



Douglas College

Douglas College Learning Centre

## THE NEURAL IMPULSE

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A **neuron**, or nerve cell, is the most basic component of the nervous system (**Figure 1**).

To understand how neurons send messages, it is important to become familiar with their specialized structures.

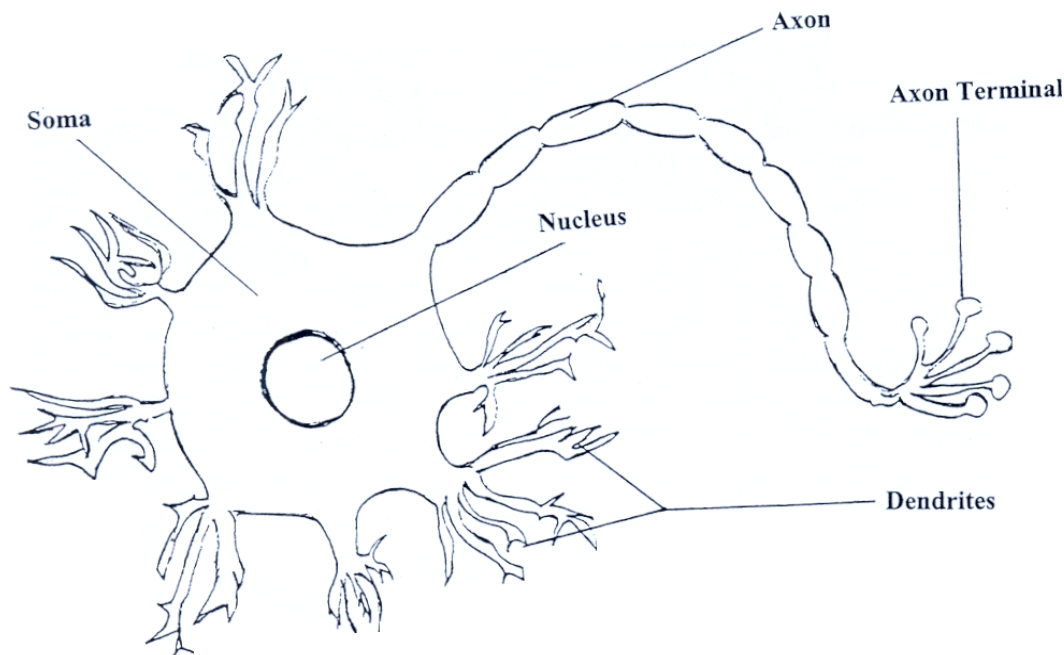
The **soma** (or cell body) is the neuron's control centre. It contains the nucleus and other organelles which are necessary for the neuron's survival.

**Dendrites** are branched structures specialized to receive information from other neurons or cells. Therefore, the dendrites are the neuron's **information** receivers.

**Axons** are long, tail-like fibers that extend from the soma. Their function is to send information to other neurons. Axons can be thought of as the neuron's **information senders**.

The structure at the end of the axon is called the **axon terminal**. This is where neurotransmitters are released.

A neuron may have many dendrites, but it has only one axon.



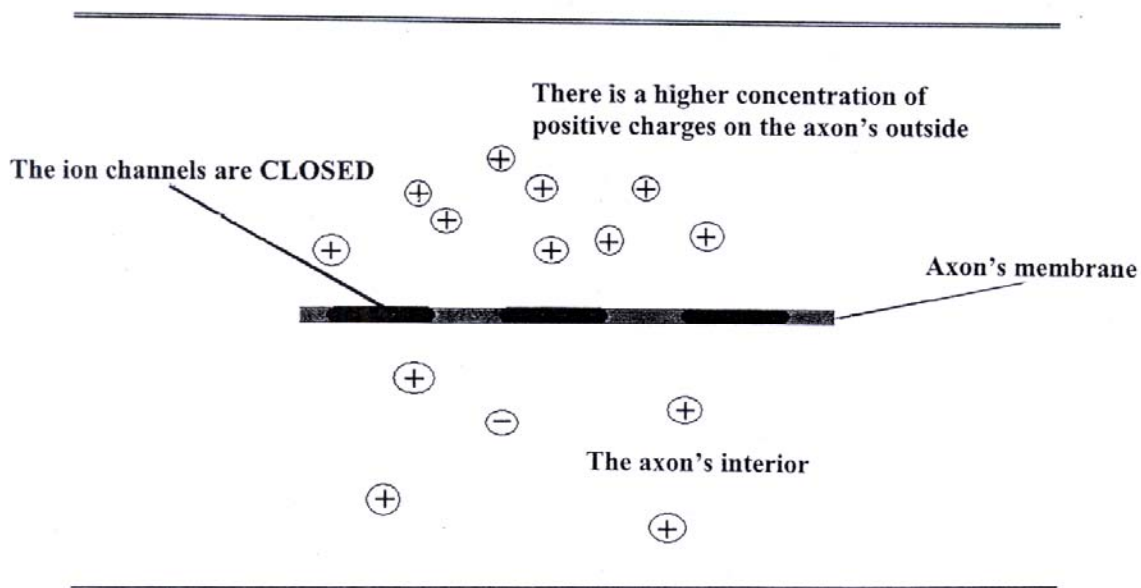
**Figure 1**

Neurons' specialized structures allow them to transmit messages throughout the nervous system. The sending of a message from one neuron to the next is called the **neural impulse**.

Figure 2 is a series of simplified diagrams meant to familiarize you with the steps involved in the neural impulse. Refer to diagrams 2 and 3 as you read through the description of each step.

The transmission of a neural impulse occurs on the neuron's axon.

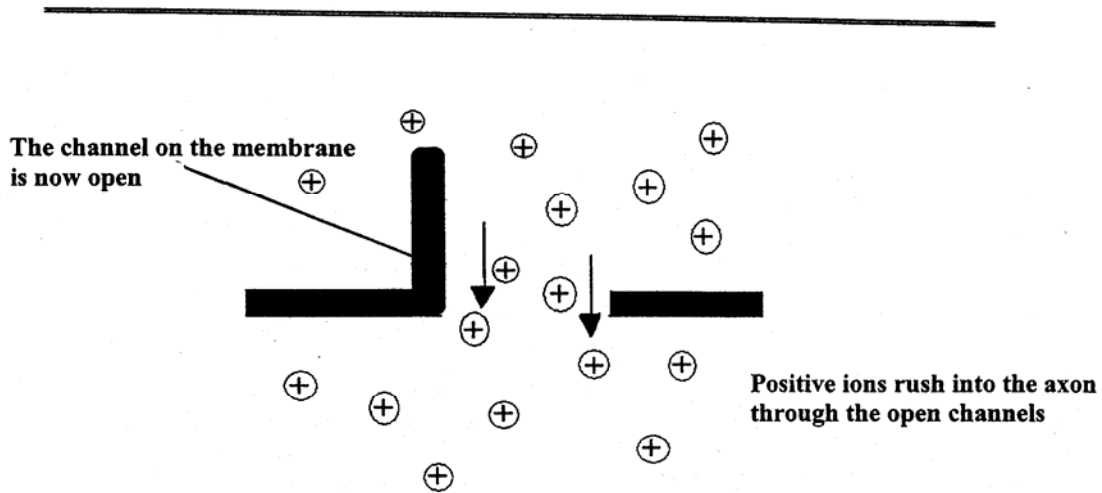
1. At rest, there is a different concentration of ions, or charged atoms, between the outside and the inside of the axon. Namely, there is a larger concentration of positive ions outside of the axon than there is inside of it. As is well known, opposite charges are strongly attracted to each other. That is, the positive charges on the outside of the axon are strongly drawn to the axon's more negative interior. Keeping these charges apart is the **neuron's membrane**. The membrane has small **channels** through which these ions can pass, but at rest, these channels are closed. This is called the resting potential (**Figure 2a**).



### 2a) Resting Potential

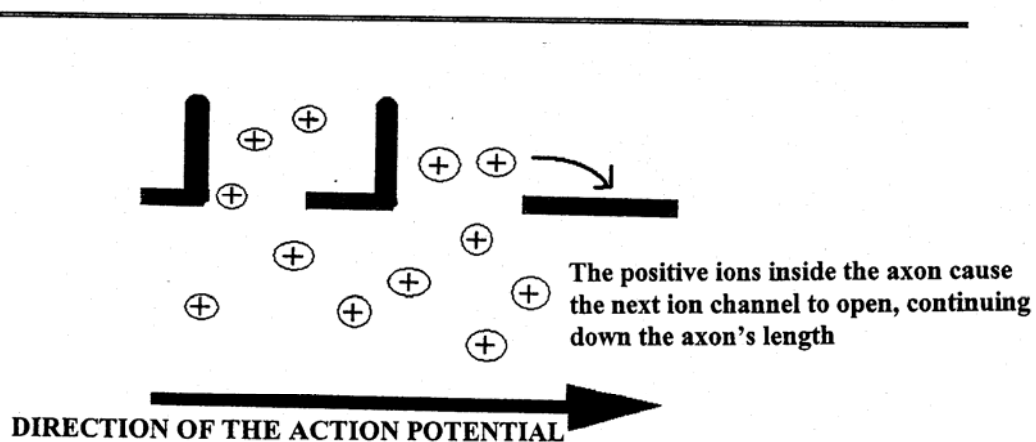
2. Eventually, a stimulus will excite a neuron's information receiver- the dendrite. This stimulus may come from an organism's external environment (such as touching a hot flame) or may originate from within the organism (for example, the release of hormones).

Once the stimulus reaches a certain strength or **the threshold**, the small channels on the axon's membrane open. The opening of the channels on the axon's membrane allows the positive ions outside of the axon to rush in. The influx of positive ions changes the charge inside the axon, making it more positive. This process is called **depolarization** (*Figure 2b*).



**2b) Depolarization**

- As ions rush in through one gate, their positive charge causes the next, nearby gate to open, letting in more positive ions. The gates on the axon continue to open, and in this way, transmit the message down its entire length. The message traveling down the axon is the **action potential** (*Figure 2c*).



**2c) Transmission of the action potential**

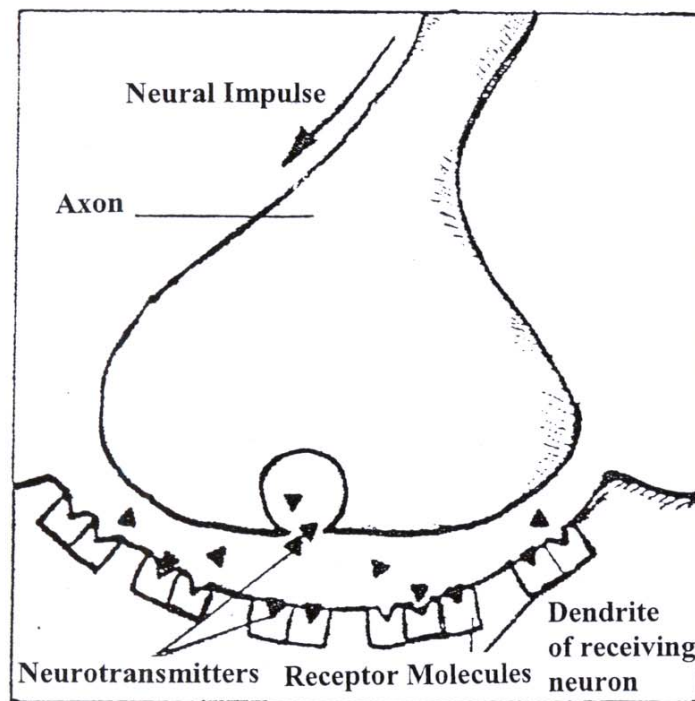
4. After transmitting a message, the axon returns to its resting state by pumping out positive ions through the channels on its membrane. This process is called the **refractory period**. Once the refractory period is over, the neuron is ready to transmit a message again.

How does the axon of one neuron transmit messages to other, nearby neurons?

In the nervous system, the axon terminals of one neuron are in very close contact with the dendrites of neighboring neurons. The signal is transmitted from one neuron to the next through the release of **neurotransmitters**, or chemical messengers.

More specifically, when the action potential reaches the axon terminal of the sending neuron, it causes neurotransmitters to be released. The neurotransmitters then attach to receptors located on the receiving dendrite. This starts another action potential, and the entire process is repeated (**Figure 3**).

After stimulating the receiving dendrite, neurotransmitters are taken back into the sending neuron. This recycling process is called **reuptake**.



*Figure 3*

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#### References:

- Kalat, J. W. (2004). *Biological Psychology* (8th ed.). Belmont: Wadsworth. 29-48  
Myers, D. G. (2004). *Psychology* (7th ed.). New York: Worth. 57-68