

## STUDY GUIDE

# Biological Bases of Behavior:

## 3B: The Brain

### UNIT OVERVIEW

Unit 3B is concerned with the functions of the brain and how our millions of brain cells come together to create our consciousness.

The brain consists of the brainstem, the thalamus, the cerebellum, the limbic system, and the cerebral cortex. Knowledge of the workings of the brain has increased with advances in neuroscientific methods such as the PET scan. Studies of split-brain patients have also given researchers a great deal of information about the specialized functions of the brain's right and left hemispheres.

### UNIT REVIEW

First, skim each section, noting headings and boldface items. After you have read the section, review each objective by answering the fill-in and essay-type questions that follow it. As you proceed, evaluate your performance by consulting the answers beginning on page 56. Do not continue with the next section until you understand each answer. If you need to, review or reread the section in the textbook before continuing.

### The Tools of Discovery: Having Our Head Examined (pp. 67-68)

Objective 1: Describe several techniques for studying the brain.

1. Researchers sometimes study brain function by producing \_\_\_\_\_ or by selectively destroying brain cells. The oldest technique for studying the brain involves \_\_\_\_\_ of patients with brain injuries or diseases.
2. The \_\_\_\_\_ is an amplified recording of the waves of electrical activity that sweep across the brain's surface.
3. The technique in which X-ray photographs are combined to form a composite representation of a slice through the body is called the \_\_\_\_\_.
4. The technique depicting the level of activity of brain areas by measuring the brain's consumption of glucose is called the \_\_\_\_\_.

Briefly explain the purpose of the PET scan.

5. A technique that produces clearer images of the brain (and other body parts) by using magnetic fields and radio waves is known as \_\_\_\_\_.
6. By comparing scans taken less than a second apart, the \_\_\_\_\_ detects oxygen-laden bloodflow to the part of the brain thought to control the bodily activity being studied. Using this technique, researchers found that bloodflow to the back of the brain (increases / decreases) when people view a scene because that is where \_\_\_\_\_ information is processed.

### Older Brain Structures (pp. 69-73)

Objective 2: Describe the components of the brainstem, and summarize the functions of the brain stem, thalamus, and cerebellum.

1. The oldest and innermost region of the brain is the \_\_\_\_\_.
2. At the base of the brainstem, where the spinal cord enters the skull, lies the \_\_\_\_\_, which controls \_\_\_\_\_ and \_\_\_\_\_. Just above this part is the \_\_\_\_\_ which helps coordinate movements.
3. Nerves from each side of the brain cross over to connect with the body's opposite side in the \_\_\_\_\_.
4. The finger-shaped network of neurons, the \_\_\_\_\_, is contained inside the brainstem and plays an important role in controlling \_\_\_\_\_. Electrically stimulating this area will produce an \_\_\_\_\_ animal. Lesioning this area will cause an animal to lapse into a \_\_\_\_\_.
5. At the top of the brainstem sits the \_\_\_\_\_, which serves as the brain's sensory switchboard, receiving information from all the senses except and routing it to the regions dealing with those senses. These egg-shaped structures also receive replies from the higher regions, which they direct to the and to the \_\_\_\_\_.

- At the rear of the brainstem lies the \_\_\_\_\_. It influences one type of \_\_\_\_\_ and memory. It also coordinates voluntary movement and \_\_\_\_\_ control.
- The lower brain functions occur without \_\_\_\_\_ effort, indicating that our brains process most information (inside/outside) of our awareness.

Objective 3: Describe the structures and functions of the limbic system, and explain how one of these structures controls the pituitary gland.

- Between the brainstem and cerebral hemispheres is the \_\_\_\_\_ system. One component of this system that processes memory is the \_\_\_\_\_.
- Aggression or fear will result from stimulation of different regions of the lima bean-sized neural clusters, the \_\_\_\_\_.
- We must remember, however, that the brain (is/is not) neatly organized into structures that correspond to our categories of behavior. For example, aggressive behavior (does/does not) involve neural activity in many brain levels.
- Below the thalamus is the \_\_\_\_\_ which regulates bodily maintenance behaviors such as \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ behavior. This area also regulates behavior by secreting \_\_\_\_\_ that enable it to control the \_\_\_\_\_ gland. Olds and Milner discovered that this region also contains \_\_\_\_\_ centers, which animals will work hard to have stimulated.
- Some researchers believe that alcohol dependence, drug abuse, binge eating, and other \_\_\_\_\_ disorders may stem from a genetically disposed \_\_\_\_\_ in the natural brain systems for pleasure and well-being.

### The Cerebral Cortex (pp. 74-83)

Objective 4: Describe the structure of the cerebral cortex, and explain the various functions of the four lobes.

- The most complex functions of human behavior are linked to the most developed part of the brain, the \_\_\_\_\_. This thin layer of interconnected neural cells is the body's ultimate control and \_\_\_\_\_ center.
- The cells that support, protect, and nourish cortical neurons are called \_\_\_\_\_. These cells may also play a role in \_\_\_\_\_ and \_\_\_\_\_.
- Compared with the cortexes of lower mammals, the human cortex has a (smoother/more wrinkled) surface. This (increases/decreases) the overall surface area of our brains.

List the four lobes of the brain.

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

Objective 5: Summarize some of the findings on the functions of the motor cortex and the sensory cortex, and discuss the importance of the association areas.

- Electrical stimulation of one side of the \_\_\_\_\_ cortex, an arch-shaped region at the back of the \_\_\_\_\_ lobe, will produce movement on the opposite side of the body. The more precise the control needed, the (smaller / greater) amount of cortical space occupied. Findings from clinical trials involving \_\_\_\_\_, in which, for example, recording electrodes were implanted in this area of a 25-year-old man's brain, raise hopes that people who are \_\_\_\_\_ may one day be able to control machines directly with their \_\_\_\_\_.
- At the front of the parietal lobes lies the \_\_\_\_\_ cortex, which, when stimulated, elicits a sensation of \_\_\_\_\_.
- The more sensitive a body region, the greater the area of \_\_\_\_\_ devoted to it.
- Visual information is received in the \_\_\_\_\_ lobes, whereas auditory information is received in the \_\_\_\_\_ lobes.
- Areas of the brain that don't receive sensory information or direct movement but, rather, integrate and interpret information received by other regions are known as \_\_\_\_\_. Approximately \_\_\_\_\_ of the human cortex is of this type. Such areas in the lobe are involved in judging, planning, and processing of new memories and in some aspects of personality. In the \_\_\_\_\_ lobe, these areas enable mathematical and spatial reasoning, and an area of the \_\_\_\_\_ lobe enables us to recognize faces.

Objective 6: Identify the brain areas involved in language processing, and describe the process that enables us to speak and understand language.

- Brain injuries may produce an impairment in language use called \_\_\_\_\_. Studies of people with such impairments have shown that \_\_\_\_\_ is involved in producing speech, \_\_\_\_\_ is involved in understanding speech, and the \_\_\_\_\_ is involved in recoding printed words into auditory form.

- Norman Geschwind has explained how we use language. When we read aloud, the words register in the brain's \_\_\_\_\_ . They are then relayed to the \_\_\_\_\_ , which transforms them into an auditory code. The code is received and understood in \_\_\_\_\_ and sent to \_\_\_\_\_ , which controls the \_\_\_\_\_ as it creates the pronounced word.
- Although the mind's subsystems are localized in particular brain regions, the brain acts as a \_\_\_\_\_ .

Objective 7: Discuss the brain's plasticity following injury or illness.

- The quality of the brain that makes it possible for undamaged brain areas to take over the functions of damaged regions is known as \_\_\_\_\_ . This quality is especially apparent in the brains of (young children/adolescents/ adults).
- Although severed neurons usually (will/will not) regenerate, some neural tissue can \_\_\_\_\_ in response to damage. The form of therapy aimed at helping to reprogram a damaged brain is called \_\_\_\_\_ - \_\_\_\_\_ therapy. New evidence suggests that adult mice and humans (can/cannot) generate new brain cells through a process called \_\_\_\_\_ . Research also reveals the existence of master \_\_\_\_\_ cells in the human embryo that can develop into any type of brain cell.

### Our Divided Brain (pp. 83-86)

Objective 8: Describe split-brain research, and explain how it helps us understand the functions of our left and right hemispheres.

- The brain's two sides serve differing functions, which is referred to as hemispheric specialization, or \_\_\_\_\_ . Because damage to it will impair language and understanding, the \_\_\_\_\_ hemisphere came to be known as the \_\_\_\_\_ hemisphere.
- In treating several patients with severe epilepsy, Vogel and Bogen separated the two hemispheres of the brain by cutting the \_\_\_\_\_ . When this structure is severed, the result is referred to as a \_\_\_\_\_ .
- In a split-brain patient, only the \_\_\_\_\_ hemisphere will be aware of an unseen object held in the left hand. In this case, the person would not be able to \_\_\_\_\_ the object. When different words are shown in the left and right visual fields, if the patient fixates on a point on the center line between the fields, the patient will be able to say only the word shown on the \_\_\_\_\_ .

Explain why a split-brain patient would be able to read aloud the word pencil flashed to his or her right visual field, but would be unable to identify a pencil by touch using only the left hand.

- When the "two minds" of a split brain are at odds, the hemisphere tries to rationalize what it doesn't understand. The \_\_\_\_\_ hemisphere often acts on autopilot. This phenomenon demonstrates that the \_\_\_\_\_ mind (can/cannot) control our behavior.

### Right-Left Differences in the Intact Brain (pp.86-89)

Objective 9: Describe the distinct functions of the brain's two hemispheres, and discuss the relationship between brain organization and handedness.

- Deaf people use the \_\_\_\_\_ hemisphere to process sign language.
- Although the hemisphere is better at making literal interpretations of language, the \_\_\_\_\_ hemisphere excels at quick, intuitive responses and at copying drawings, \_\_\_\_\_ , perceiving objects, and perceiving \_\_\_\_\_ .
- (Close-Up) In all cultures of the world, most of the human population is (right/left)-handed. Genetic factors (play / do not play) a role in handedness.

### The Brain and Consciousness (pp. 89-91)

Objective 10: Describe research that leads cognitive neuroscientists to infer how the brain's dual processing affects our perception, memory, and attitudes on conscious and unconscious levels.

- The study of \_\_\_\_\_ was central in the early years of psychology and has increased in recent decades.
- The interdisciplinary study of how brain activity is linked with mental processes is called \_\_\_\_\_ .
- Much of our everyday thinking, feeling, and acting operates outside of our \_\_\_\_\_ awareness.

- Solving new problems (requires/ does not require) conscious attention.
- In comparison with unconscious processing, conscious processing has a(n) (limited/unlimited) capacity, is relatively (fast/slow), and processes pieces of information (simultaneously / serially).

## PROGRESS TEST 1

### Multiple-Choice Questions

Circle your answers to the following questions and check them with the answers on page 57. If your answer is incorrect, read the explanation for why it is incorrect and then consult the appropriate pages of the text (in parentheses following the correct answer).

- The brain research technique that involves monitoring the brain's usage of glucose is called (in abbreviated form) the
  - PET scan.
  - fMRI.
  - EEG.
  - MR!
- Though there is no single "control center" for emotions, their regulation is primarily attributed to the brain region known as the
  - limbic system.
  - reticular formation.
  - brainstem.
  - cerebellum.
- Which of the following is typically controlled by the right hemisphere?
  - language
  - learned voluntary movements
  - arithmetic reasoning
  - perceptual tasks
- The increasing complexity of animals' behavior is accompanied by an
  - increase in the size of the brainstem.
  - increase in the depth of the corpus callosum.
  - increase in the size of the frontal lobes.
  - increase in the amount of association area.
- Following a head injury, a person has ongoing difficulties staying awake. Most likely, the damage occurred to the
  - thalamus.
  - corpus callosum.
  - reticular formation.
  - cerebellum.
- An experimenter flashes the word FLYTRAP onto a screen facing a split-brain patient so that FLY projects to her right hemisphere and TRAP to her left hemisphere. When asked what she saw, the patient will
  - say she saw FLY.
  - say she saw TRAP.
  - point to FLY using her right hand.
  - point to TRAP using her left hand.
- Cortical areas that are not primarily concerned with sensory, motor, or language functions are
  - called projection areas.
  - called association areas.
  - located mostly in the parietal lobe.
  - located mostly in the temporal lobe.
- Damage to will usually cause a person to lose the ability to comprehend language.
  - the angular gyrus
  - Broca's area
  - Wernicke's area
  - frontal lobe association areas
- In a soccer game, Laura suffered damage to her left temporal lobe. As a result, she is unable to speak in meaningful sentences. The damage affected
  - Wernicke's area.
  - Broca's area.
  - the angular gyrus.
  - the hippocampus.
- Consciousness is defined in the text as
  - mental life.
  - selective attention to ongoing perceptions, thoughts, and feelings.
  - information processing.
  - our awareness of ourselves and our environment.

### Matching Items

Match each structure or technique with its corresponding function or description.

Structures

- |          |                     |           |            |
|----------|---------------------|-----------|------------|
| 1. _____ | hypothalamus        | 9. _____  | cerebellum |
| 2. _____ | lesion              | 10. _____ | amygdala   |
| 3. _____ | EEG                 | 11. _____ | medulla    |
| 4. _____ | fMRI                |           |            |
| 5. _____ | reticular formation |           |            |
| 6. _____ | MRI                 |           |            |
| 7. _____ | thalamus            |           |            |

### Functions or Descriptions

- a. amplified recording of brain waves
- b. technique that uses radio waves and magnetic fields to image brain anatomy
- c. serves as sensory switchboard
- d. contains reward centers
- e. tissue destruction

- f. technique that uses radio waves and magnetic fields to show brain function
- g. helps control arousal
- h. links the cerebral hemispheres
- i. influences rage and fear
- j. regulates breathing and heartbeat
- k. enables coordinated movement

## PROGRESS TEST 2

Progress Test 2 should be completed during a final unit review. Answer the following questions after you thoroughly understand the correct answers for the section reviews and Progress Test 1.

### Multiple-Choice Questions

1. The visual cortex is located in the
  - a. occipital lobe.
  - b. frontal lobe.
  - c. temporal lobe.
  - d. parietal lobe.
2. Which of the following is typically controlled by the left hemisphere?
  - a. spatial reasoning
  - b. word recognition
  - c. the left side of the body
  - d. perceptual skills
3. In the brain, I outnumber neurons. I also provide nutrients to the neurons and help remove excess neurotransmitters. I am a
  - a. hormone.
  - b. myelin sheath.
  - c. glial cell.
  - d. stem cell.
4. The technique that uses magnetic fields and radio waves to produce computer images of structures within the brain is called
  - a. the EEG.
  - b. a PET scan.
  - c. a lesion.
  - d. MRI.
5. Jessica experienced difficulty keeping her balance after receiving a blow to the back of her head. It is likely that she injured her
  - a. medulla.
  - b. hypothalamus.
  - c. thalamus.
  - d. cerebellum.
6. Moruzzi and Magoun caused a cat to lapse into a coma by severing neural connections between the cortex and the
  - a. reticular formation.
  - b. hypothalamus.
  - c. thalamus.
  - d. cerebellum.
7. Research has found that the amount of representation in the motor cortex reflects the
  - a. size of the body parts.
  - b. degree of precise control required by each of the parts.
  - c. sensitivity of the body region.
  - d. area of the occipital lobe being stimulated by the environment.
8. The nerve fibers that enable communication between the right and left cerebral hemispheres and that have been severed in split-brain patients form a structure called the
  - a. reticular formation.
  - b. association areas.
  - c. corpus callosum.
  - d. parietal lobes.
9. Beginning at the front of the brain and moving toward the back of the head, then down the skull and back around to the front, which of the following is the correct order of the cortical regions?
  - a. occipital lobe; temporal lobe; parietal lobe; frontal lobe
  - b. temporal lobe; frontal lobe; parietal lobe; occipital lobe
  - c. frontal lobe; occipital lobe; temporal lobe; parietal lobe
  - d. frontal lobe; parietal lobe; occipital lobe; temporal lobe
10. Following a nail gun wound to his head, Jack became more uninhibited, irritable, dishonest, and profane. It is likely that his personality change was the result of injury to his
  - a. parietal lobe.
  - b. temporal lobe.
  - c. occipital lobe.
  - d. frontal lobe.
11. Three-year-old Marco suffered damage to the speech area of the brain's left hemisphere when he fell from a swing. Research suggests that
  - a. he may never speak again.
  - b. his motor abilities may improve so that he can easily use sign language.
  - c. his right hemisphere may take over much of the language function.
  - d. his earlier experience with speech may enable him to continue speaking.

## Matching Items

Match each structure or term with its corresponding function or description.

### Structures or Terms

1. right hemisphere
2. brainstem
3. temporal lobes
4. occipital lobes
5. plasticity
6. neurogenesis
7. Broca's area
8. limbic system
9. association areas
10. left hemisphere
11. glial cells

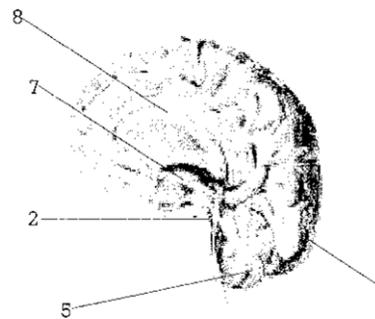
### Functions or Descriptions

- a. the formation of new neurons
- b. specializes in rationalizing reactions
- c. support cells of the nervous system
- d. specializes in spatial relations
- e. brain areas containing the auditory cortex
- f. brain areas containing the visual cortex
- g. oldest part of the brain
- h. regulates emotion
- i. the brain's capacity for modification
- j. controls speech production
- k. brain areas involved in higher mental functions

In the diagrams to the right, the numbers refer to brain locations that have been damaged. Match each location with its probable effect on behavior.

### Location Behavioral Effect

- |          |                             |
|----------|-----------------------------|
| _____ 1. | a. vision disorder          |
| _____ 2. | b. insensitivity to touch   |
| _____ 3. | c. motor paralysis          |
| _____ 4. | d. hearing problem          |
| _____ 5. | e. lack of coordination     |
| _____ 6. | f. abnormal hunger          |
| _____ 7. | g. split brain              |
| _____ 8. | h. sleep / arousal disorder |



## PSYCHOLOGY APPLIED

Answer these questions the day before a test as a final check on your understanding of the unit's terms and concepts.

### Multiple-Choice Questions

- The part of the human brain that is most like that of a fish is the
  - cortex.
  - limbic system.
  - brainstem.
  - right hemisphere.
- To pinpoint the location of a tumor, a neurosurgeon electrically stimulated parts of the patient's sensory cortex. If the patient was conscious during the procedure, which of the following was probably experienced?
  - "hearing" faint sounds
  - If seeing" random visual patterns
  - movement of the arms or legs
  - a sense of having the skin touched
- If Dr. Rogers wishes to conduct an experiment on the effects of stimulating the reward centers of a rat's brain, he should insert an electrode into the
  - thalamus.
  - sensory cortex.
  - hypothalamus.
  - corpus callosum.
- A split-brain patient has a picture of a knife flashed to her left hemisphere and that of a fork to her right hemisphere. She will be able to
  - identify the fork using her left hand.
  - identify a knife using her left hand.
  - identify a knife using either hand.
  - identify a fork using either hand.
- Anton is applying for a technician's job with a neurosurgeon. In trying to impress his potential employer with his knowledge of the brain, he says, "After my father's stroke I knew immediately that the blood clot had affected his left cerebral hemisphere because he no longer recognized a picture of his friend." Should Anton be hired?
  - Yes. Anton obviously understands brain structure and function.
  - No. The right hemisphere, not the left, specializes in-picture recognition.
  - Yes. Although blood clots never form in the left hemisphere, Anton should be rewarded for recognizing the left hemisphere's role in picture recognition.
  - No. Blood clots never form in the left hemisphere, and the right hemisphere is more involved than the left in recognizing pictures.
- Dr. Johnson briefly flashed a picture of a key in the right visual field of a split-brain patient. The patient could probably
  - verbally report that a key was seen.
  - write the word key using the left hand.
  - draw a picture of a key using the left hand.
  - do none of these things.
- In primitive vertebrate animals, the brain primarily regulates ; in lower mammals, the brain enables \_\_\_\_
  - emotion; memory
  - memory; emotion
  - survival functions; emotion
  - reproduction; emotion
- A scientist from another planet wishes to study the simplest brain mechanisms underlying emotion and memory. You recommend that the scientist study the
  - brainstem of a frog.
  - limbic system of a dog.
  - cortex of a monkey.
  - cortex of a human.
- Dr. Frankenstein made a mistake during neurosurgery on his monster. After the operation, the monster "saw" with his ears and "heard" with his eyes. It is likely that Dr. Frankenstein "rewired" neural connections in the monster's
  - hypothalamus.
  - cerebellum.
  - amygdala.
  - thalamus.
- Raccoons have much more precise control of their paws than dogs. You would expect that raccoons have more cortical space dedicated to u paw control" in the of their brains.
  - frontal lobes
  - temporal lobes
  - parietal lobes
  - occipital lobes

### Essay Question

A patient presents to the hospital complaining of headaches and difficulty speaking. Describe what a physician or cognitive neuroscientist might do to diagnose the patient's problem, and identify the possible results of such an investigation.

### KEY TERMS

Using your own words, on a piece of paper write a brief definition or explanation of each of the following terms.

- lesion
- electroencephalogram (EEG)
- CT (computed tomography) scan

4. PET (positron emission tomography) scan
5. MRI (magnetic resonance imaging)
6. fMRI (functional magnetic resonance imaging)
7. brainstem
8. medulla
9. reticular formation
10. thalamus
11. cerebellum
12. limbic system
13. amygdala
14. hypothalamus
15. cerebral cortex
16. glial cells
17. frontal lobes
18. parietal lobes
19. occipital lobes
20. temporal lobes
21. motor cortex
22. sensory cortex
23. association areas
24. aphasia
25. Broca's area
26. Wernicke's area
27. plasticity
28. neurogenesis
29. corpus callosum
30. split brain
31. consciousness
32. cognitive neuroscience
33. dual processing