotransmitter binds.

2. Exciting & Inhibiting Activity

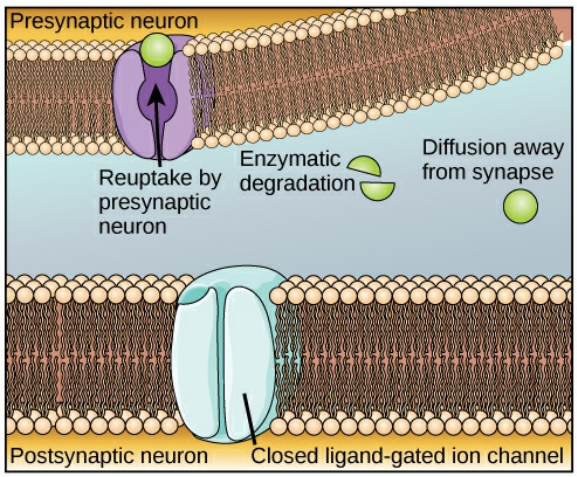
Neurotransmitters can either excite or inhibit activity in a target cell. Whether they excite or inhibit is determined by the amount of the neurotransmitter, the type of the receptor, and other factors. **Exciting signals** will drive a membrane toward an action potential, while **inhibiting signals** will do the opposite.

Take a look at a diagram here so you can understand this a little bit more in detail.





5 Binding of neurotransmitter opens ligand-gated ion channels, resulting in graded potentials.



6 Reuptake by the presynapic neuron, enzymatic degradation, and diffusion reduce neurotransmitter levels, terminating the signal.

The picture above shows a motor neuron. The action potential will travel along that long motor neuron cell.

Then you have your synaptic vesicle. These synaptic vesicles are what contain neurotransmitters. The line is your muscle fiber. Above the muscle fiber line is the presynaptic cell and below the muscle fiber line is the postsynaptic cell. The gap between them is the synapse.

The neurotransmitter is going to carry information from the presynaptic cell across the synapse to the postsynaptic cell, which is the muscle fiber in this example. You also have the plasma membrane of this muscle fiber and these proteins that are embedded in the plasma membrane. On those proteins, you have this binding site for neurotransmitters.

In the example in the picture, when the binding site is empty, the ion channels are closed. But when a neurotransmitter binds to the binding site, it causes that ion channel to open, allowing the ions to flow through the plasma membrane and then allow for an action potential to occur. This is an example of an exciting signal.

TERMS TO KNOW

Exciting Signals

Signals that trigger an action potential.

Inhibiting Signals

Neurotransmitters that inhibit or prevent action potentials.

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3. Botox

Botox is a type of injection that people get to smooth out facial wrinkles that are actually made from a bacterium.

What it does is block the release of acetylcholine so that the muscle contractions that produce wrinkles will stop temporarily. So people get this in order to stop or slow down facial wrinkles.

Also, acetylcholine is a type of neurotransmitter.

TERM TO KNOW

Botox

A bacterial toxin that is often used to smooth facial wrinkles by stopping the release of the neurotransmitter acetylcholine; technically, it's not an inhibiting signal; it stops the signal from being sent, rather than sending a signal that tells a neuron not to have an action potential.

SUMMARY

This lesson has been an overview of neurotransmitters. Specifically, you learned about **how neurons communicate** and that neurotransmitters can either **excite or inhibit activity** in a target cell. Finally, you learned about **botox** and the neurotransmitter acetylcholine.

Keep up the learning and have a great day!

Source: THIS WORK IS ADAPTED FROM SOPHIA AUTHOR AMANDA SODERLIND

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TERMS TO KNOW

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A nerve impulse.

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A bacterial toxin that is often used to smooth facial wrinkles by stopping the release of the neurotransmitter acetylcholine.

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Inhibiting Signals
Neurotransmitters that inhibit or prevent action potentials.

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Postsynaptic Cell
The cell at a synapse to which the neurotransmitter binds.

Presynaptic Cell
The cell at a synapse that stores a neurotransmitter for release.

Synapse
The gap between a neuron and a gland cell, muscle cell and another neuron.