CHAPTER 2

The Neuroscience of Learning and Memory

Multiple-Choice Questions

1. Four people failed a difficult exam and are trying to forget about the experience. Which person will be MOST successful?
   A) Manny, who has been staying awake for the past three nights
   B) Jacob, who keeps thinking about how important this test was
   C) Joan, who has taken up meditation
   D) Bree, who enjoys listening to music, watching TV, and talking to her friends all at once
   Ans: A Difficulty: Medium Page: 40 Section: Top Five Tips for Faster Forgetting

2. Early learning and memory researchers focused on behavior, rather than brain function, because:
   A) they did not think the brain was involved in learning and memory.
   B) they were not interested in how the brain was involved in learning and memory.
   C) technology wasn't yet available for studying the complexities of the brain.
   D) none of them knew how to study physiology.
   Ans: C Difficulty: Easy Page: 41 Section: A Quick Tour of the Brain

3. The nervous system:
   A) is mainly involved in cooling the blood.
   B) has always been considered the seat of learning and memory.
   C) is a relatively simple anatomical system.
   D) is devoted to the distribution and processing of information.
   Ans: D Difficulty: Easy Page: 41 Section: A Quick Tour of the Brain; The Brain and the Nervous System

4. The central nervous system is made up of the:
   A) nerves and muscles.
   B) sensory organs.
   C) sensory and motor neurons.
   D) The brain and the spinal cord.
   Ans: D Difficulty: Easy Page: 41 Section: The Brain and the Nervous System

5. If a friend pats you on the back, the neurons that carry the information from the touch receptors on your back to your brain are part of the:
   A) central nervous system.
   B) peripheral nervous system.
   C) left hemisphere.
   D) right hemisphere.
   Ans: B Difficulty: Medium Page: 41 Section: The Brain and the Nervous System

6. When you reach to catch a basketball, the neurons that carry the message from your brain to the muscles in your arms and hands are part of the:
   A) central nervous system.
   B) peripheral nervous system.
   C) left hemisphere.
   D) right hemisphere.
   Ans: B Difficulty: Medium Page: 41 Section: The Brain and the Nervous System

7. In vertebrates, the nervous system is divided into the:
   A) brain and neurons.
   B) parietal lobe and the occipital lobe.
   C) central nervous system and the peripheral nervous system.
   D) cerebellum and the brainstem.
   Ans: C Difficulty: Medium Page: 41 Section: The Brain and the Nervous System

8. The largest structure of the human brain is the:
   A) cerebral cortex. B) frontal lobe. C) cerebellum. D) temporal lobe.
   Ans: A Difficulty: Medium Page: 42 Section: The Human Brain

9. The structure that sits at the base of the brain is known as the:
   A) cerebral cortex. B) parietal lobe. C) brainstem. D) frontal lobe.
   Ans: C Difficulty: Easy Page: 42 Section: The Human Brain

10. If you fall and injure the back of your head, which of the following will you MOST likely experience?
    A) difficulty understanding speech
    B) difficulty seeing your friend's face
    C) difficulty remembering names
    D) difficulty feeling the difference between silk and sandpaper
    Ans: B Difficulty: Difficult Page: 42 Section: The Human Brain

11. Mary is having trouble hearing her friends when they speak to her. Which part of her brain might be damaged?
    A) frontal lobe
    B) parietal lobe
    C) temporal lobe
    D) occipital lobe
    Ans: C Difficulty: Medium Page: 42 Section: The Human Brain

12. Which brain structure is involved in helping you learn the coordinated movements necessary for learning to ride a bike?
    A) temporal lobe B) brainstem C) thalamus D) cerebellum
    Ans: D Difficulty: Medium Page: 42 Section: The Human Brain

13. Which part of the brain helps regulate autonomic functions such as breathing?
    A) cerebellum B) brainstem C) hippocampus D) temporal lobe
    Ans: B Difficulty: Easy Page: 42 Section: The Human Brain

14. Which of the following would be MOST likely to involve the amygdala?
    A) remembering the details of your first date
    B) remembering how you felt when you graduated from high school
    C) remembering how to perform an intricate sequence of gymnastic moves
    D) remembering the definition of new terms in your psychology class
    Ans: B Difficulty: Difficult Page: 43 Section: The Human Brain

15. Which of the following brain structures is especially important for remembering your eighth birthday party?
    A) thalamus B) basal ganglia C) amygdala D) hippocampus
    Ans: D Difficulty: Difficult Page: 43 Section: The Human Brain

16. Which of the following brain structures receives sensory information from the peripheral nervous system and relays this information to other parts of the brain?
    A) thalamus B) basal ganglia C) amygdala D) hippocampus
    Ans: A Difficulty: Easy Page: 43 Section: The Human Brain

17. Which of the following is true?
    A) Animals must have both a central and peripheral nervous system in order to be able to learn.
    B) Animals with larger brains have higher intelligence than animals with smaller brains.
    C) Only vertebrates have both a central and a peripheral nervous system.
    D) The cerebral cortex takes up about the same percentage of total brain volume in humans as it does in other vertebrates.
    Ans: C Difficulty: Medium Page: 44 Section: Comparative Neuroanatomy

18. Studying invertebrate nervous systems is useful because invertebrates:
    A) have more simple nervous systems than vertebrates do.
    B) have clearly defined central and peripheral nervous systems.
    C) are incapable of learning, making it easier to study their other behaviors.
    D) do not have any neurons in their nervous systems .
    Ans: A Difficulty: Medium Page: 45 Section: Comparative Neuroanatomy

19. Which part of a neuron transmits information to other neurons?
A) dendrites B) cell body C) axon D) glia
Ans: C Difficulty: Easy Page: 45 Section: Neurons

20. What is the usual function of dendrites?
A) receiving signals from other neurons
B) transmitting information to other neurons
C) transferring oxygen from the blood to neurons
D) wrapping neurons in myelin
Ans: A Difficulty: Medium Page: 45 Section: Neurons

21. Which of the following is true?
A) There are more neurons than glia in the brain.
B) Neurons are all the same shape and size.
C) Some neurons have no axons.
D) Glia are not necessary for normal brain functioning.
Ans: C Difficulty: Medium Page: 46 Section: Neurons

22. Which cells provide functional and structural support to neurons?
A) pyramidal cells B) stellate cells C) interneurons D) glia
Ans: D Difficulty: Easy Page: 46 Section: Neurons

23. The study of the relationship between the size and shape of different parts of people's skulls and their personalities and abilities is called:
A) equipotentiality. C) phrenology.
B) comparative brain anatomy. D) neuropsychology.
Ans: C Difficulty: Easy Page: 46 Section: Observing Learning-Related Changes in Brain Structure

24. Phrenology was a systematic study of the brain that was pursued by:
A) Galen. B) Aristotle. C) Paul Broca. D) Franz Joseph Gall.
Ans: D Difficulty: Medium Page: 46 Section: Observing Learning-Related Changes in Brain Structure

25. Imagine a parent who has two children. The first child has a very large forehead, and the second child's head is very large at the back. According to the system of phrenology, the first child would excel at _____ and the second would excel at _____.
A) planning and performing actions; remembering
B) remembering; seeing the world
C) seeing the world; planning and performing actions
D) planning and performing actions; seeing the world
Ans: D Difficulty: Difficult Page: 46 Section: Observing Learning-Related Changes in Brain Structure

26. Which of the following is true regarding the computed tomography (CT) scan method of brain imaging?
    A) It uses changes in magnetic fields to create images of the internal structure of the brain.
    B) Multiple scans must be taken at different angles in order to determine the depth of a structure.
    C) It is used more commonly today than the magnetic resonance imaging (MRI) technique.
    D) Brain structures usually show up more clearly than do bones and tumors.
    Ans: B Difficulty: Medium Page: 47
    Section: Observing Learning-Related Changes in Brain Structure

27. Which neuroimaging technique uses changes in magnetic fields to generate images of internal brain structure?
    A) single-cell recording
    B) lesions
    C) computed tomography (CT)
    D) magnetic resonance imaging (MRI)
    Ans: D Difficulty: Easy Page: 47 Section: Observing Learning-Related Changes in Brain Structure

28. Which brain imaging method is especially useful for studying the connections between brain regions?
    A) diffusion tensor imaging (DTI)
    B) magnetic resonance imaging (MRI)
    C) computed tomography (CT)
    D) lesions
    Ans: A Difficulty: Medium Page: 48 Section: Observing Learning-Related Changes in Brain Structure

29. If you put your hand on a hot stove, you will automatically pull it away before realizing what you've done. This is an example of a(n):
    A) reflexive behavior.
    B) voluntary behavior.
    C) learned behavior.
    D) intentional behavior.
    Ans: A Difficulty: Easy Page: 49 Section: Information Pathways in the Central Nervous System

30. Which of the following is an example of a reflexive behavior?
    A) Pavlov’s dog salivating in response to a sound that has predicted food
    B) a dog that has learned to sit to obtain a treat
    C) a newborn sucking when encountering a nipple
    D) a rat pressing a bar to obtain a drink of water
    Ans: C Difficulty: Medium Page: 49 Section: Information Pathways in the Central Nervous System

31. According to the Bell-Magendie law of neural specialization:
    A) reflexes are caused by spirits flowing from the brain into the muscles.
    B) the brain plays a major role in reflexes like the “knee-jerk” response to a doctor's

rubber mallet.
C) the spinal cord has one nerve system for sensing and another nerve system for responding.
D) spinal reflexes can be combined into complex sequences of movements that are the basis of all behavior.
Ans: C Difficulty: Medium Page: 50 Section: Information Pathways in the Central Nervous System

32. Which of the following would occur if the sensory fibers in your arm were cut?
A) You would still automatically jerk your hand away from a hot stove.
B) You would have a limited range of motion in your arm.
C) You would not be able to move your arm at all.
D) You would not be able to feel a sharp poke on your arm.
Ans: D Difficulty: Difficult Page: 50 Section: Information Pathways in the Central Nervous System

33. Many basic reflexes:
A) do not require the brain's involvement.
B) use only the sensory neurons.
C) involve the pumping of spirits or fluids into the muscles.
D) end with input to the sensory neurons.
Ans: A Difficulty: Medium Page: 50
Section: Information Pathways in the Central Nervous System

34. Incoming sensory information is passed from the thalamus to the:
A) spinal cord.
B) muscles.
C) primary motor cortex.
D) primary sensory cortices.
Ans: D Difficulty: Easy Page: 51 Section: Incoming Stimuli: Sensory Pathways into the Brain

35. Most sensory information enters the brain through the:
A) thalamus.
B) occipital lobe.
C) primary motor cortex.
D) primary sensory cortices.
Ans: A Difficulty: Easy Page: 51 Section: Incoming Stimuli: Sensory Pathways into the Brain

36. The primary sensory cortices:
A) process the outputs that control movements.
B) are responsible for processing the more complex characteristics of stimuli.
C) are specialized for processing particular sensory stimuli.
D) send most of their output to the peripheral nervous system.
Ans: C Difficulty: Medium Page: 51
Section: Incoming Stimuli: Sensory Pathways into the Brain

37. When you open a door, which part of the brain is responsible for sending signals to your arm muscles, causing you to open the door?
    A) V1 (visual cortex)
    B) frontal cortex
    C) M1 (motor cortex)
    D) basal ganglia and cerebellum
    Ans: C Difficulty: Medium Page: 51 Section: Outgoing Responses: Motor Control

38. The primary motor cortex is located in the:
    A) frontal lobe.
    B) parietal lobe.
    C) occipital lobe.
    D) temporal lobe.
    Ans: A Difficulty: Easy Page: 51 Section: Outgoing Responses: Motor Control

39. The motor cortex (M1) sends its output signals to the:
    A) frontal lobes. B) basal ganglia. C) cerebellum. D) brainstem.
    Ans: D Difficulty: Medium Page: 51 Section: Outgoing Responses: Motor Control

40. Which part of the brain is involved in the high-level planning of the movements involved in picking up and using a pencil?
    A) frontal lobes B) basal ganglia C) cerebellum D) brainstem
    Ans: A Difficulty: Medium Page: 51 Section: Outgoing Responses: Motor Control

41. What is the name of the narrow gap across which neurons pass chemical messages to each other?
    A) axon B) dendrite C) synapse D) cell body
    Ans: C Difficulty: Easy Page: 53 Section: The Synapse: Where Neurons Connect

42. Most neural connections are between the:
    A) axons of the presynaptic and the postsynaptic neurons.
    B) dendrites of the presynaptic and the postsynaptic neurons.
    C) axons of the presynaptic neuron and the dendrites of the postsynaptic neuron.
    D) dendrites of the presynaptic neuron and the axons of the postsynaptic neuron.
    Ans: C Difficulty: Medium Page: 53 Section: The Synapse: Where Neurons Connect

43. *Neurotransmitters* are:
    A) chemical substances that carry messages between neurons.
    B) the part of a neuron that receives signals from other neurons.
    C) types of neurons that connect other neurons together.
    D) types of neurons that have pyramid-shaped cell bodies.

Ans: A Difficulty: Easy Page: 53 Section: The Synapse: Where Neurons Connect

44. Most neurons can produce and release _____ and can receive _____.
A) many different neurotransmitters; many different neurotransmitters
B) just one neurotransmitter; just one neurotransmitter
C) just one neurotransmitter; many different neurotransmitters
D) many different neurotransmitters; just one neurotransmitter
Ans: C Difficulty: Medium Page: 54 Section: The Synapse: Where Neurons Connect

45. Molecules on the surface of the postsynaptic cell that bind with and respond to neurotransmitters are called:
A) synapses.
B) receptors.
C) neuromodulators.
D) glia.
Ans: B Difficulty: Medium Page: 53 Section: The Synapse: Where Neurons Connect

46. After a neuron fires, there is a brief period during which it is unable to fire again. What is this period called?
A) refractory period
B) inactivation period
C) postsynaptic period
D) reuptake period
Ans: A Difficulty: Medium Page: 54 Section: The Synapse: Where Neurons Connect

47. Inactivation and reuptake are mechanisms for:
A) inhibiting neurons from responding.
B) removing dead neurons from the brain.
C) increasing the amount of neurotransmitter that is released.
D) clearing neurotransmitters from the synapse.
Ans: D Difficulty: Medium Page: 55 Section: The Synapse: Where Neurons Connect

48. Neurotransmitters that affect activity in entire brain areas, rather than just at a single synapse, are called:
A) neuromodulators.
B) refractory transmitters.
C) glia.
D) reuptake transmitters.
Ans: A Difficulty: Easy Page: 55 Section: The Synapse: Where Neurons Connect

49. The most prevalent excitatory neurotransmitter is:
A) glutemate.
B) dopamine.
C) GABA.
D) acetylcholine.

Ans: A Difficulty: Medium Page: 54 Section: The Synapse: Where Neurons Connect, Table 2.1

50. Which neurotransmitter increases attention and concentration?
    A) serotonin
    B) epinephrine
    C) histamine
    D) glycine
    Ans: B: Difficulty: Medium Page: 54 Section: The Synapse: Where Neurons Connect, Table 2.1

51. Glycine:
    A) connects motor neurons and muscles.
    B) contributes to long-lasting memories.
    C) regulates mood.
    D) decreases neural activity.
    Ans: D Difficulty: Medium Page: 54 Section: The Synapse, Where Neurons Connect, Table 2.1

52. Laci is trying to teach her toddler to use his manners. She gives him a cookie whenever he remembers to say "please". Which neurotransmitter regulates the toddler's use of manners to obtain the cookie?
    A) glutemate
    B) dopamine
    C) GABA
    D) acetylcholine
    Ans: B Difficulty: Difficult Page: 54 Section: The Synapse: Where Neurons Connect, Table 2.1

53. Which field involves the study of patients with specific types of brain damage in order to learn about the relation between brain function and behavior?
    A) neurophysiology
    B) functional neuroimaging
    C) neuropsychology
    D) synaptic plasticity
    Ans: C Difficulty: Medium Page: 55 Section: Discovering How Different Brain Regions Function

54. What is an *engram*?
    A) a measure of the amount of electrical activity on a person's scalp
    B) a change in synaptic transmission as a result of recent activity
    C) a physical change in the brain that forms the basis of a memory
    D) a map that shows which part of the body each region of M1 controls
    Ans: C Difficulty: Easy Page: 56 Section: Discovering How Different Brain Regions Function

55. The idea that memories are stored across the brain as a whole is called the:
    A) engram theory.
    B) theory of equipotentiality.
    C) localization theory.
    D) phrenology theory.
    Ans: B Difficulty: Easy Page: 56 Section: Discovering How Different Brain Regions Function

56. One of the reasons Karl Lashley was unable to find evidence for the engram was that:
    A) he used too simple a task for assessing memory.
    B) he limited his lesions to the cerebral cortex.
    C) he was unable to lesion rat brains due to ethical constraints.
    D) the memories of rats are too different from the memories of humans.
    Ans: B Difficulty: Mediu Page: 56 Section: Discovering How Different Brain Regions Function

57. The basic idea behind functional neuroimaging is:
    A) researchers can learn about brain structures by removing them and observing any changes in behavior.
    B) brain structures change color when they are active.
    C) structures that are more active use more oxygen.
    D) structures that are more active use less oxygen.
    Ans: C Difficulty: Easy Page: 58 Section: Functional Neuroimaging and Electroencephalography

58. In functional neuroimaging, a difference image is used for determining:
    A) how long it takes a person to complete a memory task.
    B) what percentage of the brain is being used at any given moment.
    C) how much neural activity has changed relative to a baseline.
    D) how much neural activity occurs while a person is relaxed.
    Ans: C Difficulty: Medium Page: 58 Section: Functional Neuroimaging and Electroencephalography

59. Which neuroimaging technique involves injecting a radioactive chemical into the bloodstream in order to measure the amount of activity in different brain regions?
    A) positron emission tomography (PET)
    B) functional magnetic resonance imaging (fMRI)
    C) single-cell recording
    D) event-related potentials (ERP)
    Ans: A Difficulty: Easy Page: 59 Section: Functional Neuroimaging and Electroencephalography

60. Functional magnetic resonance imaging (fMRI):
    A) directly measures neural activity.
    B) usually picks up more areas of brain activation than does positron emission tomography (PET).
    C) requires injecting radioactive materials into the participant's bloodstream.
    D) is faster than positron emission tomography (PET).
    Ans: D Difficulty: Medium Page: 59 Section: Functional Neuroimaging and Electroencephalography

61. Which neuroimaging technique uses electrodes to record electrical activity emitted from a person's scalp?
    A) positron emission tomography (PET)
    B) functional magnetic resonance imaging (fMRI)
    C) electroencephalography (EEG)
    D) computed tomography (CT)
    Ans: C Difficulty: Easy Page: 60 Section: Functional Neuroimaging and Electroencephalography

62. If a researcher uses an EEG to measure the brain's response to a visual stimulus, neurons other than those that respond to visual stimuli will also be active. How do researchers determine which neurons are responding only to the visual stimulus?
    A) They present the visual stimulus at a very high intensity.
    B) They measure the activity of just one neuron at a time.
    C) They make sure to present only a visual stimulus and nothing else.
    D) They take the average of several EEGs.
    Ans: D Difficulty: Easy Page: 61 Section: Functional Neuroimaging and Electroencephalography

63. An event-related potential (ERP) is:
    A) the average of many EEGs across repetitions of an event.
    B) a measure of the amount oxygen being used by brain structures.
    C) a measure of the activity of a single neuron.
    D) the electrical activity emitted from the scalp, recorded on a single trial.
    Ans: A Difficulty: Easy Page: 61 Section: Functional Neuroimaging and Electroencephalography

64. In comparison to the fMRI and the PET, the EEG technique:
    A) is less expensive.
    B) gives less precise information about rapid changes in the brain.
    C) has better spatial precision.
    D) is better at measuring metabolic activity in the brain.
    Ans: A Difficulty: Medium Page: 61 Section: Functional Neuroimaging and Electroencephalography

65. What technique can be used to determine whether a single neuron responds better to a red light or to a green light?
    A) positron emission tomography (PET)
    B) functional magnetic resonance imaging (fMRI)
    C) electroencephalography (EEG)
    D) single-cell recording

Ans: D Difficulty: Medium Page: 61 Section: Recording from and Activating Neurons

66. Single-cell recordings:
    A) are very uncomfortable for animals when electrodes are implanted into their brains.
    B) have been used to demonstrate cells that are "tuned" to particular body movements.
    C) are taken from the surface of an animal's brain.
    D) are used to determine the activity in large regions of the brain.
    Ans: B Difficulty: Medium Page: 62 Section: Recording from and Activating Neurons

67 Which of the following statements about the homunculus is false?
    A) It represents the activity of neurons in the hippocampus.
    B) It means "little man."
    C) It is somewhat different for each individual.
    D) It exaggerates the parts of the body that have more fine motor control.
    Ans: A Difficulty: Easy Pages: 63-64 Section: Recording from and Activating Neurons

68. The technique in which researchers activate parts of the brain by placing a magnet on the skull is called:
    A) single-cell recording.
    B) transcranial magnetic stimulation (TMS).
    C) functional magnetic resonance imaging (fMRI).
    D) electroencephalography (EEG)
    Ans: B Difficulty: Easy Page: 64 Section: Recording from and Activating Neurons

69. Drugs are able to:
    A) change the behavior of the presynaptic neuron.
    B) change the behavior of the postsynaptic neuron.
    C) change the rate at which neurotransmitters are cleared from the synapse.
    D) All of the answers are correct.
    Ans: D Difficulty: Easy Pages: 64-65 Section: Observing the Effects of Drugs

70. Which of the following is false?
    A) The influence of drugs on learning and memory is usually a side effect.
    B) A given drug usually affects just one neurotransmitter system.
    C) Drugs can alter the ability of postsynaptic receptors to receive neurotransmitters.
    D) Drugs affect the brain by altering synaptic transmission.
    Ans: B Difficulty: Easy Pages: 64-65 Section: Observing the Effects of Drugs

71. Which of the following has been shown to clearly improve memory in healthy individuals?
    A) drugs that increase levels of acetylcholine in Alzheimer's patients
    B) drugs that improve attention
    C) drugs that treat sleep disorders
    D) None of the answers is correct.
    Ans: D Difficulty: Easy Page: 66 Section: Can a Pill Improve Your Memory?

72. What is synaptic plasticity?
    A) the ability of synapses to change as a result of experience
    B) the finding that neurons are not rigid, but can bend to connect with nearby neurons
    C) the ability of neurons to absorb a stain of silver chromate
    D) the finding that drugs can impact the release of neurotransmitters by the presynaptic neuron
    Ans: A Difficulty: Easy Page: 66 Section: Neural Plasticity

73. The idea that "neurons that fire together, wire together," was proposed by:
    A) Santiago Ramón y Cajal.
    B) Camillo Golgi.
    C) Donald Hebb.
    D) Ivan Pavlov.
    Ans: C Difficulty: Easy Page: 66 Section: Neural Plasticity

74. Long-term potentiation is when:
    A) neurons continue to respond long after a stimulus has been removed.
    B) a recent strong stimulus causes a neuron to overrespond to a subsequent stimulus.
    C) neurons respond in the absence of a stimulus.
    D) a strong stimulus leads to a weaker-than-normal response in a neuron.
    Ans: B Difficulty: Medium Page: 67 Section: Long-Term Potentiation and Depression

75. Long-term potentiation has been shown to occur:
    A) in the hippocampus, but not in other brain areas.
    B) only when the presynaptic neuron is stimulated.
    C) in all brain areas, except for the hippocampus.
    D) when the presynaptic and postsynaptic neurons are active at the same time.
    Ans: D Difficulty: Easy Pages: 67-68 Section: Long-Term Potentiation and Depression

76. Which of the following has NOT been proposed as a mechanism of LTP?
    A) Postsynaptic receptors become more responsive to inputs.
    B) Presynaptic neurons are changed by a retrograde messenger.
    C) New synapses are built.
    D) Postsynaptic neurons release more neurotransmitters.

Ans: D Difficulty: Medium Page: 68 Section: How Is LPT Implemented in a Neuron?

77. When synaptic transmission becomes less effective as a result of recent activity, it is known as:
A) long-term potentiation.
B) inhibition.
C) retrograde potentiation.
D) long-term depression.
Ans: D Difficulty: Easy Page: 69 Section: Long-Term Potentiation and Depression

78. Compared to rats raised in a standard laboratory environment, rats raised in an enriched environment:
A) show the same ability to learn a maze.
B) have more and longer dendrites .
C) have fewer synapses.
D) have brains that weigh less.
Ans: B Difficulty: Easy Page: 70 Section: Experience-Dependent Neural Growth

79. Mitsy is a dog whose owners work long hours. She spends most of her day in her kennel with a blanket and a bone. Max is a dog who lives with a large family. He spends his days playing with the children and neighbors and the variety of dog toys they bring him. If you could look at the brains of these two dogs, which of the following you would expect to see?
A) You wouldn't expect any differences.
B) Mitsy's brain would be heavier than Max's.
C) Max's brain would have more synapses than Mitsy's.
D) Max's brain would have fewer dendrites than Mitsy's.
Ans: C Difficulty: Medium Page: 70 Section: Experience-Dependent Neural Growth

80. One study showed that taxi drivers in London had a_____ than age-matched controls:
A) larger hippocampus
B) larger cortex
C) smaller hippocampus
D) smaller cortex
Ans: A Difficulty: Medium Page: 70 Section: Experience-Dependent Neural Growth

Web Quiz Questions

1. If you stub your toe, the painful sensation is carried to the brain by neurons in the:
   A) occipital lobe.
   B) frontal lobe.
   C) central nervous system.
   D) peripheral nervous system.
   Ans: D Difficulty: Easy Page: 41 Section: The Brain and the Nervous System

2. Which lobe of the cerebral cortex is responsible for processing things that you hear?
   A) frontal lobe B) temporal lobe C) occipital lobe D) parietal lobe
   Ans: B Difficulty: Easy Page: 42 Section: The Human Brain

3. *Comparative brain anatomy* refers to the examination of the similarities and differences among the:
   A) brains of people of different ages.
   B) cerebral hemispheres.
   C) different lobes of the cerebral cortex.
   D) brains of different organisms.
   Ans: D Difficulty: Easy Page: 43 Section: Comparative Neuroanatomy

4. The ability of worms and jellyfish to learn is notable because they each have:
   A) a central nervous system but not a peripheral nervous system.
   B) no recognizable brain.
   C) no neurons.
   D) very large brainstems.
   Ans: B Difficulty: Medium Page: 44 Section: Comparative Neuroanatomy

5. Which part of a neuron sends signals to other neurons?
   A) dendrites B) cell body C) axon D) glia
   Ans: C Difficulty: Easy Page: 45 Section: Neurons

6. *Phrenology* involves:
   A) scanning the brains of living humans using a magnetic field.
   B) associating deficits in mental abilities with damage to specific brain regions.
   C) associating bumps on the skull with abilities and personality traits.
   D) examining which parts of the brain are damaged after a head injury.
   Ans: C Difficulty: Easy Page: 46 Section: Observing Learning-Related Changes in Brain Structure

7. A doctor is concerned that Martha has dysfunction involving the axons of her brain. Which neuroimaging technique would BEST be able to detect this problem?
   A) phrenology
   B) diffusion tensor imaging (DTI)
   C) computed tomography (CT) scan
   D) magnetic resonance imaging (MRI)
   Ans: B Difficulty: Difficult Page: 48
   Section: Observing Learning-Related Changes in Brain Structure

8. Which of the following is a reflexive behavior?
   A) a dog salivating in response to food
   B) a student studying hard after receiving a poor grade

C) a pigeon pecking at a light to obtain food
D) a child saying "please" in order to get a cookie
Ans: A Difficulty: Medium Page: 49
Section: Information Pathways in the Central Nervous System

9. The Bell-Magendie law:
A) applies to the brainstem but not to the spinal cord.
B) proposes one nerve system for sensing and another for responding.
C) applies to the central nervous system but not to the peripheral nervous system.
D) proposes that the brain is divided into two hemispheres.
Ans: B Difficulty: Medium Page: 50
Section: Information Pathways in the Central Nervous System

10. When you recognize a friend at a party, which brain area is the first to receive the information from your visual receptors?
A) primary visual cortex (V1) C) thalamus
B) primary sensory cortex D) frontal cortex
Ans: C Difficulty: Medium Page: 51
Section: Incoming Stimuli: Sensory Pathways into the Brain

11. Suppose researchers train a pigeon to peck at a blue disc to obtain food. They then lesion a very small part of its brain and find that the pigeon has forgotten that it needs to peck the blue disc for food. Such a finding would be evidence for:
A) the theory of equipotentiality.
B) the Bell-Magendie law of neural specialization.
C) synaptic plasticity.
D) the engram.
Ans: D Difficulty: Difficult Page: 56 Section: Discovering How Different Brain Regions Function

12. Which of the following is true regarding positron emission tomography (PET)?
A) It is a direct measure of brain activity.
B) It is a very fast measure of brain activity.
C) It involves injecting a radioactive chemical into the person's bloodstream.
D) It involves measuring electrical activity from a person's scalp.
Ans: C Difficulty: Medium Page: 59
Section: Functional Neuroimaging and Electroencephalography

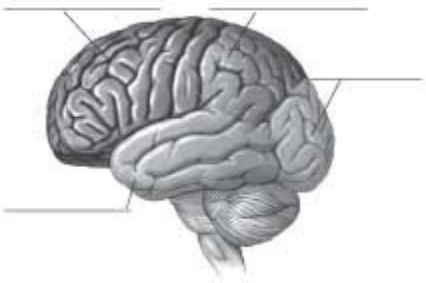
13. In neuroimaging studies, researchers use a(n) _____ to determine how activity at each point in the image has changed relative to a baseline.
A) engram B) event-related potential C) lesion D) difference image
Ans: D Difficulty: Easy Page: 58
Section: Functional Neuroimaging and Electroencephalography

14. Which of the following is NOT a mechanism by which drugs alter synaptic transmission?
    A) increasing the ability of the presynaptic neuron to produce neurotransmitter
    B) increasing the ability of the presynaptic neuron to receive neurotransmitter
    C) decreasing the ability of the presynaptic neuron to produce neurotransmitter
    D) altering the mechanisms for clearing neurotransmitter from the synapse
    Ans: B Difficulty: Difficult Pages: 64-65 Section: Observing the Effects of Drugs

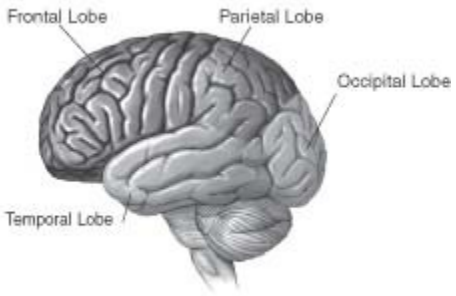
15. Long-term potentiation:
    A) was first observed in the thalamus.
    B) occurs when the postsynaptic neuron is stimulated with a high-frequency burst.
    C) can last for hours or even longer.
    D) involves a weakening in synaptic transmission following recent activity.
    Ans: C Difficulty: Medium Page: 67 Section: Long-term Potentiation and Depression

Essay Questions

1. Label the four lobes of the cerebral cortex in the following figure.



    Ans:

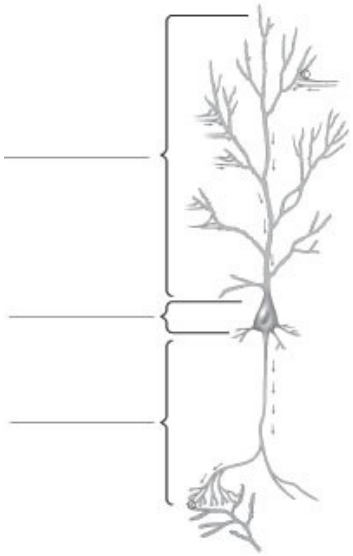


2. List two brain structures that are especially important for learning and memory. Briefly describe the involvement of each one.
    Ans: Grading criteria: There are four structures described in the chapter:
    1. Thalamus--receives sensory input from the PNS
    2. Basal ganglia—is important for learning skills (movement)

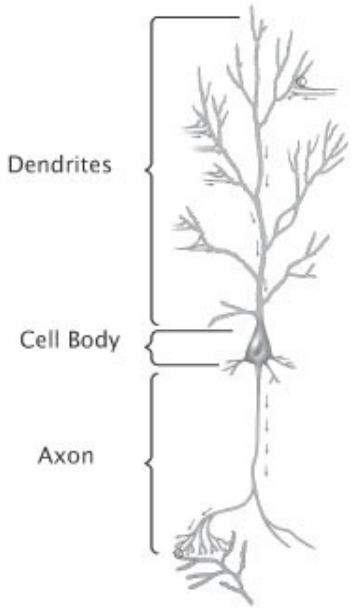
3. Hippocampus—is critical for learning new information and remembering autobiographical information
4. Amygdala--adds emotional content to memories

3. Describe one piece of evidence that shows learning in invertebrates.
   Ans: Grading criteria: There are two examples described in the chapter:
   1. Octopus--finds its way through a maze, learns to open a jar for a food reward, learns to grab the correct ball by watching another octopus (social learning)
   2. Nematodes--learn to approach or avoid tastes/odors.

4. Label the parts of the neuron in the following figure.



Ans:



5. What was one of the problems with phrenology?
   Ans: Grading criteria: The main problem is that phrenology assumes that the shape of the skull reflects the shape of the brain, which is not true. Other acceptable answers: Gall studied only the skulls, not the actual brains, of living people; it was misused by quacks trying to make money; it was used to justify mistreatment of criminals and others deemed inferior to the ruling class.

6. Describe how magnetic resonance imaging (MRI) works.
   Ans: Grading criteria: Include all of the main steps—brain (or area to be scanned) is surrounded by a magnetic field, magnet aligns some of the atoms in the brain, radio waves disturb the atoms, atoms return to aligned state; how long this takes depends on the density of atoms in that part of the brain.

7. What is the difference between structural neuroimaging and functional neuroimaging?
   Ans: Grading criteria: Structural neuroimaging allows one to see the anatomical areas but not their activity; functional neuroimaging allows one to look at the activity of brain areas.

8. Give an example of a reflex that humans have.
   Ans: Grading criteria: There are numerous possible examples, including eyeblink, knee-jerk, newborns' sucking, diving reflex, palmar grasp reflex, among others. Answer must not be a learned response, e.g., salivating when driving past one's favorite restaurant, which is learned, not reflexive.

9. Describe the sensory and motor processes involved in crossing a busy street, including the areas of the brain that are involved.
   Ans: Grading criteria: Some of the key components are: Watch for cars; visual input passes from eyes, through thalamus, to visual cortex; frontal cortex helps determine movements such as stepping down off the curb, how quickly to move legs; this information is sent to M1; M1 sends messages down to the brainstem, which connects to the spinal cord, and so the messages travel down spinal cord to muscles; you walk across the street.

10. Describe the process of transmitting messages from one neuron to the next.
    Ans: Grading criteria: Include basic details: presynaptic cell, release of neurotransmitter (and that it is a chemical), postsynaptic receptors bind to neurotransmitter, postsynaptic cell integrates the message and decides to fire if the signal is strong enough. (Ideally, explain that this is all-or-nothing.)

11. Explain why experimental brain lesions in animals allow for greater precision than is typically possible in humans.
    Ans: Grading criteria: Explain that human brain lesions are usually due to accidents/illness and vary from person to person, and can involve many brain

areas; in animals, can disable specific single brain regions. Note that a general explanation of why animal research is justified would not be sufficient to answer this question.

12. Explain what Karl Lashley meant by the *engram*. How did he attempt to find it? Was he successful? What did his findings teach us about learning in the brain?
    Ans: Grading criteria: The *engram* is the supposed physical change in the brain that forms the basis of a memory. Lashley tried to find the engram by lesioning different areas of rats' brains and examining the effect on them of learning to run a maze. He was not successful--no one area appeared to be crucial for remembering the maze. His results revealed that memories are not completely localized in the brain.

13. In brain lesion studies, what kinds of results would you expect to see if memory is based on the engram? How would the results differ if the theory of equipotentiality were true?
    Ans: Grading criteria: Engram—should be able to lesion a small area and "erase" something that was previously learned; Equipotentiality—lesioning a small area should have little to no effect on a learned ability, since other areas can compensate.

14. Describe the advantages and disadvantages to using PET scans, fMRI, and EEG.
    Ans: Grading criteria: PET: The advantage is good spatial precision; the disadvantages are radioactive material needs to be injected, it requires expensive equipment, and it is relatively slow.

    fMRI: The advantage is that it has the best spatial precision; the disadvantages are that it is slower than EEG and it requires an expensive scanner.

    EEG: The advantage is that it is best for getting an immediate measure of brain activity (temporal precision); the disadvantage is that it has the worst spatial precision.

15. Describe the process of single-cell recording. When would a researcher want to use this technique?
    Ans: Grading criteria: Single-cell recording involves implanting a microelectrode into a single neuron and transmiting the signal to speakers that "hear" the response; a stimuli is presented or the animal subject performs a task as changes in the response of the neuron are measured. Researchers would use this technique in order to find out what individual neurons' roles are in a behavior, which is more precise than determining entire brain areas involved.

16. Describe two techniques that can be used to stimulate neural activity.
    Ans: Grading criteria:
    1. Electrical stimulation of individual neurons--use electrodes to deliver electrical stimulation, causing a response in the neuron.
    2. Transcranial magnetic stimulation--stimulate entire brain areas in humans with a strong magnetic pulse.

17. Suppose your roommate wants to take Ritalin (an attention-boosting drug) to help her remember information for her upcoming exam. What should you tell her?
    Ans: Grading criteria: Attention can improve memory in general; however, there is not good evidence at this time that any attention-boosting drugs improve memory in normal healthy people.

18. Describe the procedures used to elicit long-term potentiation in a neuron.
    Ans: Grading criteria: Include the main steps: Stimulate cell A, record from cell B; stimulate A with a burst of high-frequency stimulation; later, stimulate A again with weak stimulation, see that B responds more strongly than it did before.