LEARNING OBJECTIVES

- List and describe the components and basic operation of the nervous system
- Contrast the central and peripheral nervous systems
- Define the parts and functions of the nervous tissue
- Discuss the anatomy and physiology of the spinal cord
- List and describe various nervous system disorders of the nerves and spinal cord
ETHICAL DILEMMA

1. Research indicates that stem cells may resolve spinal trauma by regrowing attachments between severed nerves. However, many

ANSWERS TO TEST YOUR KNOWLEDGE

Test Your Knowledge 9–1 Answers, p. 199

1. b
2. b
3. c
4. b
5. b

Test Your Knowledge 9–2 Answers, p. 201

1. c
2. b
3. b
4. a
5. b

Test Your Knowledge 9–3 Answers, p. 205

1. c
2. d
3. c
4. c
5. b

Test Your Knowledge 9–4 Answers, p. 212

1. b
2. b
3. b
4. c
5. a
ANSWERS TO THE CASE STUDY, P. 214

Bill’s most likely injury is to the cervical spinal cord. A spinal cord injury is mostly likely because he is paralyzed on both sides of his body. A brain injury would leave him paralyzed on only one side, typically. That he cannot breathe points to a high cervical injury. Impulses are not moving from his brain to his cervical plexus, where the phrenic nerve connects. Thus he cannot breathe on his own.

ANSWERS TO REVIEW QUESTIONS, P. 215

Multiple Choice
1. b, 2. a, 3. d, 4. b, 5. c, 6. b, 7. b, 8. c

Fill in the Blank
1. diameter; myelin
2. Action
3. columns; horns
4. CSF; subarachnoid
5. reflex
6. ventral/anterior

Short Answer
1. As a neuron is stimulated, sodium channels open and sodium rushes in, bringing positive charges into the cell. The cell becomes more positive, or depolarized. With a brief delay, sodium channels shut, preventing more sodium from entering the cell. Then potassium channels open, allowing potassium to leave the cell. Because potassium is also positively charged, it takes positive charges with it, making the neuron more negative. The neuron is repolarizing. If potassium continues to rush out of the cell, the cell will become more negative than at rest. The cell is then hyperpolarized.
2. An action potential reaches the axon terminal and depolarizes it. Voltage-gated calcium channels open, and calcium rushes into the cell. The calcium coming into the cell triggers exocytosis of vesicles containing neurotransmitter. The neurotransmitters leave the cell, diffuse across the synaptic cleft, and bind to the receptors on the receiving cell. The receiving cell undergoes some kind of permeability change. Then cleanup occurs.
3. The bones of the skull and vertebrae protect the CNS. In addition, three layers of meninges protect the CNS. The outer layer is the dura mater. The middle layer is the arachnoid mater, and the inner layer is the pia mater. CSF is contained in the subarachnoid space and in the hollow spaces inside the CNS.
4. There are four CNS neuroglia. Astrocytes are general support cells. Oligodendrocytes make myelin. Ependymal cells line cavities.
Microglia destroy debris. In the PNS, there are two types of neuroglia: satellite cells are general support cells; Schwann cells myelinate axons.

5. A spinal cord injury at C2 would cause quadriplegia and sensory loss from the neck down. Patients with this injury would likely be ventilator dependent because of paralysis of the diaphragm. A spinal cord injury at T3 would cause paralysis of some thoracic and abdominal muscles and paraplegia as well as loss of sensation from the chest down. Patients would be able to breathe on their own but might have some difficulty with coughing or shortness of breath because of paralysis of thoracic and abdominal muscles. A spinal cord injury at L2 would cause paraplegia and sensory loss below the waist.