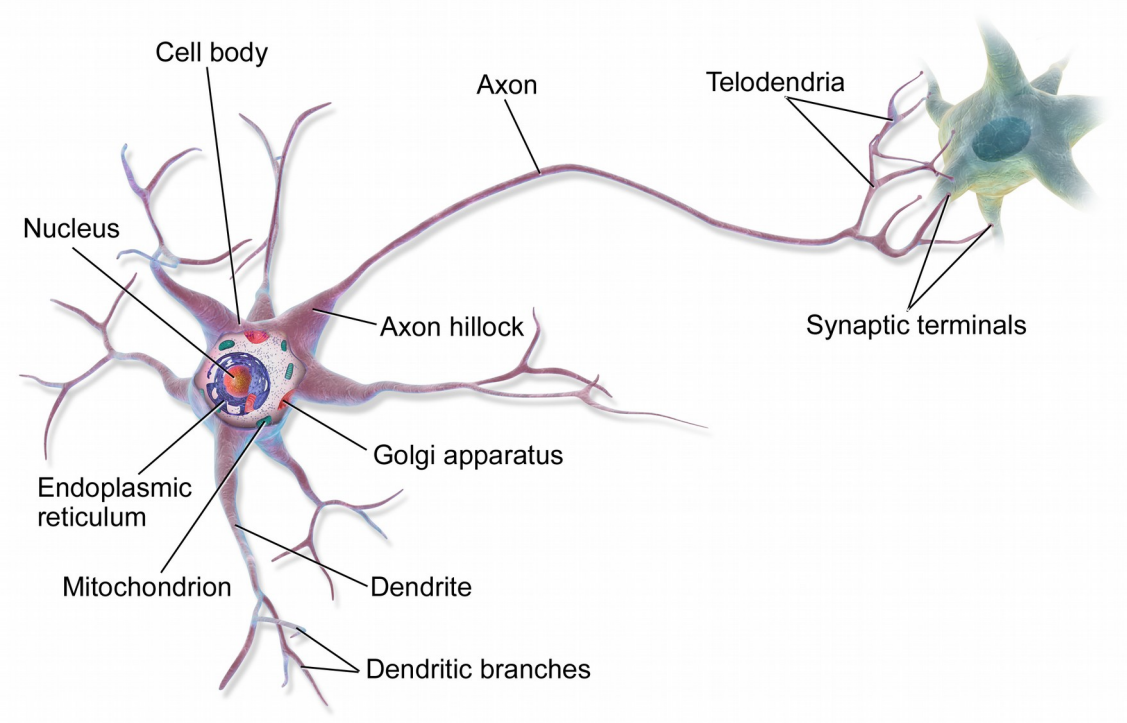
The nervous system.

It is a network of nervous tissue that communicates different parts of the body by means of nerve impulses.

1. Neurons.

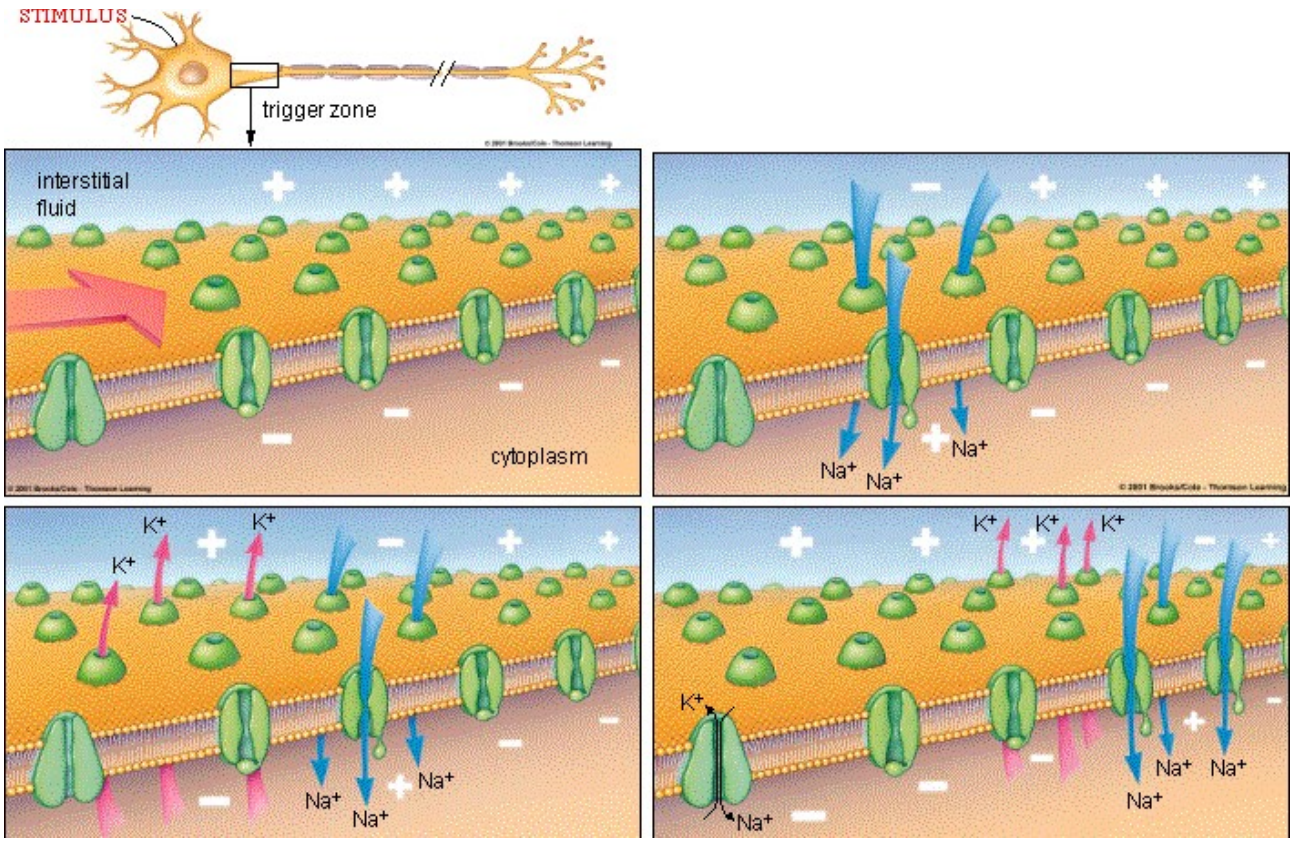
The nervous system is composed of neurons, which are specialized cells that can establish communication links among themselves and transmit impulses.



Neurons have a very characteristic shape: besides the main cell body, which contains the nucleus and most of the cytoplasm, they have protrusions in the shape of a tree called “dendrites”. One of said protrusion is especially long, called the axon.
The membrane of the neuron has a special composition, and in it there are enzymes that pump certain ions inside the cell and others outside the cell. The membrane is also specially impermeable to ions but has “gates” to allow said ions to pass through under certain circumstances.

The neuron is connected to other neurons or to other cells through the dendrites or the axon, that is, each dendrite can be connected to another's cell dendrite or axon and the axon of a neuron can be connected to either another neuron or other type of cell. The conjunction between two neurons or between one neuron and another cell is called synapse.
Neurons send information to other neurons through the axon and receive information through the dendrites.

The nerve impulse is the phenomenon that carries the information through the axon. It entails four phenomena: membrane polarization, initial discharge, depolarization propagation and restoration.

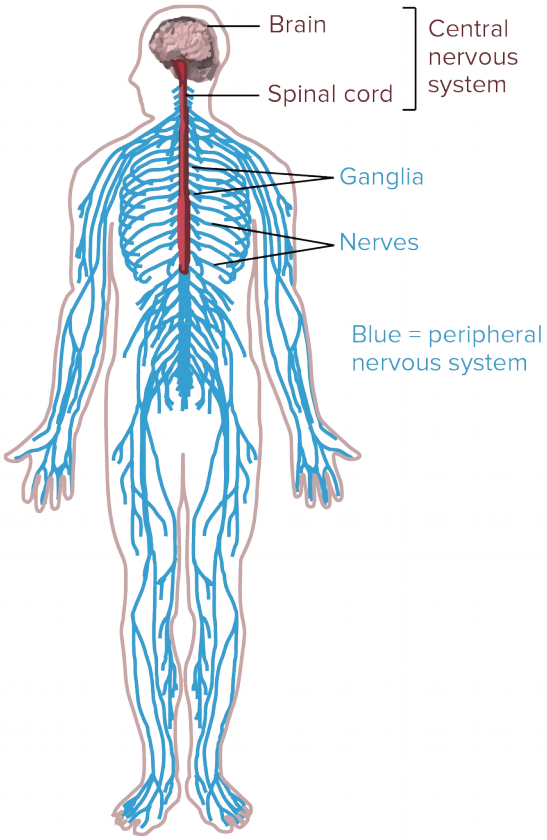


Before the neuron sends the impulse, the enzymes in the membrane of the axon are continually pumping potassium ions (K^+) from outside to inside the cell (this means that, if the “gates” are open, a lot of potassium will want to get out) and sodium ion (Na^+) from inside to outside the cell (which means that if the “gates” open, a lot of sodium will want to come back in).
We say that when the neuron is in this state it is “polarized”.
The key is that the “gates” that we have mentioned earlier, they open if they feel that the adjacent gate is also open (it is the sudden rush of ions going in and out in the adjacent gate that makes them open), so when the cell needs to send an impulse, all it has to do is cause a sudden rush of ions at the stem of the axon. That will trigger the opening of the nearby ion gates and this “opening” will propagate all along the axon.
The gate will automatically close after a short while (when the impulse has passed) and remain closed enough time for the ion pumps to pump again all the potassium in and the sodium out and restore the “polarized” state.

We could imagine that the axon is a long domino line in which each ion gate is a tile, but with the added advantage that these tiles stand up by themselves after the impulse has passed.

2. The central nervous system.

Humans have a large mass of nerve tissue (neurons) inside the cranium that is called central nervous system, although there is also a large nerve going through the vertebral column called the spinal cord. This spinal cord is also considered part of the central nervous system.

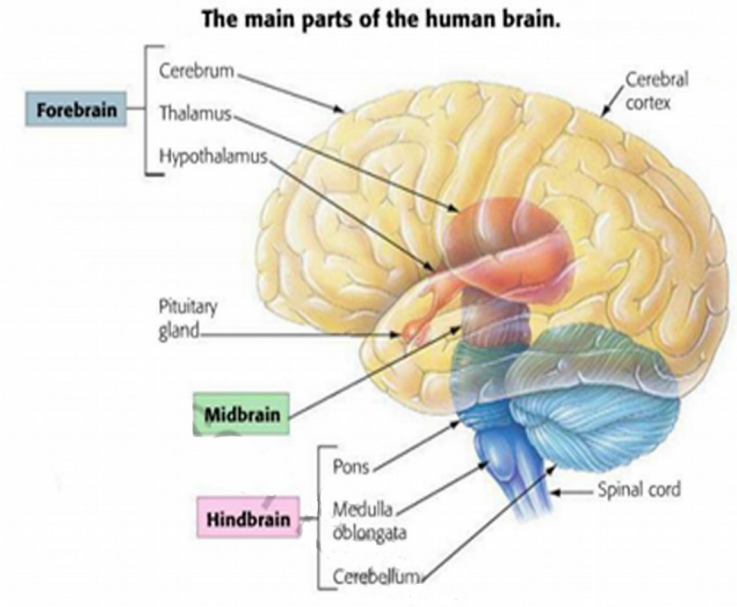


- The brain.

The aforesaid mass of nerve tissue that resides inside the cranium is called the brain, and it is divided into more than 10 parts, although we will only mention a few of them.

· The cerebrum is the most prominent part of the brain, with its characteristic wrinkled shape and large size, it is the part of the brain used for (for want of a better word) thinking.

It is divided into two hemispheres, the right and the left hemispheres, which are connected by the corpus callosum. Each hemisphere is itself divided into four lobes. Different hemispheres handle impulses from different sides of the body, for example the control of the right arm and leg is done by the left hemisphere, which handles also the sensory information they send. However, other senses such as hearing don't cross hemispheres (that is, the information from the left ear goes to the left hemisphere. In the case of the optic nerves they get even weirder.



· The hypothalamus is a small part of the brain that resides roughly below its center. It regulates sleep cycles, eating cycles and releases hormones. It has close connection with the pituitary gland, being capable to stimulate it to release or not release certain hormones.

· The medulla oblongata is a part of the brain located in the stem of the spinal cord. It regulates involuntary actions such as breathing and heart beat, as well as vomiting and blood pressure.

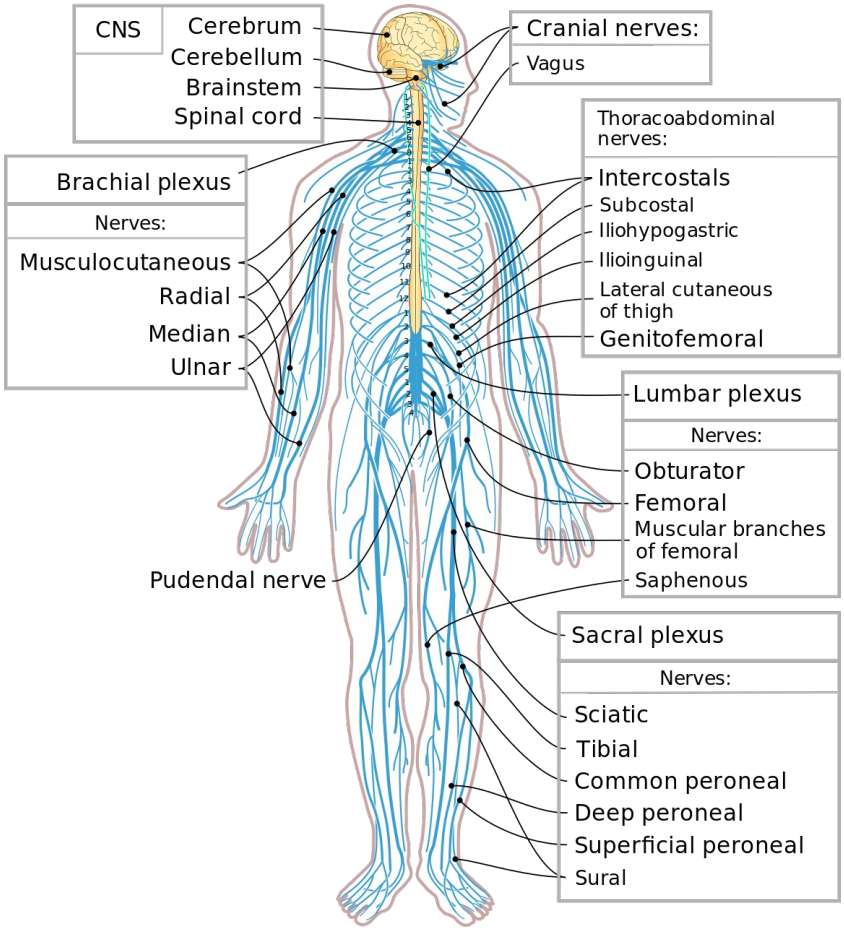
· The cerebellum is a part of the brain located near the back of the cranium. It is in charge of automated movements and thoughts, but only when they have been thoroughly practiced. When we tie up our shoelaces, skate or swim (and, of course, walk, run or go up or down the stairs) we are

using the cerebellum. When we are learning a new physical task, like typing, the brain has to do all the steps, but with practice, the cerebellum will “automate” that task and the performance will be much faster and reliable.

- The spinal cord.
It is a thick bundle of axons that stem from neurons that reside in the brain. Each vertebra has a junction between the spinal cord and nerves that stem from that vertebra and communicate with other parts of the body. These nerves are called spinal nerves.
When we have a reflex movement, for example when we touch something that is unexpectedly hot, the impulse sending the information (that the object is hot) only reaches the spinal cord and the response (withdrawing the hand) is given by it; the impulse doesn't need to reach the brain.

3. The peripheral nervous system.

The nerves originating from the central nervous system and other intermediate neurons form a network that reaches most parts of the body. This network, mainly consisting of axons, is called the peripheral nervous system.
We can divide it into somatic nervous system and autonomic nervous system.



- The somatic nervous system is the set of nerves of neurons that are used for voluntary actions. They include reflexes because, although they are involuntary, it is the nerves of the somatic nervous system that carry the impulse.

- The autonomic nervous system is the set of nerves that are in charge of involuntary actions and processes. It has two sides, the sympathetic and the parasympathetic nervous systems. The parts of the body that receive impulses from the autonomic nervous system do so from both sides at the same time, and the impulses are opposite.
A good but a bit inaccurate example would be: the sympathetic nervous system tells the heart to work faster and the parasympathetic nervous system tells it to work slower, so there is a balance between the two impulses and the heart has a constant heart rate. If the impulse from the sympathetic nervous system becomes more intense, then the heart will beat faster.
In the case of the stomach it is the other way round: the sympathetic nervous system tells it to work slower and the parasympathetic nervous system tells it to work faster.
When you are awake, the sympathetic nervous system usually sends stronger signals to the organs, and when you sleep, it is the parasympathetic nervous system that is stronger. This is why when you sleep, the heart rate is low but the stomach is working hard.