

## CHAPTER 48

### NEURONS, SYNAPSES, AND SIGNALING

#### Learning objectives:

##### An Overview of Nervous Systems

1. Name the three stages in the processing of information by nervous systems.
2. Distinguish among sensory neurons, interneurons, and motor neurons.
3. List and describe the major parts of a neuron and explain the function of each.
4. Describe the function of glia.

##### The Nature of Nerve Signals

5. Define a membrane potential and a resting potential.
6. Describe the factors that contribute to a membrane potential.
7. Explain why the membrane potential of a resting neuron is typically between -60 and -80 mV.
8. Explain the role of the sodium-potassium pump in maintaining the resting potential.
9. Explain why the electrical potential across the membrane prevents the build-up of negative charge from increasing indefinitely.
10. Explain how the Nernst equation may be used to calculate  $E_K$ , the equilibrium potential for  $K^+$ .
11. Distinguish between gated and ungated ion channels.
12. Describe the characteristics of an action potential. Explain the role of voltage-gated ion channels in this process.
13. Define the refractory period.
14. Explain how an action potential is propagated along an axon.
15. Explain why the action potential cannot travel back toward the cell body.
16. Describe the factors that affect the speed of action potentials along an axon and describe adaptations that increase the speed of propagation. Describe saltatory conduction.

##### The Synapse

17. Distinguish between an electrical synapse and a chemical synapse.
18. Describe the structures of a chemical synapse and the events that lead to the release of neurotransmitters into the synaptic cleft.
19. Explain how excitatory postsynaptic potentials (EPSP) and inhibitory postsynaptic potentials (IPSP) affect the postsynaptic membrane potential.
20. Explain this statement: "Unlike action potentials, which are all-or-none events, postsynaptic potentials are graded."
21. Define summation and distinguish between temporal and spatial summation. Explain how summation applies to EPSPs and IPSPs.
22. Explain the integrative role of the axon hillock.
23. Describe the role of signal transduction pathways in indirect synaptic transmission.
24. Describe the specific properties of the neurotransmitter acetylcholine. Explain the link between botulism and acetylcholine.
25. Name four biogenic amines. Briefly describe the role of each molecule in the nervous system.

26. Identify and describe the functions of two amino acids and several neuropeptides that work as neurotransmitters.
27. Explain how endorphins function as natural analgesics.
28. Describe the roles of nitric oxide and carbon monoxide as local regulators.