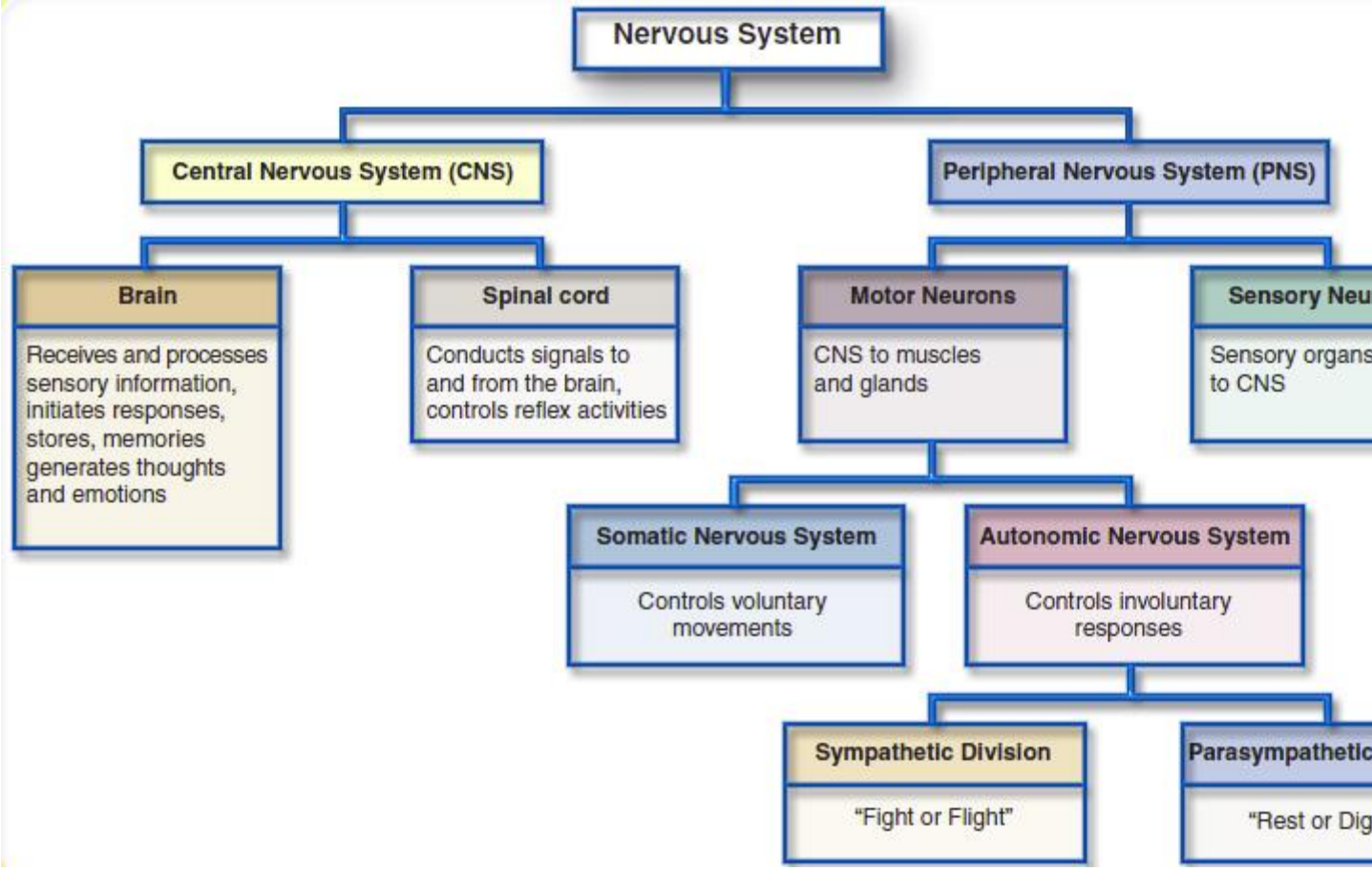
Organization of the Nervous System/ Classification of nervous system

The nervous system coordinates voluntary and involuntary actions in the body by sending and receiving information. The nervous system is comprised of an enormous number of cells (over 100 billion), primarily of two types: **neurons** (the signaling units) and **glial cells** (the supporting units). However, nervous system function is mostly a story of the neuron. The neuron is the functional unit of the nervous system and is designed to transmit information between cells. Interestingly, neurons with a particular function are found in a predictable location. This regularity in structure has permitted neurobiologists to categorically organize the nervous system based on location and function (see figure below).

Thus, the nervous system can first be divided into two major parts: the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS consists of neurons associated with central processing and which are located in the brain and spinal cord. The peripheral nervous system (PNS) consists of neurons associated with sensory input (afferent) and motor output (efferent), and functions to connect the central nervous system to all other parts of the body. Stated another way, if the entire structure of the neuron is contained within the brain and/or spinal cord, the neuron would be considered part of the CNS. In contrast, if any part of the neuronal structure is located outside of the brain and/or spinal cord the neuron would be considered part of the PNS (see image below).



Neurons:

Neurons are **information messengers**. They use electrical impulses and chemical signals to transmit information between different areas of the brain, and between the brain and the rest of the nervous system.

A neuron, neurone, or nerve cell is an electrically excitable cell that communicates with other cells via synapses - specialized connections that commonly use minute amounts of neurotransmitters to pass the electric signal from the presynaptic neuron to the target cell through the synaptic gap. The neuron is the main component of nervous tissue in all animals except sponges and placozoa. Non-animals like plants and fungi do not have nerve cells.

Neurons are typically classified into three types based on their function. Sensory neurons respond to stimuli such as touch, sound, or light that affect the cells of the sensory organs, and they send signals to the spinal cord or brain. Motor neurons receive signals from the brain and spinal cord to control everything from muscle contractions to glandular output. Interneurons connect neurons to other neurons within the same region of the brain or

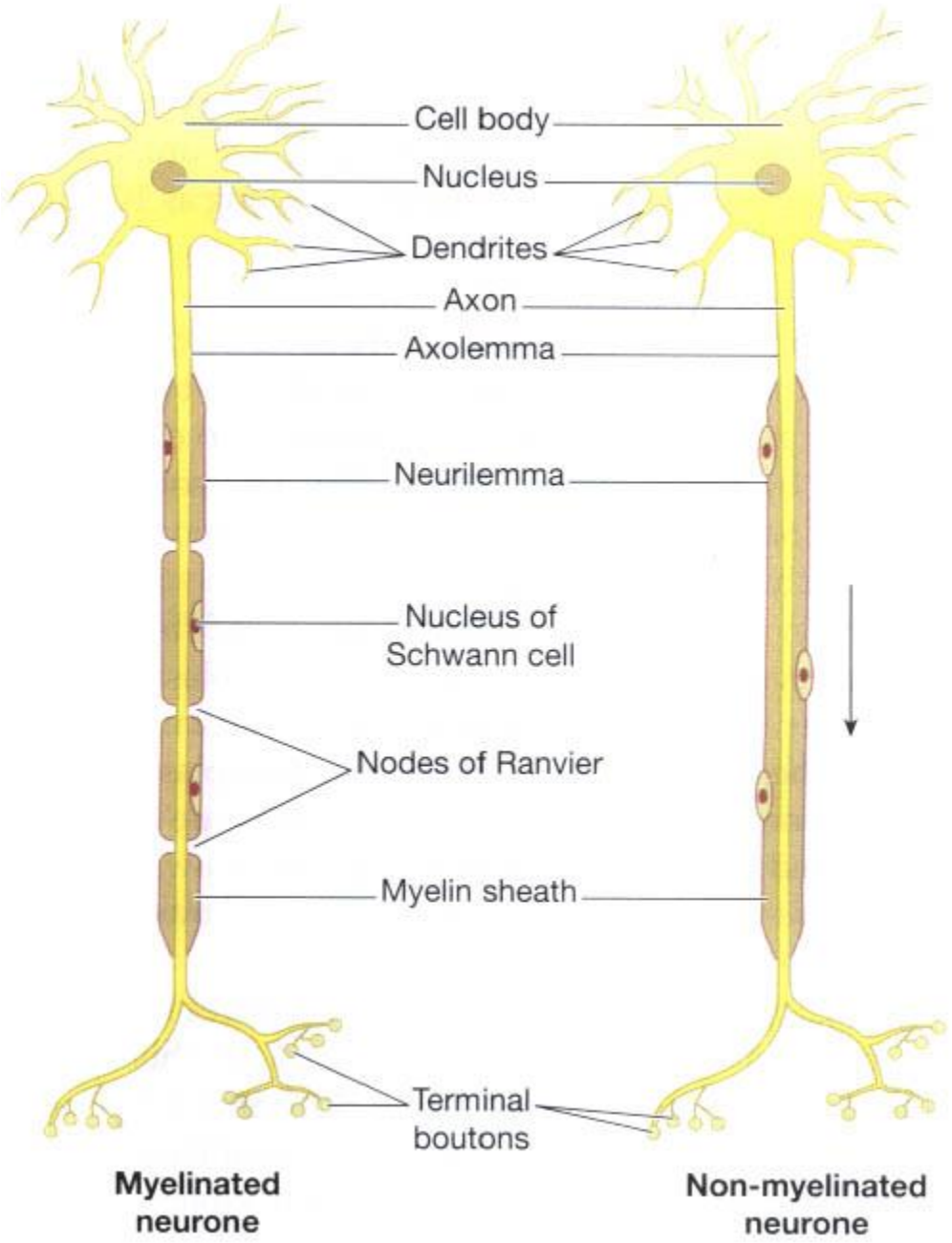
spinal cord. When multiple neurons are connected together, they form what is called a neural circuit.

A typical neuron consists of a cell body (soma), dendrites, and a single axon. The soma is a compact structure, and the axon and dendrites are filaments extruding from the soma. Dendrites typically branch profusely and extend a few hundred micrometers from the soma. The axon leaves the soma at a swelling called the axon hillock and travels for as far as 1 meter in humans or more in other species. It branches but usually maintains a constant diameter. At the farthest tip of the axon's branches are axon terminals, where the neuron can transmit a signal across the synapse to another cell. Neurons may lack dendrites or have no axon. The term neurite is used to describe either a dendrite or an axon, particularly when the cell is undifferentiated.

Most neurons receive signals via the dendrites and soma and send out signals down the axon. At the majority of synapses, signals cross from the axon of one neuron to a dendrite of another. However, synapses can connect an axon to another axon or a dendrite to another dendrite.

The signaling process is partly electrical and partly chemical. Neurons are electrically excitable, due to maintenance of voltage gradients across their membranes. If the voltage changes by a large enough amount over a short interval, the neuron generates an all-or-nothing electrochemical pulse called an action potential. This potential travels rapidly along the axon and activates synaptic connections as it reaches them. Synaptic signals may be excitatory or inhibitory, increasing or reducing the net voltage that reaches the soma.

In most cases, neurons are generated by neural stem cells during brain development and childhood. Neurogenesis largely ceases during adulthood in most areas of the brain.



The nervous system consists of a vast number of cells called *neurones* (Fig. 7.2), supported by a special type of connective tissue, *neuroglia.* Each neurone consists of a *cell body* and its processes, one *axon* and many *dendrites.* Neurones are commonly referred to simply as nerve cells. Bundles of axons bound together are called *nerves.* Neurones cannot divide and for survival they need a continuous supply of oxygen and glucose. Unlike many other cells, neurones can synthesise chemical energy (ATP) only from glucose. *nerve impulses,* or *action potentials,* which are akin to tiny
electrical charges. However, unlike ordinary electrical wires, the neurones are actively involved in conducting nerve impulses. In effect the strength of the impulse is maintained throughout the

length of the neurone. Some neurones initiate nerve impulses while others act as 'relay stations' where impulses are passed on and sometimes redirected.

Properties of neurones

Neurones have the characteristics of *irritability* and *conductivity*.

Irritability is the ability to initiate nerve impulses in response to stimuli from:

• outside the body, e.g. touch, light waves

• inside the body, e.g. a change in the concentration of carbon dioxide in the blood alters respiration; a thought may result in voluntary movement.