

CONCEPT 49.1: Nervous systems consist of circuits of neurons and supporting cells

- Bilaterally symmetrical animals exhibit **cephalization**, the clustering of sensory organs at the front end of the body
- The simplest such animals, flatworms, have a **central nervous system (CNS)** consisting of a small brain and longitudinal nerve cords
- The **peripheral nervous system (PNS)** consists of neurons carrying information into and out of the CNS
- Nervous system organization usually correlates with lifestyle

Figure 49.2 Nervous system organization

- Annelids and arthropods have segmentally arranged clusters of neurons called **ganglia**
- Sessile molluscs (for example, clams and chitons) have simple systems, whereas more complex molluscs (for example, octopuses and squids) have more sophisticated systems

Figure 49.3 The vertebrate nervous system

- In vertebrates
 - The CNS is composed of the brain and spinal cord
 - The PNS is composed of nerves and ganglia
- Regional specialization is a hallmark of both systems

Organization of the Vertebrate Nervous System

- The CNS develops from the hollow dorsal nerve cord
- The cavity of the nerve cord gives rise to the narrow **central canal** of the spinal cord and the **ventricles** of the brain
- The canal and ventricles fill with **cerebrospinal fluid**, which supplies the CNS with nutrients and hormones and carries away wastes
- The brain and spinal cord contain
 - **Gray matter**, which consists of neuron cell bodies, dendrites, and unmyelinated axons
 - **White matter**, which consists of bundles of myelinated axons

Figure 49.4 Ventricles, gray matter, and white matter

Figure 49.5 The knee-jerk reflex

- The spinal cord conveys information to and from the brain and generates basic patterns of locomotion
- The spinal cord also produces reflexes independently of the brain
- A **reflex** is the body's automatic response to a stimulus
 - For example, a doctor uses a mallet to trigger a knee-jerk reflex

The Peripheral Nervous System

- The PNS transmits information to and from the CNS and regulates movement and the internal environment
- In the PNS, **afferent** neurons transmit information to the CNS, and **efferent** neurons transmit information away from the CNS
- The PNS has two efferent components: the motor system and the autonomic nervous system
- The **motor system** carries signals to skeletal muscles and can be voluntary or involuntary
- The **autonomic nervous system** regulates smooth and cardiac muscles and is generally involuntary
- The **enteric nervous system** exerts direct, partially independent, control over the digestive tract, pancreas, and gallbladder
- The autonomic nervous system has sympathetic and parasympathetic divisions

Figure 49.7 The parasympathetic and sympathetic divisions of the autonomic nervous system

Figure 49.8 Comparison of pathways in the motor and autonomic nervous system

- In both sympathetic and parasympathetic systems, the pathway for information flow involves a preganglionic and postganglionic neuron
- **Preganglionic neurons** have cell bodies in the CNS and release acetylcholine as a neurotransmitter; **postganglionic neurons** of the parasympathetic division release acetylcholine
- Their counterparts in the sympathetic division release norepinephrine
- The nervous systems of vertebrates and most invertebrates include glial cells in addition to neurons
- **Glial cells**, or **glia**, have numerous functions to nourish, support, and regulate neurons
 - Embryonic radial glia form tracks along which newly formed neurons migrate
 - Astrocytes participate in the formation of the blood-brain barrier, which restricts the entry of most substances into the brain

CONCEPT 49.2: The vertebrate brain is regionally specialized

- The vertebrate brain has three major regions: the forebrain, midbrain, and hindbrain
- Each region is specialized in function
- The forebrain has activities including processing of olfactory input, regulation of sleep, learning, and any complex processing

Biology 49 Nervous Systems Guide Answers

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