

ANSWERS

Biological Bases of Behavior: 3B: The Brain

The Tools of Discovery: Having Our Head Examined

1. lesions; clinical observation
2. electroencephalogram (EEG)
3. CTscan
4. PETscan

By depicting the brain's consumption of radioactively labeled glucose, the PET scan allows researchers to see which brain areas are most active as a person performs various tasks. This provides additional information on the specialized functions of various regions of the brain.

5. MRI.(magnetic resonance imaging)
6. functional MRI; increases; visual

Older Brain Structures

1. brainstem
2. medulla; breathing; heartbeat; pons
3. brainstem
4. reticular formation; arousal; alert (awake); coma
5. thalamus; smell; medulla; cerebellum
6. cerebellum; nonverbal learning; balance
7. conscious; outside
8. limbic; hippocampus
9. amygdala
10. is not; does
11. hypothalamus; hunger; thirst; body temperature; sexual; hormones; pituitary; reward
12. addictive; reward deficiency syndrome

The Cerebral Cortex

1. cerebral cortex; information-processing
2. glial cells; learning; thinking
3. more wrinkled; increases
4. a. frontal lobe
b. parietal lobe
c. occipital lobe
d. temporal lobe
5. motor; frontal; greater; neural prosthetics; paralyzed; thoughts (or brains)
6. sensory; touch
7. sensory cortex

9. association areas; three-fourths; frontal; parietal; temporal
10. aphasia; Broca's area; Wernicke's area; angular gyrus
11. visual area; angular gyrus; Wernicke's area; Broca's area; motor cortex
12. unified whole
13. plasticity; young children
14. will not; reorganize; constraint-induced; can; neurogenesis; stem

Our Divided Brain

1. lateralization; left; dominant (major)
2. corpus callosum; split brain
3. right; name; right

The word pencil when flashed to a split-brain patient's right visual field would project only to the opposite, or left, hemisphere of the patient's brain. Because the left hemisphere contains the language control centers of the brain, the patient would be able to read the word aloud. The left hand is controlled by the right hemisphere of the brain. Because the right hemisphere would not be aware of the word, it would not be able to guide the left hand in identifying a pencil by touch.

4. left; right; unconscious; can

Right-Left Differences in the Intact Brain

1. left
2. left; right; recognizing faces; emotion
3. right; play

The Brain and Consciousness

1. consciousness
2. cognitive neuroscience
3. conscious
4. simultaneously; parallel
5. requires
6. limited; slow; serially

Progress Test 1

1. a. is the answer. The PET scan measures glucose consumption in different areas of the brain to determine their levels of activity. (p. 68)
b. The fMRI compares MRI scans taken less than a second apart to reveal brain structure and

- c. The EEG is a measure of electrical activity in the brain.
- d. MRI uses magnetic fields and radio waves to produce computer-generated images of soft tissues of the body.
2. a. is the answer. (p. 71)
- b. The reticular formation is linked to arousal.
- c. The brainstem governs the mechanisms of basic survival – heartbeat and breathing, for example – and has many other roles.
- d. The cerebellum coordinates movement output and balance.
3. d. is the answer. (p. 87)
- a. In most persons, language is primarily a left hemisphere function.
- b. Learned movements are unrelated to hemispheric specialization.
- c. Arithmetic reasoning is generally a left hemisphere function.
4. d. is the answer. As animals increase in complexity, there is an increase in the amount of association areas. (p. 78)
- a. The brainstem controls basic survival functions and is not related to the complexity of an animal's behavior.
- b. The corpus callosum connects the brain's two hemispheres; it's not necessarily related to more complex behaviors.
- c. The frontal lobe is concerned with personality, planning, and other mental functions, but its size is unrelated to intelligence or the complexity of behavior.
5. c. is the answer. The reticular formation plays an important role in arousal. (p. 70)
- a. The thalamus relays sensory input.
- b. The corpus callosum links the two cerebral hemispheres.
- d. The cerebellum is involved in coordination of movement output and balance.
6. b. is the answer. (p. 84)
7. b. is the answer. Association areas interpret, integrate, and act on information from other areas of the cortex. (p. 78)
8. c. is the answer. (p. 80)
- a. The angular gyrus translates the signals into the auditory code.
- b. Broca's area is involved in speech production.
- d. The association areas are involved in higher order activities such as planning.
9. a. is the answer. (p. 80)
- b. Broca's area is involved in speech production.
- c. The angular gyrus converts to auditory code.
- d. The hippocampus has nothing to do with language.

Matching Items

- | | | |
|--------------|--------------|---------------|
| 1. d(p.72) | 5. g(p.70) | 9. k(p.70) |
| 2. e (p. 67) | 6. b (p. 68) | 10. i (p. 71) |
| 3. a(p.67) | 7. c(p.70) | 11. j(p.69) |
| 4. f (p. 68) | s. h (p. 84) | |

Progress Test 2

Multiple-Choice Questions

1. a. is the answer. The visual cortex is located at the very back of the brain. (p. 77)
2. b. is the answer. (p. 87) a., c., & d. Spatial reasoning, perceptual skills, and the left side of the body are primarily influenced by the right hemisphere.
- c. is the answer. (p. 74)
3. a. Hormones are secreted by endocrine glands directly into the bloodstream.
- b. Myelin sheath is the fatty tissue that intermittently surrounds the axons of neurons.
- d. Stem cells in the embryo can develop into any kind of cell.
4. d. is the answer. (p. 68)
- a. The EEG is an amplified recording of the brain's electrical activity.
- b. A lesion is destruction of tissue.
- c. The PET scan is a visual display of brain activity that detects the movement of a radioactive form of glucose as the brain performs a task.
5. d. is the answer. The cerebellum is involved in the coordination of voluntary muscular movements. (p. 70)
- a. The medulla regulates breathing and heartbeat.
- b. The thalamus relays sensory inputs to the appropriate higher centers of the brain.
- c. The hypothalamus is concerned with the regulation of basic drives and emotions.
6. a. is the answer. The reticular formation controls arousal via its connections to the cortex. Thus, separating the two produces a coma. (p. 70) b., c., & d. None of these structures controls arousal. The hypothalamus regulates hunger, thirst, sexual behavior, and other basic drives; the thalamus is a sensory relay station; and the cerebellum is involved in the coordination of voluntary movement.
7. b. is the answer. (p. 75)
- c. & d. These refer to the sensory cortex.
8. c. is the answer. The corpus callosum is a large band of neural fibers linking the right and left cerebral hemispheres. To sever the corpus callosum is in effect

9. d. is the answer. The frontal lobe is in the front of the brain. Just behind is the parietal lobe. The occipital lobe is located at the very back of the head and just below the parietal lobe. Next to the occipital lobe and toward the front of the head is the temporal lobe. (p. 74)
10. d. is the answer. As demonstrated in the case of Phineas Gage, injury to the frontal lobe may produce such changes in personality. (p. 79)
 - a. Damage to the parietal lobe might disrupt functions involving the sensory cortex.
 - b. Damage to the temporal lobe might impair hearing.
 - c. Occipital damage might impair vision.
11. c. is the answer. (p. 80)

Matching Items

- | | | |
|--------------|--------------|---------------|
| 1. d (p. 74) | 5. i (p. 82) | 9. k (p. 78) |
| 2. g (p. 69) | 6. a (p. 83) | 10. b (p. 74) |
| 3. e (p. 74) | 7. j (p. 80) | 11. c (p. 74) |
| 4. f (p. 74) | 8. h (p. 71) | |

Brain Damage Diagram

- | | | |
|------|------|------|
| 1. a | 4. d | 7. f |
| 2. h | 5. e | 8. g |
| 3. c | 6. b | |

Psychology Applied

Multiple-Choice Questions

1. c. is the answer. The brainstem is the oldest and most primitive region of the brain. It is found in lower vertebrates, such as fish, as well as in humans and other mammals. The structures mentioned in the other choices are associated with stages of brain evolution beyond that seen in the fish. (p. 69)
2. d. is the answer. Stimulation of the sensory cortex elicits a sense of touch, as the experiments of Penfield demonstrated. (p. 77)
 - a., b., & c. Hearing, seeing, or movement might be expected if the temporal, occipital, and motor regions of the cortex, respectively, were stimulated.
3. c. is the answer. As Lids and Milner discovered, electrical stimulation of the hypothalamus is a highly reinforcing event because it is the location of the animal's reward centers. The other brain
 4. a. is the answer. The left hand, controlled by the right hemisphere, would be able to identify the fork, the picture of which is flashed to the right hemisphere. (p. 84)
 5. b. is the answer. (p. 87) a., c., & d. The left hemisphere does not specialize in picture recognition. And blood clots can form anywhere in the brain.
 6. a. is the answer. The right visual field projects directly to the verbal left hemisphere. (pp. 84-85)
 - b. & c. The left hand is controlled by the right hemisphere, which, in this situation, would be unaware of the word since the picture has been flashed to the left hemisphere.
 7. c. is the answer. (p. 69)
 - d. Reproduction is only one of the basic survival functions the brain regulates.
 8. b. is the answer. The hippocampus of the limbic system is involved in processing memory. The amygdala of the limbic system influences fear and anger. (p. 71)
 - a. The brainstem controls vital functions such as breathing and heartbeat; it is not directly involved in either emotion or memory.
 - c. & d. These answers are incorrect because the limbic system is an older brain structure than the cortex. Its involvement in emotions and memory is therefore more basic than that of the cortex.
 9. d. is the answer. The thalamus relays sensory messages from the eyes, ears, and other receptors to the appropriate projection areas of the cortex. "Rewiring" the thalamus, theoretically, could have the effects stated in this question. (p. 70)
 - a., b, & c. These brain structures are not directly involved in brain processes related to sensation or perception.
 10. a. is the answer. The motor cortex, which determines the precision with which various parts of the body can be moved, is located in the frontal lobes. (pp. 75, 76)
 - b. The parietal lobes contain the sensory cortex, which controls sensitivity to touch.
 - c. The temporal lobes contain the primary projection areas for hearing and, on the left side, are also involved in language use.
 - d. The occipital lobes contain the primary projection areas for vision.

Essay Question

The patient's two key symptoms (headaches and difficulty speaking) implicate the brain, and specifically Broca's area because of its involvement in controlling speech. To pinpoint possible brain damage and its resulting aphasia, a physician or cognitive neuroscientist might order an

activity in the patient's brain is abnormal. To gather more detailed information, a PET scan might be used to measure glucose-related activity in Broca's area. To examine whether structural damage has occurred, an MRI or fMRI might be used.

Key Terms

1. A lesion is destruction of tissue; studying the consequences of lesions in different regions of the brain—both surgically produced in animals and naturally occurring—helps researchers to determine the normal functions of these regions. (p.67)
2. An electroencephalogram (EEG) is an amplified recording of the waves of electrical activity of the brain. *Encephala* comes from a Greek word meaning "related to the brain." (p. 67)
3. A CT (computed tomography) scan is a series of X-ray photographs combined by computer into a composite representation of a slice through the body. (p. 68)
4. The PET (positron emission tomography) scan measures the levels of activity of different areas of the brain by tracing their consumption of a radioactive form of glucose, the brain's fuel. (p.68)
5. MRI (magnetic resonance imaging) uses magnetic fields and radio waves to produce computer-generated images that show brain structures more clearly. (p. 68)
6. In a fMRI (functional magnetic resonance imaging) MRI scans taken less than a second apart are compared to reveal blood flow and, therefore, brain structure and function. (p. 68)
7. The brainstem, the oldest and innermost region of the brain, is an extension of the spinal cord and is the central core of the brain; its structures direct automatic survival functions. (p. 69)
8. Located in the brainstem, the medulla controls breathing and heartbeat. (p. 69)
9. Also part of the brainstem, the reticular formation is a nerve network that plays an important role in controlling arousal. (p. 70)
10. Located atop the brainstem, the thalamus routes incoming messages to the sensory receiving areas in the cortex and transmits replies to the medulla and cerebellum. (p. 70)
11. The cerebellum processes sensory input and coordinates movement output and balance. (p.70)

12. The limbic system is a neural system associated with emotions such as fear and aggression and basic physiological drives. (p. 71)

Memory aid: Its name comes from the Latin word *limbus*, meaning "border"; the limbic system is at the border of the brainstem and cerebral hemispheres.

13. The amygdala is part of the limbic system and influences the emotions of fear and aggression.

14. Also part of the limbic system, the hypothalamus regulates hunger, thirst, body temperature, and sexual behavior; helps govern the endocrine system via the pituitary gland; and contains the so-called reward centers of the brain. (p. 72)

15. The cerebral cortex is a thin intricate covering of interconnected neural cells atop the cerebral hemispheres. The seat of information processing, the cortex is responsible for those complex functions that make us distinctively human. (p. 74)

Memory aid: Cortex in Latin means "bark." As bark covers a tree, the cerebral cortex is the "bark of the brain."

16. More numerous than cortical neurons, the glial cells of the brain guide neural connections, provide nutrients and insulating myelin, and help remove excess ions and neurotransmitters. (p. 74)

17. Located at the front of the brain, just behind the forehead, the frontal lobes are involved in speaking and muscle movements and in making plans and judgments. (p. 74)

18. Situated between the frontal and occipital lobes, the parietal lobes contain the sensory cortex. (p.74)

19. Located at the back and base of the brain, the occipital lobes contain the visual cortex, which receives information from the eyes. (p. 74)

20. Located on the sides of the brain, the temporal lobes contain the auditory cortex, which receives information from the ears. (p. 74)

Memory aid: The temporal lobes are located near the temples.

21. Located at the back of the frontal lobe, the motor cortex controls voluntary movement. (p. 75)

22. The sensory cortex is located at the front of the parietal lobes, just behind the motor cortex. It registers and processes sensory information from the body.

23. Located throughout the cortex, association areas of the brain are involved in higher mental functions, such as learning, remembering, and abstract thinking. (p. 78)

Memory aid: Among their other functions, association areas of the cortex are involved in integrating, or associating, information from different areas of the brain.

24. Aphasia is an impairment of language as a result of damage to any of several cortical areas, including Broca's area and Wernicke's area. (p. 80)

25. Broca's area, located in the left frontal lobe, is involved in controlling the motor ability to produce speech. (p. 80)

28. Wernicke's area/located in the left temporal lobe, is involved in language comprehension and expression. (p. 80)

27. Plasticity is the brain's capacity for modification, as evidenced by brain reorganization following damage (especially in children). (p. 82)

28. Neurogenesis is the formation of new neurons. (p.83)

29. The corpus callosum is the large band of neural fibers that links the right and left cerebral hemispheres. Without this band of nerve fibers, the two hemispheres could not interact. (p. 84)

30. Split brain is a condition in which the major connections between the two cerebral hemispheres (the corpus callosum) are severed, literally resulting in a split brain. (p. 84)

31. Consciousness is awareness of ourselves and the environment. (p. 89)

32. Cognitive neuroscience is the interdisciplinary study of brain activity linked with perception, thinking, memory, and language. (p. 89)

33. Dual processing is the principle that the brain often processes information simultaneously on separate conscious and unconscious tracks. (p. 90)