Campbell's Biology, 9e **(Reece et al.)**
Chapter 49 Nervous Systems

In addition to chemical signaling (for example, hormones), neuronal communication among the body parts of an animal is of substantial importance for the coordination of homeostasis. The organization of neurons into systems for communication is the central theme of Chapter 49. Following a brief description of simple circuits, the organization of the vertebrate brain is presented. Changes in synaptic effectiveness, the basis of learning and memory, are also discussed. Finally, elaboration of the molecular basis for several disorders of the nervous system establishes the importance of the reductionist approach to understanding.

Multiple-Choice Questions

1) Although an exact count is not available, it is likely that the human brain has as many as
A) 10,000 neurons.
B) 500,000 neurons.
C) 1 million neurons.
D) 10 million neurons.
E) 100 billion neurons.
Answer: E
Topic: Concept 49.1
Skill: Knowledge/Comprehension

2) The central nervous system is lacking in animals that have
A) a complete gut.
B) bilateral symmetry.
C) radial symmetry.
D) a closed circulatory system.
E) excitable membranes.
Answer: B
Topic: Concept 49.1
Skill: Knowledge/Comprehension

3) Cephalization, the clustering of neurons and interneurons in the anterior part of the animal, is apparent in
A) *Hydra.*
B) cnidarians.
C) *Planaria.*
D) sea stars.
E) invertebrate animals with radial symmetry.
Answer: C
Topic: Concept 49.1
Skill: Knowledge/Comprehension

4) An organism that lacks integration centers
A) cannot receive stimuli.
B) will not have a nervous system.
C) will not be able to interpret stimuli.
D) can be expected to lack myelinated neurons.
Answer: C
Topic: Concept 49.1
Skill: Knowledge/Comprehension

5) In the human knee-jerk reflex, as the calf is raised from the vertical toward the horizontal, the muscles of the quadriceps (flexors on the ventral side of the thighs) and the muscles of the hamstring (extensors on the dorsal side of the thighs) are
A) both excited and contracting.
B) both inhibited and relaxed.
C) excited and inhibited, respectively.
D) inhibited and excited, respectively.
Answer: C
Topic: Concept 49.1
Skill: Application/Analysis

6) The stretch receptors of the sensory neurons in the human knee-jerk reflex are located in the
A) gastrocnemius muscle, in the calf.
B) cartilage of the knee.
C) quadriceps, the flexor muscles on the ventral side of the thighs.
D) hamstring, the extensor muscles on the dorsal side of the thighs.
E) brain, the sensorimotor relay.
Answer: C
Topic: Concept 49.1
Skill: Knowledge/Comprehension

7) Choose the correct match of glial cell type and function.
A) astrocytesÃmetabolize neurotransmitters and modulate synaptic effectiveness
B) oligodendrocytesÃproduce the myelin sheaths of myelinated neurons in the peripheral nervous system
C) microgliaÃproduce the myelin sheaths of myelinated neurons in the central nervous system
D) radial gliaÃthe source of immunoprotection against pathogens.
E) Schwann cellsÃprovide nutritional support to non-myelinated neurons
Answer: A
Topic: Concept 49.1
Skill: Knowledge/Comprehension

8) The cerebrospinal fluid is
A) a filtrate of the blood.
B) a secretion of glial cells.
C) a secretion of interneurons.
D) cytosol secreted from ependymal cells.
E) secreted by the hypothalamus.
Answer: A
Topic: Concept 49.1
Skill: Knowledge/Comprehension

9) The human knee-jerk reflex requires an intact
A) spinal cord.
B) hypothalamus.
C) corpus callosum.
D) cerebellum.
E) medulla.
Answer: A
Topic: Concept 49.1
Skill: Knowledge/Comprehension

10) The blood-brain barrier
A) is formed by tight junctions.
B) is formed by oligodendrocytes.
C) tightly regulates the intracellular environment of the CNS.
D) uses chemical signals to communicate with the spinal cord.
E) provides support to the brain tissue.
Answer: A
Topic: Concept 49.1
Skill: Knowledge/Comprehension

11) Myelinated neurons are especially abundant in the
A) gray matter of the brain and the white matter of the spinal cord.
B) white matter of the brain and the gray matter of the spinal cord.
C) gray matter of the brain and the gray matter of the spinal cord.
D) white matter in the brain and the white matter in the spinal cord.
E) all areas of the brain and spinal cord.
Answer: D
Topic: Concept 49.1
Skill: Knowledge/Comprehension

12) An amino acid neurotransmitter that operates at inhibitory synapses in the brain is
A) acetylcholine.
B) epinephrine.
C) endorphin.
D) serotonin.
E) gamma-aminobutyric acid, GABA.
Answer: E
Topic: Concept 49.1
Skill: Knowledge/Comprehension

13) Cerebrospinal fluid can be described as all of the following *except*
A) functioning in transport of nutrients and hormones through the brain.
B) a product of the filtration of blood in the brain.
C) formed from layers of connective tissue.
D) functioning to cushion the brain.
E) filling cavities in the brain called ventricles.
Answer: C
Topic: Concept 49.1
Skill: Knowledge/Comprehension

14) The divisions of the nervous system that have antagonistic, or opposing, actions are
A) motor and sensory systems.
B) sympathetic and parasympathetic systems.
C) presynaptic and postsynaptic membranes.
D) forebrain and hindbrain.
E) central nervous system and peripheral nervous system.
Answer: B
Topic: Concept 49.1
Skill: Knowledge/Comprehension

15) Preparation for the fight-or-flight response includes activation of the _____ nervous system.
A) sympathetic
B) somatic
C) central
D) visceral
E) parasympathetic
Answer: A
Topic: Concept 49.1
Skill: Knowledge/Comprehension

16) Exercise and emergency reactions include
A) increased activity in all parts of the peripheral nervous system.
B) increased activity in the sympathetic, and decreased activity in the parasympathetic branches.
C) decreased activity in the sympathetic, and increased activity in the parasympathetic branches.
D) increased activity in the enteric nervous system.
E) reduced heart rate and blood pressure.
Answer: B
Topic: Concept 49.1
Skill: Knowledge/Comprehension

17) Increased activity in the sympathetic nervous system leads to
A) decreased heart rate.
B) increased secretion by the pancreas.
C) increased secretion by the gallbladder.
D) increased contraction of the stomach.
E) relaxation of the airways in the lungs.
Answer: E
Topic: Concept 49.1
Skill: Knowledge/Comprehension

18) The activation of the parasympathetic branch of the autonomic nervous system is associated with
A) resting and digesting.
B) release of epinephrine into the blood.
C) increased metabolic rate.
D) fight-or-flight responses.
E) intensive aerobic exercise.
Answer: A
Topic: Concept 49.1
Skill: Knowledge/Comprehension

19) In a cephalized invertebrate, the system that transmits "efferent" impulses from the anterior ganglion to distal segments is the
A) central nervous system.
B) peripheral nervous system.
C) autonomic nervous system.
D) parasympathetic nervous system.
E) sympathetic nervous system.
Answer: B
Topic: Concept 49.1
Skill: Knowledge/Comprehension

20) Afferent neuronal systems include the
A) sensory systems.
B) peripheral nervous system.
C) autonomic nervous system.
D) parasympathetic nervous system.
E) sympathetic nervous system.
Answer: A
Topic: Concept 49.1
Skill: Knowledge/Comprehension

21) Cranial nerves originate in the brain and are thus part of the
A) central nervous system.
B) peripheral nervous system.
C) autonomic nervous system.
D) parasympathetic nervous system.
E) sympathetic nervous system.
Answer: A
Topic: Concept 49.1
Skill: Knowledge/Comprehension

22) The system that modulates excitation and inhibition of smooth and cardiac muscles of the digestive, cardiovascular, and excretory systems is the
A) central nervous system.
B) peripheral nervous system.
C) autonomic nervous system.
D) parasympathetic nervous system.
E) sympathetic nervous system.
Answer: C
Topic: Concept 49.1
Skill: Knowledge/Comprehension

23) Calculation, contemplation, and cognition are human activities associated with increased activity in the
A) pituitary gland.
B) hypothalamus.
C) cerebrum.
D) cerebellum.
E) spinal cord.
Answer: C
Topic: Concept 49.2
Skill: Knowledge/Comprehension

24) Central coordination of vertebrate biological rhythms in physiology and behavior reside in the
A) pituitary gland.
B) hypothalamus.
C) cerebrum.
D) cerebellum.
E) thalamus.
Answer: B
Topic: Concept 49.2
Skill: Knowledge/Comprehension

25) The endogenous nature of biological rhythms is based on the observations that animals isolated from light and dark cues
A) continue to have cycles of exactly 24 hours' duration.
B) continue to have cycles of approximately 24 hours' duration; some more rapid, some slower.
C) synchronize activity with whatever lighting cycle is imposed on them.
D) cease having any rhythms.
E) are independent of any genetic determinants.
Answer: B
Topic: Concept 49.2
Skill: Knowledge/Comprehension

26) Bottlenose dolphins breathe air but can sleep in the ocean because
A) they cease breathing while sleeping and remain underwater.
B) they sleep for only 30 minutes at a time, which is the maximum interval they can cease breathing.
C) they fill their swim bladder with air to keep their blowholes above the surface of the water while they sleep.
D) they move to shallow water to sleep, so they do not need to swim to keep their blowholes above the surface of the water.
E) they alternate which half of their brains is asleep and which half is awake.
Answer: E
Topic: Concept 49.2
Skill: Knowledge/Comprehension

27) The limbic system in the central nervous system sustains many vegetative functions in mammals and is closely associated with structures that process cues about
A) gustation.
B) olfaction.
C) vision.
D) audition.
E) mechanosensation.
Answer: B
Topic: Concept 49.2
Skill: Knowledge/Comprehension

28) The telencephalon region of the developing brain of a mammal
A) develops as the neural tube differentiates.
B) develops from the midbrain.
C) is the brain region most like that of ancestral vertebrates.
D) gives rise to the cerebrum.
E) divides further into the metencephalon and myelencephalon.
Answer: D
Topic: Concept 49.2
Skill: Knowledge/Comprehension

29) Increases and decreases of the heart rate result from changes in the activity of the
A) corpus callosum.
B) medulla oblongata.
C) thalamus.
D) pituitary.
E) cerebellum.
Answer: B
Topic: Concept 49.2
Skill: Knowledge/Comprehension

30) The unconscious control of respiration and circulation are associated with the
A) thalamus.
B) cerebellum.
C) medulla oblongata.
D) corpus callosum.
E) cerebrum.
Answer: C
Topic: Concept 49.2
Skill: Knowledge/Comprehension

31) Which of the following structures are correctly paired?
A) forebrain and medulla oblongata
B) forebrain and cerebellum
C) midbrain and cerebrum
D) hindbrain and cerebellum
E) brainstem and anterior pituitary gland
Answer: D
Topic: Concept 49.2
Skill: Knowledge/Comprehension

32) Hormones that are secreted by the posterior pituitary gland are made in the
A) cerebrum.
B) cerebellum.
C) thalamus.
D) hypothalamus.
E) medulla oblongata.
Answer: D
Topic: Concept 49.2
Skill: Knowledge/Comprehension

33) The coordination of groups of skeletal muscles is driven by activity in the
A) cerebrum.
B) cerebellum.
C) thalamus.
D) hypothalamus.
E) medulla oblongata.
Answer: B
Topic: Concept 49.2
Skill: Knowledge/Comprehension

34) The regulation of body temperature derives from the activity of the
A) cerebrum.
B) cerebellum.
C) thalamus.
D) hypothalamus.
E) medulla oblongata.
Answer: D
Topic: Concept 49.2
Skill: Knowledge/Comprehension

35) The regulatory centers for the respiratory and circulatory systems are found in the
A) cerebrum.
B) cerebellum.
C) thalamus.
D) hypothalamus.
E) medulla oblongata.
Answer: E
Topic: Concept 49.2
Skill: Knowledge/Comprehension

36) Food and water appetites are under the regulatory influence of the
A) cerebrum.
B) cerebellum.
C) thalamus.
D) hypothalamus.
E) medulla oblongata.
Answer: D
Topic: Concept 49.2
Skill: Knowledge/Comprehension

37) Which processes in animals are regulated by circadian rhythms?
A) sleep cycles
B) hormone release
C) sex drive
D) sleep cycles and hormone release only
E) sleep cycles, hormone release, and sex drive
Answer: E
Topic: Concept 49.2
Skill: Knowledge/Comprehension

38) The motor cortex is part of the
A) cerebrum.
B) cerebellum.
C) spinal cord.
D) midbrain.
E) medulla oblongata.
Answer: A
Topic: Concept 49.2
Skill: Knowledge/Comprehension

39) The suprachiasmatic nuclei are found in the
A) thalamus.
B) hypothalamus.
C) epithalamus.
D) amygdala.
E) Broca's area.
Answer: B
Topic: Concept 49.2
Skill: Knowledge/Comprehension

40) In mammals, advanced cognition is usually correlated with a large and very convoluted neocortex, but birds are capable of sophisticated cognition because they have
A) a more advanced cerebellum.
B) a cerebellum with several flat layers.
C) a pallium with neurons clustered into nuclei.
D) microvilli to increase the brain's surface area.
Answer: C
Topic: Concept 49.2
Skill: Application/Analysis

41) Wernicke's and Broca's regions of the brain affect
A) olfaction.
B) vision.
C) speech.
D) memory.
E) hearing.
Answer: C
Topic: Concept 49.3
Skill: Knowledge/Comprehension

42) Which of the following shows a brain structure correctly paired with one of its primary functions?
A) frontal lobeÃdecision making
B) occipital lobeÃcontrol of skeletal muscles
C) temporal lobeÃvisual processing
D) cerebellumÃlanguage comprehension
E) occipital lobeÃspeech production
Answer: A
Topic: Concept 49.3
Skill: Knowledge/Comprehension

43) If you were writing an essay, the part of your brain that would be actively involved in this task is the
A) temporal and frontal lobes.
B) parietal lobe.
C) Broca's area.
D) Wernicke's area.
E) occipital lobe.
Answer: A
Topic: Concept 49.3
Skill: Knowledge/Comprehension

44) The establishment and expression of emotions involves the
A) frontal lobes and limbic system.
B) frontal lobes and parietal lobes.
C) parietal lobes and limbic system.
D) frontal and occipital lobes.
E) occipital lobes and limbic system.
Answer: A
Topic: Concept 49.3
Skill: Knowledge/Comprehension

45) Our understanding of mental illness has been most advanced by discoveries involving
A) the degree of convolutions in the brain's surface.
B) the evolution of the telencephalon.
C) the sequence of developmental specialization.
D) the chemicals involved in brain communications.
E) the nature of the blood-brain barrier.
Answer: D
Topic: Concept 49.3
Skill: Synthesis/Evaluation

46) Wernicke's area
A) is active when speech is heard and comprehended.
B) is active during the generation of speech.
C) coordinates the response to olfactory sensation.
D) is active when you are reading silently.
E) is found on the left side of the brain.
Answer: A
Topic: Concept 49.3
Skill: Knowledge/Comprehension

47) Failure of an embryonic neuron to establish a synaptic connection to another cell
A) converts that neuron to an ependymal cell.
B) causes the neuron to migrate to another part of the brain.
C) converts that neuron to a glial cell.
D) leads to Alzheimer's disease.
E) results in the apoptosis of that neuron.
Answer: E
Topic: Concept 49.4
Skill: Knowledge/Comprehension

48) Short-term memory information processing usually causes changes in the
A) brainstem.
B) medulla.
C) hypothalamus.
D) hippocampus.
E) cranial nerves.
Answer: D
Topic: Concept 49.4
Skill: Knowledge/Comprehension

49) Learning a new language during adulthood alters activity in the brain's language processing locations by
A) altering synaptic effectiveness in these locations.
B) increasing the rate of mitosis in these locations.
C) inhibiting synapses that work in the previously learned language.
D) causing established neurons to produce different neurotransmitter molecules.
E) forming electrical synapses between cells.
Answer: A
Topic: Concept 49.4
Skill: Knowledge/Comprehension

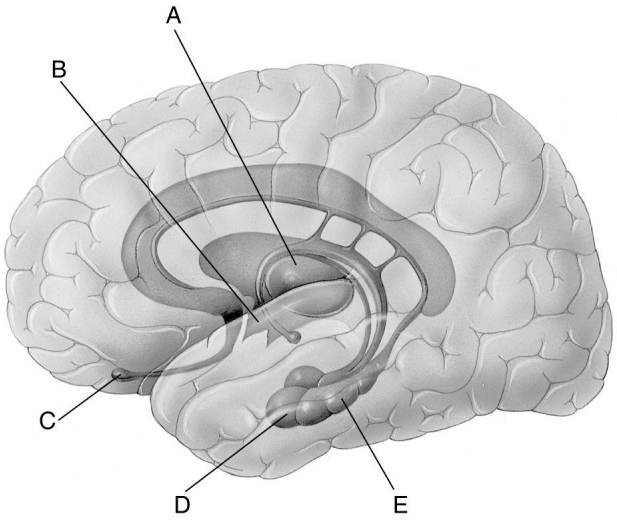
50) Forming new long-term memories is strikingly disrupted after damage to the
A) thalamus.
B) hypothalamus.
C) hippocampus.
D) somatosensory cortex.
E) primary motor cortex.
Answer: C
Topic: Concept 49.4
Skill: Knowledge/Comprehension

51) Bipolar disorder is similar to schizophrenia in that researchers suspect that both include trouble with the neurotransmitter
A) dopamine.
B) acetylcholine.
C) norepinephrine.
D) nitric oxide.
E) ethanol.
Answer: A
Topic: Concept 49.5
Skill: Application/Analysis

52) Bipolar disorder differs from schizophrenia in that
A) schizophrenia results in hallucinations.
B) schizophrenia results in both manic and depressive states.
C) schizophrenia results in decreased dopamine.
D) bipolar disorder involves both genes and environment.
E) bipolar disorder increases biogenic amines.
Answer: A
Topic: Concept 49.5
Skill: Application/Analysis

Art Questions

Refer to the following illustration of the limbic system to help answer the next few questions.



53) In the figure, which letter points to the amygdala?
A) A
B) B
C) C
D) D
E) E
Answer: D
Topic: Concept 49.2
Skill: Knowledge/Comprehension

54) In the figure, which letter points to the thalamus?
A) A
B) B
C) C
D) D
E) E
Answer: A
Topic: Concept 49.2
Skill: Knowledge/Comprehension

55) In the figure, which letter points to the olfactory bulb?
A) A
B) B
C) C
D) D
E) E
Answer: C
Topic: Concept 49.2
Skill: Knowledge/Comprehension

56) In the figure, which letter points to the hippocampus?
A) A
B) B
C) C
D) D
E) E
Answer: D
Topic: Concept 49.2
Skill: Knowledge/Comprehension

57) In the figure, which letter points to the hypothalamus?
A) A
B) B
C) C
D) D
E) E
Answer: D
Topic: Concept 49.2
Skill: Knowledge/Comprehension

Scenario Questions

58) Imagine you are resting comfortably on a sofa after dinner. This could be described as a state with
A) increased activity in the sympathetic, parasympathetic, and enteric nervous systems.
B) decreased activity in the sympathetic, parasympathetic, and enteric nervous systems.
C) decreased activity in the sympathetic nervous system, and increased activity in the parasympathetic and enteric nervous systems.
D) increased activity in the sympathetic nervous system, and decreased activity in the parasympathetic and enteric nervous systems.
E) increased activity in the sympathetic nervous system, decreased activity in the parasympathetic nervous system, and increased activity in the enteric nervous system.
Answer: C
Topic: Concept 49.1
Skill: Knowledge/Comprehension

59) When Phineas Gage had a metal rod driven into his frontal lobe, or when someone had a frontal lobotomy, they would
A) lose the ability to reason.
B) lose all short-term memory.
C) have greatly altered emotional responses.
D) lose all long-term memory.
E) lose their sense of balance.
Answer: C
Topic: Concept 49.3
Skill: Application/Analysis

End-of-Chapter Questions

The following questions are from the end-of-chapter "Test Your Understanding" section in Chapter 49 of the textbook.

60) Wakefulness is regulated by the reticular formation, which is present in the
A) basal nuclei.
B) cerebral cortex.
C) brainstem.
D) limbic system.
E) spinal cord.
Answer: C
Topic: End-of-Chapter Questions
Skill: Knowledge/Comprehension

61) Which of the following structures or regions is *incorrectly* paired with its function?
A) limbic systemÃmotor control of speech
B) medulla oblongataÃhomeostatic control
C) cerebellumÃcoordination of movement and balance
D) corpus callosumÃcommunication between the left and right cerebral cortices
E) amygdalaÃemotional memory
Answer: A
Topic: End-of-Chapter Questions
Skill: Knowledge/Comprehension

62) Patients with damage to Wernicke's area have difficulty
A) coordinating limb movement.
B) generating speech.
C) recognizing faces.
D) understanding language.
E) experiencing emotion.
Answer: D
Topic: End-of-Chapter Questions
Skill: Knowledge/Comprehension

63) The cerebral cortex plays a major role in all of the following *except*
A) short-term memory.
B) long-term memory.
C) circadian rhythm.
D) foot-tapping rhythm.
E) breath holding.
Answer: C
Topic: End-of-Chapter Questions
Skill: Knowledge/Comprehension

64) After suffering a stroke, a patient can see objects anywhere in front of him but pays attention only to objects in his right field of vision. When asked to describe these objects, he has difficulty judging their size and distance. What part of the brain was likely damaged by the stroke?
A) the left frontal lobe
B) the right frontal lobe
C) the left parietal lobe
D) the right parietal lobe
E) the corpus callosum
Answer: D
Topic: End-of-Chapter Questions
Skill: Application/Analysis

65) Injury localized to the hypothalamus would most likely disrupt
A) short-term memory.
B) coordination during locomotion.
C) executive functions, such as decision making.
D) sorting of sensory information.
E) regulation of body temperature.
Answer: E
Topic: End-of-Chapter Questions
Skill: Application/Analysis