

Reading Explorer 5 Unit 7 Lesson A

DIRECTIONS: Choose the best answer for each question.

Secrets of the Brain

New technologies are helping researchers solve a great biological mystery: how the brain really works. Carl Zimmer takes a journey into his own head to see what it's all about.

My Contribution to Science

[A] In a scanning room at the Martinos Center for Biomedical Imaging in Boston, Massachusetts, I lay on my back on a slab,¹ my head resting in an open plastic box. I had offered myself as a guinea pig² to neuroscientist Van Wedeen and his colleagues who were now going to scan my brain. A white plastic helmet was lowered over my face, and the slab slowly glided into the scanner tube.

[B] The magnets that surrounded me began to rumble³ and beep. For an hour I lay still, eyes closed, and tried to remain calm in the narrow scanner - it wasn't easy. To suppress feelings of panic, I breathed smoothly and transported myself to places in my memory. At one point I recalled walking my nine-year-old daughter to school through the snow. And as I lay there, I reflected on the fact that all my thoughts and emotions were the creation of the 1.3 kilo loaf of flesh that was being scrutinized: my brain.

[C] Submitting to this uncomfortable scanning procedure was part of reporting on the stunning advances in understanding the human brain. Wedeen, who is at the forefront of brain imaging, creates in unprecedented detail representations of the brain's wiring. My brain scan was the first step in creating an image of my own brain, but I would have to make a second appointment to see the final product.

[D] On my return trip to his lab, Wedeen opened up the image on a computer screen. His technique - called diffusion spectrum imaging - translates radio signals given off by the brain. What I saw was a map of the nerve fibers that form hundreds of thousands of pathways, carrying information from one part of my brain to another. Wedeen had painted each path a rainbow of colors, so that my brain appeared as an explosion of colorful fur, like a psychedelic⁴ Persian cat.

Mapping the Brain

[E] Cutting-edge techniques for mapping the brain are giving researchers greater access to that organ than ever before. Some neuroscientists focus in on the structure of individual nerve cells, or neurons. Others chart genes that interact with those neurons. Still others - Wedeen among them - work on revealing as much of the brain's vast neural network as they can.

[F] Jeff Lichtman and his colleagues at Harvard University are creating extremely detailed three-dimensional images of neurons, revealing every bump and stalk branching from them. They begin by slicing preserved mouse brains into thin layers of tissue, each less than a thousandth the thickness of a human hair. An electron microscope⁵ is then used to take a picture of each layer, and the images are put in order using a computer. Slowly a three-dimensional image is built - one that the scientists can explore as if they were in a tiny submarine. "Everything is revealed," says Lichtman.

[G] The problem is that even a mouse brain is unbelievably complex. Lichtman and his colleagues have managed to recreate a piece about the size of a grain of salt. Its data alone is equal to the amount of data in about 25,000 high-definition movies. "It's a wake-up call to how much more complicated brains are than the way we think about them," says Lichtman. When asked if his method could be used to scan an entire human brain, which contains a thousand times more neurons than a mouse brain, Lichtman says with a laugh, "I don't dwell on that - it's too painful."

[H] When and if Lichtman completes his 3-D portrait of the brain, it will reveal much - but it will still be only an exquisitely detailed sculpture. Living neurons, on the other hand, are full of active genes that are integral to brain function. Researchers at the Allen Institute in Seattle, Washington, have developed a method for mapping these genes - the Allen Brain Atlas. First, the donated brains of recently deceased people are scanned using a powerful MRI⁶ scanner. This scan is used for reference as a kind of 3-D road map. The brain is then sliced into sections so thin that they are nearly invisible, and the slices are mounted on glass. Finally, chemicals are applied to reveal the active genes in the neurons.

[I] So far, the researchers have mapped the brains of six people. It's a huge amount of data, and they've only just begun to understand the genetic landscape of the brain. The scientists estimate that 84 percent of all the genes in our DNA become active in the adult brain. Certain combinations of genes are activated by neurons to carry out important tasks in different locations. The secret to certain disorders may be hiding in these complex networks, as certain genes shut down or switch on abnormally.

[J] Of all the new ways of visualizing the brain, perhaps the most remarkable is one invented by neuroscientist Karl Deisseroth and colleagues at Stanford University. They have found a way to make a mouse brain as transparent as glass, allowing researchers to see inside the brain while it is still intact. The technique involves replacing the naturally occurring substances in the brain with transparent ones. They can then color the brain with chemicals that show different pathways of connecting neurons. "You don't have to take it apart to show the wiring," says Deisseroth.

[K] It's not easy to dazzle neuroscientists, but Deisseroth's method, called CLARITY, has left his colleagues awestruck.⁷ Wedeen has called the research "spectacular... unlike anything else in the field." Deisseroth's ultimate goal is to make a human brain transparent - a far more difficult task, not least because a human brain is 3,000 times larger than that of a mouse. He anticipates that CLARITY may someday help patients with autism⁸ or depression, but for now he's keeping those hopes in check. "We have so far to go before we can affect treatments that I tell people, 'Don't even think about that yet.' It's just a voyage of discovery for now."

Connecting Brain with Machine

[L] For the most part, brain research has yet to change how doctors treat patients. But there is one line of research - brain-machine interfaces⁹ - where the mapping of the brain has started to change people's lives.

[M] At 43 years old, Cathy Hutchinson suffered a massive stroke, leaving her unable to move or speak. Lying in her bed in Massachusetts General Hospital, she gradually figured out that her doctors didn't know if she was brain-dead or still aware. Her sister asked Hutchinson if she could understand her, and she managed to answer by moving her eyes up as a signal. "It gave me such a relief," Hutchinson tells me 17 years later, "because everybody talked about me as if I was dying."

[N] Still almost completely unable to move or speak, she communicates by looking at letters on a computer screen. A camera tracks the movement of a tiny metal disk attached to the center of her eyeglasses, thanks to a system developed by Brown University neuroscientist John Donoghue.

[O] Donoghue wanted to find a way to help people with paralysis by using signals from the brain's motor cortex - the area where signals to move muscles originate. He spent years developing such a device, testing it on monkeys. Once he and his colleagues knew it was safe, they were ready to start working with human patients.

[P] Surgeons inserted the device into Hutchinson's motor cortex. After she had healed from her surgery, the researchers plugged in wires to send signals from her brain to nearby computers. The computers recognize the signals and use them to move a computer cursor around a screen. Two years later, they attached a robot arm with a hand to the computers, and Hutchinson quickly learned to use it.

[Q] "It felt natural," she says. So natural that one day she reached out for a cup of coffee, grabbed it, and brought it to her lips to drink. "Cathy's smile when she put down that drink - that's everything," Donoghue says.

[R] Today Donoghue and other scientists are building on that success, hoping to create human-machine interfaces that will be powerful, safe, and easy. At Duke University, Miguel Nicolelis has gotten monkeys to control full-body exoskeletons using methods similar to those that helped Hutchinson. "Eventually brain implants¹⁰ will become as common as heart implants," says Nicolelis. Predicting the future is a tricky game, however, and advances in the past have inspired expectations that have not been met. But it is clear that current research is moving neuroscience to a remarkable new stage.

¹ A **slab** is a thick, flat piece of a hard material.

² If someone is used as a **guinea pig**, they are used in an experiment or a test.

³ Something that **rumbles** makes a deep, vibrating sound.

⁴ **Psychedelic** art has bright colors and strange patterns.

⁵ An **electron microscope** is a tool that allows the viewer to see objects as small as an atom.

⁶ Magnetic Resonance Imaging (**MRI**) is a technique for creating detailed images of organs in the body.

⁷ If a person is **awestruck**, he or she is very impressed and amazed by something.

⁸ **Autism** is a mental disorder that affects a person's ability to communicate and interact with others.

⁹ An **interface** is a device or program that enables a person to interact with a computer.

¹⁰ An **implant** is something inserted into a person's body, especially by surgery.

- _____ 1. Which would be the best alternative title for this passage?
- a. New Brains for Mice
 - b. Visualizing the Brain
 - c. Repairing Broken Brains
 - d. Brain Implants Today
- _____ 2. What is the purpose of the section with the header *My Contribution to Science*?
- a. to describe the process of getting a scan
 - b. to warn readers that brain scans are uncomfortable
 - c. to detail Van Weeden's methodology
 - d. to explain why the author is participating in a scan
- _____ 3. In paragraph E, what is the best description of a *neuron*?
- a. an individual nerve cell
 - b. a network of brain pathways
 - c. a gene that activates brain cells
 - d. a signal from the motor cortex

- _____ 4. In paragraph F, when Lichtman mentions *a tiny submarine*, what is he referring to?
- a. traveling deep underwater in a ship
 - b. exploring 3-D images of the brain
 - c. watching submarine images on a computer
 - d. magnifying tissue with an electron microscope

- _____ 5. The following sentence would be best placed at the end of which paragraph?

Scientists hope that this genetic research will lead to breakthroughs in treating Parkinson's and Alzheimer's diseases.

- a. Paragraph B
 - b. Paragraph G
 - c. Paragraph I
 - d. Paragraph K
- _____ 6. Which scientist is developing a way to make an entire human brain transparent so you can see into it?
- a. Miguel Nicolelis
 - b. Jeff Lichtman
 - c. Karl Deisseroth
 - d. John Donoghue

- _____ 7. How is Cathy Hutchinson able to move a computer cursor around a screen?
- a. using signals from her brain
 - b. using her eye movement
 - c. using a robotic arm
 - d. using wires from a keyboard

- _____ 8. In paragraph Q, what does Donoghue mean when he says, "*that's everything*"?
- a. He is satisfied that the smile muscles in Cathy's face work again.
 - b. He is relieved that Cathy didn't spill hot coffee all over herself.
 - c. Cathy almost drank Donoghue's coffee by accident.
 - d. The smile on Cathy's face was his reward and purpose for doing his work.

- _____ 9. Why did the author use the passive voice in the following sentence from paragraph A?

A white plastic helmet was lowered over my face, ...

- a. The person who lowered the helmet is obvious.
 - b. The person who lowered the helmet is not known.
- _____ 10. Why did the author use the passive voice in the following sentence from paragraph H?

The brain is then sliced into sections so thin that they are nearly invisible, and the slices are mounted on glass.

- a. The author wishes to be vague.
- b. The person who performs the actions is not known.

DIRECTIONS: Complete the sentences. Choose the correct word.

- a. dazzle
- b. disorder
- c. exquisitely
- d. forefront
- e. neural
- f. organs
- g. originates
- h. scrutinize
- i. tricky
- j. unprecedented

- ____ 11. He is very careful with his money. He will ____ every bill to make sure he's not being overcharged.
- ____ 12. Recent catastrophic weather events have brought climate change to the ____ of media attention.
- ____ 13. The temperature in the city reached a(n) ____ high yesterday. There has never been a hotter day on record.
- ____ 14. Unlike ____ like the heart or liver, the appendix and its function in the body is unknown.
- ____ 15. The most important parts of the ____ system are the brain, spinal cord, and nerves.
- ____ 16. Faberge eggs are ____ decorated jewels made for the Russian tsars before 1917.
- ____ 17. On Academy Awards night, celebrities ____ spectators with their designer clothes as they walk the Red Carpet.
- ____ 18. The flight to Paris ____ in Chicago, so the plane is already full when it lands for a layover in New York.
- ____ 19. It's a(n) ____ decision, so take your time to think it through and don't rush into anything you will later regret.
- ____ 20. He has been diagnosed with a rare heart _____. Doctors are not sure how to treat it.

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Answer Section

1. ANS: B PTS: 1 REF: Pages 141-144
OBJ: Gist TOP: Human Body
2. ANS: D PTS: 1 REF: Pages 141-144
OBJ: Purpose TOP: Human Body
3. ANS: A PTS: 1 REF: Pages 141-144
OBJ: Unfamiliar Vocabulary TOP: Human Body
4. ANS: B PTS: 1 REF: Pages 141-144
OBJ: Figurative Language TOP: Human Body
5. ANS: C PTS: 1 REF: Pages 141-144
OBJ: Cohesion TOP: Human Body
6. ANS: C PTS: 1 REF: Pages 141-144
OBJ: Supporting Detail TOP: Human Body
7. ANS: A PTS: 1 REF: Pages 141-144
OBJ: Cause and Effect TOP: Human Body
8. ANS: D PTS: 1 REF: Pages 141-144
OBJ: Anaphoric Reference TOP: Human Body
9. ANS: A PTS: 1 REF: Page 147
OBJ: Understanding the Use of the Passive Voice TOP: Human Body
10. ANS: B PTS: 1 REF: Page 147
OBJ: Understanding the Use of the Passive Voice TOP: Human Body
11. ANS: H PTS: 1 REF: Page 148 OBJ: Vocabulary
TOP: Human Body
12. ANS: D PTS: 1 REF: Page 148 OBJ: Vocabulary
TOP: Human Body
13. ANS: J PTS: 1 REF: Page 148 OBJ: Vocabulary
TOP: Human Body
14. ANS: F PTS: 1 REF: Page 148 OBJ: Vocabulary
TOP: Human Body
15. ANS: E PTS: 1 REF: Page 148 OBJ: Vocabulary
TOP: Human Body
16. ANS: C PTS: 1 REF: Page 148 OBJ: Vocabulary
TOP: Human Body
17. ANS: A PTS: 1 REF: Page 148 OBJ: Vocabulary
TOP: Human Body
18. ANS: G PTS: 1 REF: Page 148 OBJ: Vocabulary
TOP: Human Body
19. ANS: I PTS: 1 REF: Page 148 OBJ: Vocabulary
TOP: Human Body
20. ANS: B PTS: 1 REF: Page 148 OBJ: Vocabulary
TOP: Human Body