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# 1 The Brain and Behavior

## 1.1 The Brain Has Distinct Functional Regions

### The Central Nervous System Has Seven Main Parts

- ▷ **Spinal cord:** most caudal part of the central nervous system. It is subdivided into cervical, thoracic, lumbar, and sacral regions.
- ▷ **Brain stem:** consists of the medulla oblongata, pons, and midbrain. Relays input from the spinal cord and back, and controls input to and from the head.
- ▷ **Medulla oblongata:** rostral to spinal cord and includes several centers responsible for vital autonomic functions.
- ▷ **Pons:** rostral to medulla and conveys information about movement.
- ▷ **Cerebellum:** lies behind pons, modulates force and range of movement, and involved in learning motor skills.
- ▷ **Diencephalon:** lies rostral to midbrain and contains two structures, thalamus (processes information reaching cerebral cortex) and hypothalamus (regulates autonomic, endocrine, and visceral functions).
- ▷ **Cerebrum:** comprises two cerebral hemispheres, each consisting of wrinkled outer layer (the cerebral cortex), and three deep lying structures (basal ganglia, the hippocampus, and the amygdaloid nuclei).
- ▷ **Cerebral cortex:** divided into four distinct lobes— frontal, parietal, occipital, and temporal. The frontal lobe is largely concerned with short-term memory and planning, as well as movement; the parietal lobe with somatic sensation, forming a body image, and relating it to extrapersonal space; the occipital lobe with vision; and the temporal lobe with hearing—combined with deeper structures—with learning, memory, and emotion.

## 2 Nerve Cells, Neural Circuitry, and Behavior

### 2.1 The Nervous System Has Two Classes of Cells

- ▷ There are two main classes of cells in the nervous system: nerve cells, or neurons, and glial cells, or glia.
- ▷ A neuron has four defined regions:
  - **Cell body:** or *soma*, is the metabolic center of the cell, containing normal cell organelles.
  - **Dendrites:** branch out in tree-like fashion and are main apparatus for receiving signals.
  - **Axon:** extends some distance from a cell and carries signals to other neurons.
  - **Presynaptic terminals:** specialized enlarged regions of its axon's branches and is responsible for transfer of signals.
- ▷ **Principle of dynamic polarization:** electrical signals only flow in one direction in neurons.
- ▷ **Connectional specificity:** nerve cells do not connect randomly with one another in the formation of networks.
- ▷ Neurons are classified into three groups:
  - **Unipolar:** simplest due to single primary process, which gives rise to many branches. One branch as axon and others as receiving structures. These cells predominate invertebrates; they occur in the autonomic nervous system in vertebrates.
  - **Bipolar:** oval soma that gives rise to two processes: a dendritic structure that receives signals and an axon that carries information towards the central nervous system. Many sensory cells are bipolar, and pain receptors are pseudo-unipolar.
  - **Multipolar:** predominate nervous system of vertebrates and vary greatly in shape; typically containing a single neuron and many dendritic points emerging from various points around the cell body.

- ▷ Glial cells support nerve cells and greatly outnumber neurons.
- ▷ Glial cells surround the cell bodies, axons, and neurons and can be divided into two major classes:
  - **Microglia**: immune system cells that become phagocytes during injury, infection, or degenerative diseases.
  - There are three main types of **macroglia**: oligodendrocytes, Schwann cells, and astrocytes. About 80% of all brain cells are macrogalia.