Nervous System:

Classification of nervous system, and Neurons:

The Nervous System Includes Both Sensory (Input) and Motor (Output) Systems Interconnected by Complex Integrative Mechanisms. The fundamental unit of operation is the neuron, which typically consists of a cell body (soma), several dendrites, and a single axon. Although most neurons exhibit the same three components, there is enormous variability in the morphology of individual neurons throughout the brain. It is estimated that the nervous system is composed of more than 100 billion neurons. Much of the activity in the nervous system arises from mechanisms that stimulate sensory receptors located at the distal termination of a sensory neuron. Signals travel over peripheral nerves to reach the spinal cord and are then transmitted throughout the brain. Incoming sensory messages are processed and integrated with information stored in various pools of neurons such that the resulting signals can be used to generate an appropriate motor response. The motor division of the nervous system is responsible for controlling a variety of bodily activities such as contraction of striated and smooth muscles and secretion by exocrine and endocrine glands. Actually, only a relatively small proportion of the sensory input received by the brain is used to generate an immediate motor response. Much of it is discarded as irrelevant to the function at hand. Sensory input can be stored in the form of memory. Information stored as memory can become part of the processing mechanism used to manage subsequent sensory input. The brain compares new sensory experiences with those stored in memory and in this way develops successful strategies to form a motor output.

Synapses:

Nervous System Function Is Based on Interactions That Occur between Neurons at Specialized Junctions Called Synapses.

At a termination site, an axon typically forms a number of branches that exhibit small dilated regions called synaptic terminals or synaptic boutons. The synaptic bouton is apposed to, but separated from, an adjacent postsynaptic structure (dendrite or soma) by a narrow space (200 to 300 angstroms) called the synaptic cleft. Synaptic boutons contain a variety of organelles, including numerous mitochondria, and they exhibit an aggregation of relatively small spheroidal synaptic vesicles, which contain molecules of a chemical neurotransmitter agent. When released from the axon terminal, this transmitter agent binds to receptors on the postsynaptic neuron and alters its membrane permeability to certain ions.

Chemical Synapses and Electrical Synapses Are the Two Major Types of Synapse in the Brain. The overwhelming majority are chemical synapses. One neuron,

the presynaptic element, releases a transmitter agent that binds to the postsynaptic neuron, which is then excited or inhibited. The transmission of signals at chemical synapses is typically “one way”—from the presynaptic
axon terminal to the postsynaptic dendrite or soma. The least common type of synapse (in mammals) is the electrical synapse. These synapses consist of gap junctions that form low resistance channels between the presynaptic and postsynaptic elements. At these synapses, various ions can freely move between the two related neurons, thereby mediating rapid transfer of signals that can spread through large pools of neurons. When a synaptic bouton is invaded by an action potential, the transmitter agent is released into the synaptic cleft, where it can bind with specific receptors located in the membrane of the postsynaptic dendrite or soma. The excitatory or inhibitory action of the transmitter agent is determined by the response of the postsynaptic receptors.