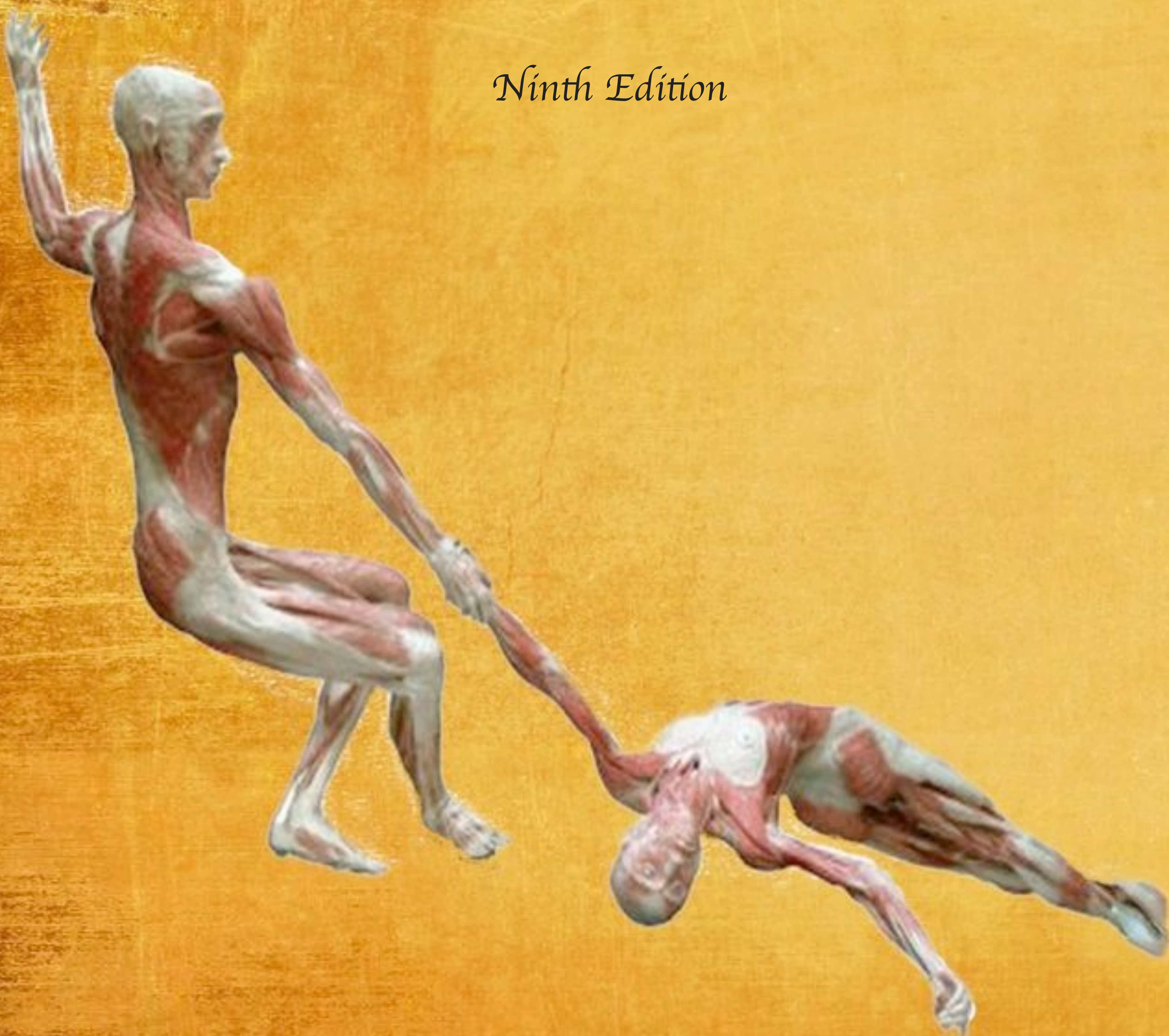
# Textbook of

# Anatomy and Physiology

Ninth Edition



Anthony and Kolthoff

# CONTENTS

## The Body as a Whole



## The Erect and Moving Body



## How the Body Controls and Integrates its Functions



## Maintaining the Metabolism of the Body



## Reproduction



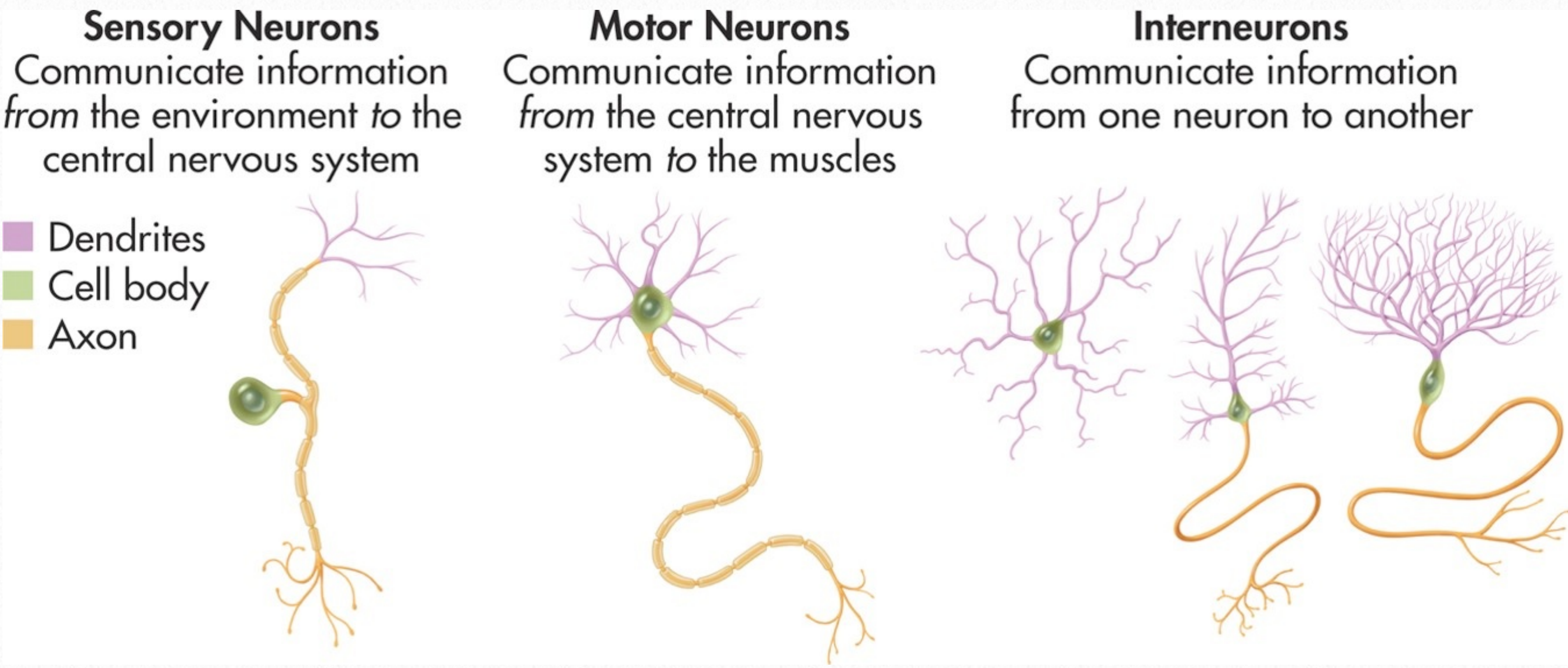
## Fluid, Electrolyte, and Acid-Base Balance



## Stress

# NEURONS

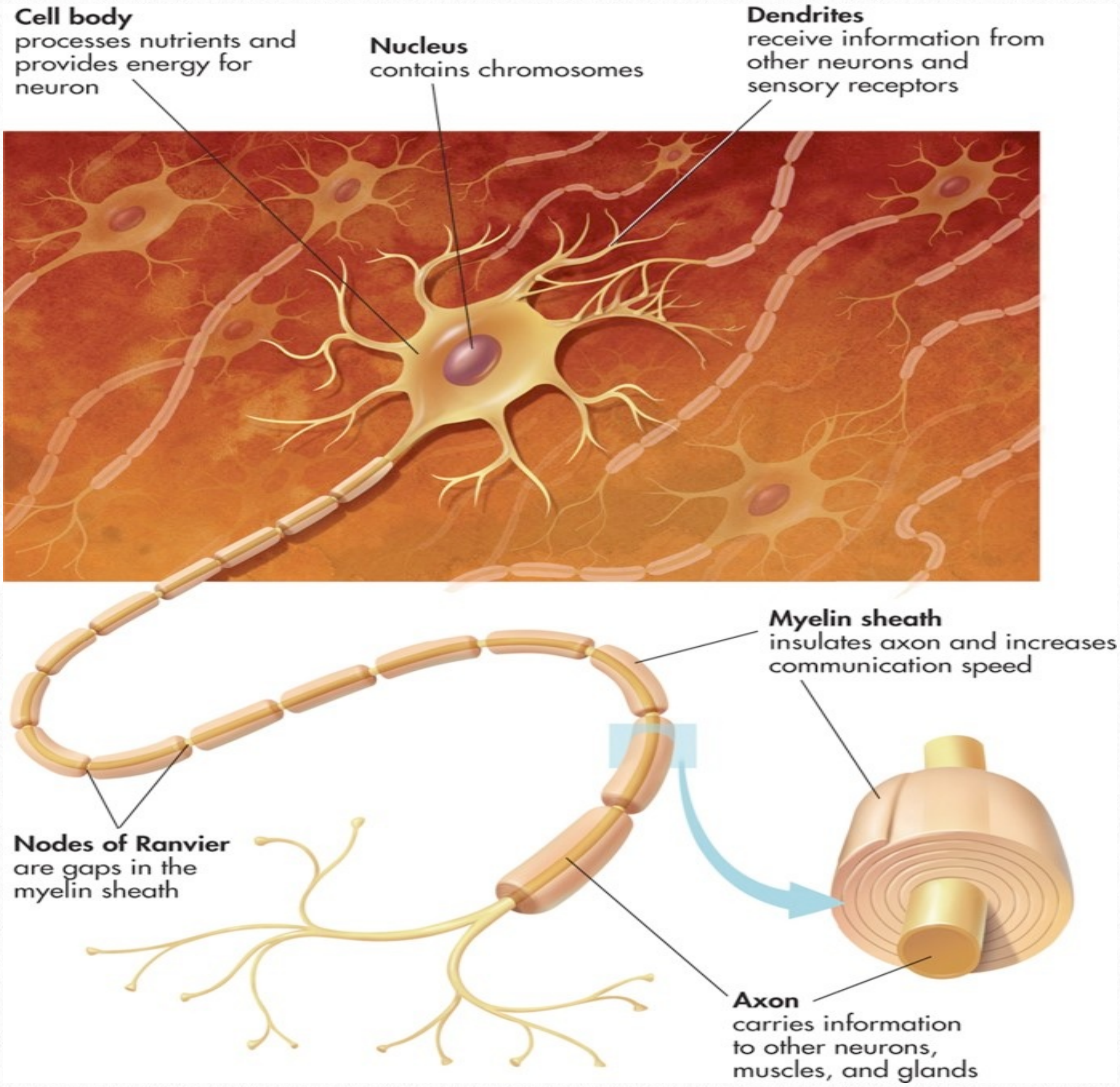
*Neurons are the "specialists" of the nervous system; they specialize in impulse conduction, the function that makes possible all other nervous system functions.*




## Types

Neurons are classified according to two different criteria—the direction in which they conduct impulses and the number of processes they have.

Classified according to the direction in which they conduct impulses, there are three types of neurons: sensory, motor, and inter—neurons. *Sensory (afferent) neurons* transmit nerve impulses to spinal cord or brain. *Motoneurons (motor or efferent neurons)* transmit nerve impulses away from brain or spinal cord to or toward muscle or glandular tissue. *Interneurons (internuncial or intercalated)* conduct impulses from sensory to motor neurons. Interneurons lie entirely within the central nervous system (brain and spinal cord).




## Structure

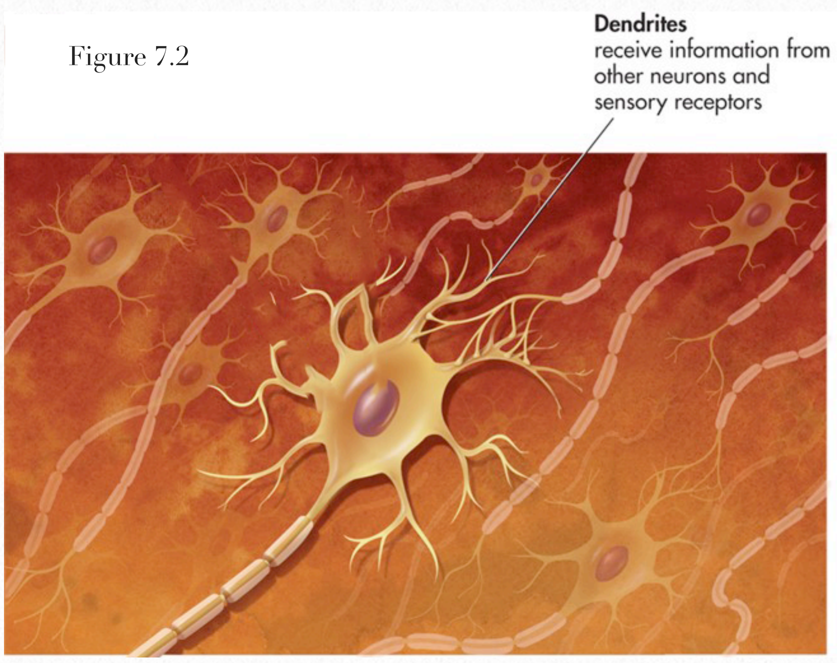
All neurons consist of a cell body (also called the soma, or perikaryon) and at least two processes: one axon, and one or more dendrites. Because dendrites and axons are threadlike extensions from a neuron's soma (it's cell body), they are often called *nerve fibers*.

Clusters of neuron cell bodies have a slightly gray color. *Gray matter* in the brain and spinal cord, for example, consist largely of neuron cell bodies. In many respects, the cell body, the largest part of a nerve cell, resembles other cells. It contains a nucleus, cytoplasm, and various organelles found in other cells—for example, mitochondria and a

Golgi apparatus. Incidentally, Golgi first saw this apparatus in neurons. A neuron's cytoplasm extends from its cell body into its processes. A plasma membrane encloses the entire neuron.

Certain structures—dendrites, axons, neurofibrils, Nissl bodies, myelin sheath, and neurilemma— are found only in neurons. The following paragraphs describe them briefly.

Figure 7.2




*Dendrites*, as you can see in Fig. 7-2, branch extensively, like tiny trees. In fact, their name derives from the Greek word for tree. The distal ends of dendrites of sensory neurons are called *receptors* because they receive the stimuli that initiate conduction. Dendrites conduct impulses to the cell body of the neuron.

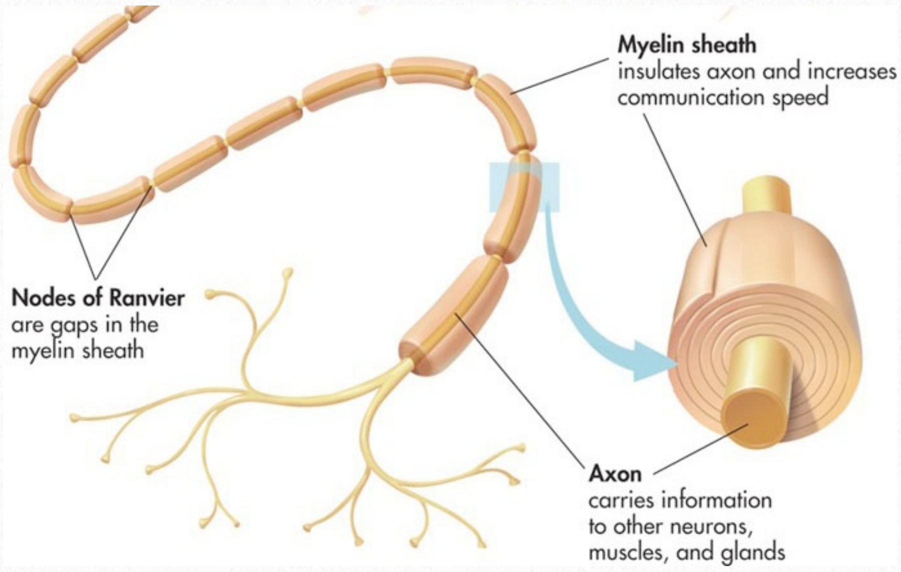
The *axon* of neuron is a single process that extends out from the neuron cell body. Although a neuron has only one axon, it often has one or more side branches *(axon collaterals)*. Moreover, axons terminate in many branched filaments, and, like dendrites, they vary considerably in length. Some are as much as 3 feet or more long. Others measure only a fraction of an inch. Axons vary also in diameter— a point of interest because it related to velocity of impulse conduction. In general, fibers with a large diameter conduct more rapidly than those with a small diameter. A neuron's axon conducts impulses away from its cell body.

*Neurofibrils* are very fine fibers extending through dendrites, cell bodies, and axons. The electron microscope has revealed that bundles if neurofibrils interlace to form a network in neuron cytoplasm.

*Nissl bodies* consist of groups of flat, membranous sacs and numerous RNA granules scattered between them. In other words, Nissl bodies constitute the rough endoplasmic reticulum of a neuron. Since this organelle specializes in protein synthesis, one would expect Nissl bodies to perform the same function. But why should neurons, whose specialty if conduction, also specialize in protein synthesis? According to one speculation, they use the protein they make for maintaining and regenerating neuron processes. Radioautographic studies have shown that proteins synthesized in neuron cell bodies quickly migrate down their axons.

The *myelin sheath* is a segmented wrapping around a nerve fiber. Note in Fig. 7-3 the small gaps called *nodes of Ranvier* between segments of the sheath. Because of the relatively high fat content in myelin, bundles of myelinated fibers appear creamy white in color. *White matter* in brain and spinal cord consist of bundles if myelinated fibers that are called *tracts* (discusses in chapter 8). *Nerves*, like tracts, consist of bundles of myelinated fibers and are white, but they are located outside of the brain and spinal cord, not in them as are tracts.

The *neurilemma* is a continuous sheath that encloses the segmented myelin sheath of peripheral nerve fibers. (Peripheral nerve fibers are those located outside of the central nervous system—in other words, outside of the



brain and spinal cord). *Schwann cells* wind themselves in jelly-roll fashion around the myelin sheaths of peripheral fibers, with one Schwann cell wrapping around each segment of a myelin sheath. This together the several successive Schwann cells form the thin, continuous sheath called either the *sheath of Schwann* or the *neruilemma*. The neurilemma plays an essential part in peripheral nerve fiber regeneration. Brain and spinal cord fibers unfortunately do not, so far as we know, have neruilemma, nor do they regenerate if disease or injury destroys them. *Peripheral nerve fibers, in contrast, can regenerate.

*Recently, a few scientists have presented findings that suggest that regeneration of CNS neurons may, under some circumstances, be possible. See Culliton, B.J.: Spinal cord regeneration, Sci. News 98: 337-338, Oct. 24, 1970.

[http://www.sciencenews.org/view/url/id/204210/goto/Spinal_Cord_Regeneration](http://www.sciencenews.org/view/url/id/204210/goto/Spinal_Cord_Regeneration)

How a Neuron Works