Learning A–Z	level **Y**	Multi-level	**Y** **Z1** **Z2**
Grade	5	Word Count	1,457
Lexile	1000L	Nonfiction • Informational	

Refer to the Focus Question on page 2 of this title to guide discussion and support additional learning connected to the text.

The human brain is an amazing organ. It controls every part of the body, from breathing to writing a symphony. In **The Amazing Brain**, students will learn how different parts of the brain perform different functions, the methods scientists use to learn more about the body's incredible control center, and most importantly, how to care for their own brains. Students will also have the opportunity to identify the main idea and details as well as to summarize the information from the text. The book is also available for levels Z1 and Z2.

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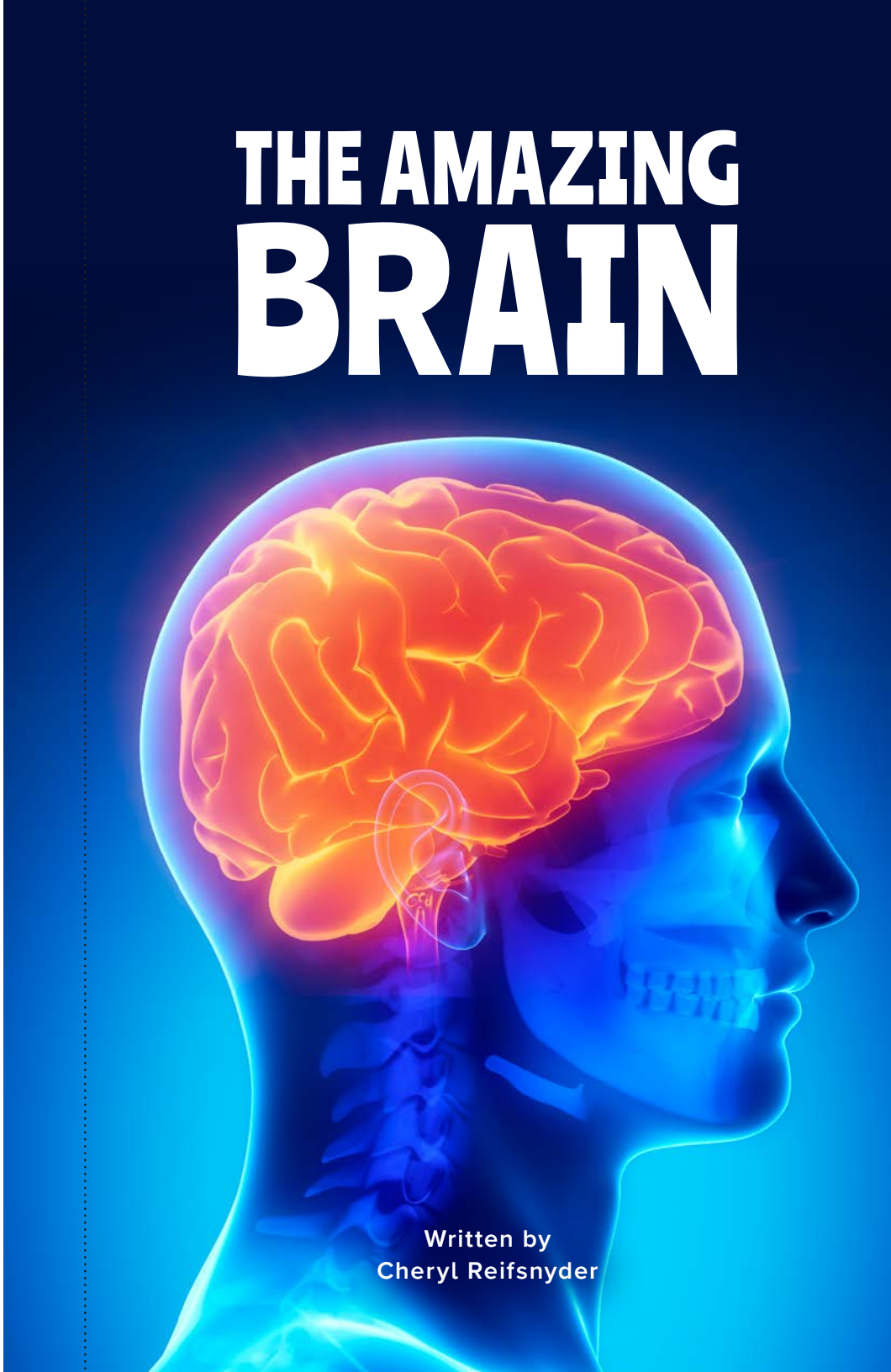
THE AMAZING BRAIN



Written by
Cheryl Reifsnyder

Glossary

brain stem *(n.)* page 5
the part of the brain at the top of the spinal cord; controls basic functions, such as breathing, heart rate, and blood pressure

cerebellum *(n.)* page 5
the lower back part of the brain; coordinates sensory information with muscle movement to allow the body to maintain balance and move smoothly

cerebrum *(n.)* page 5
the largest part of many mammals' brains; controls thinking, feeling, communicating, emotions, and some of the senses

corpus callosum *(n.)* page 7
the group of nerve fibers in the middle part of the brain in some mammals; connects and allows communication between the two hemispheres

decipher *(v.)* page 11
to make out the meaning of something that is difficult to understand

electrodes *(n.)* page 10
points through which electricity flows into or out of a device, such as a battery

hemispheres *(n.)* page 7
halves of a sphere or a mostly round object, such as a planet or a brain

interprets *(v.)* page 6
tells, explains, or understands the meaning of something

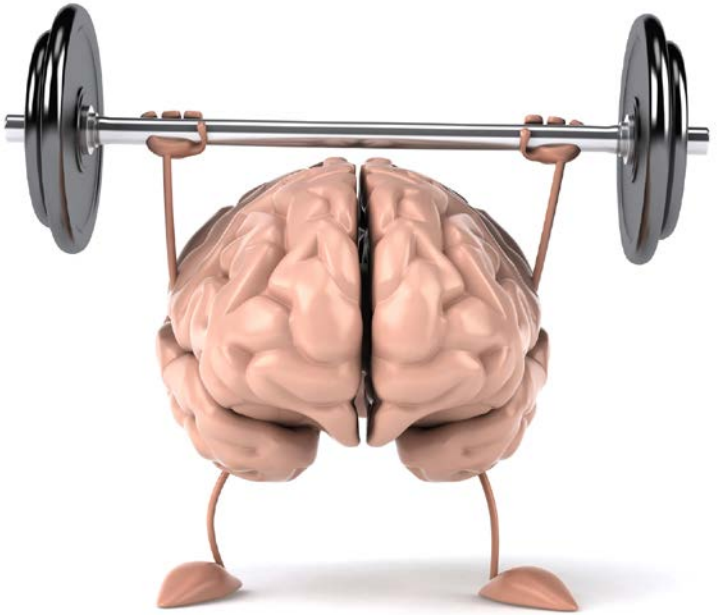
lobes *(n.)* page 7
rounded or curved sections of a body or organ, such as the ear, brain, or lungs

network *(n.)* page 4
a group of things that are connected to and communicate with each other

neurons *(n.)* page 4
nerve cells that carry information within the brain and between the brain and other parts of the body

signals *(n.)* page 4
actions, sounds, or objects used to send a message

THE AMAZING BRAIN



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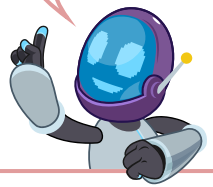
Focus Question

What makes the human brain amazing?



Words to Know

brain stem	hemispheres
cerebellum	interprets
cerebrum	lobes
corpus callosum	network
decipher	neurons
electrodes	signals

Connections

Writing

Write an article called "Your Brain at Work" to be published in a magazine or newspaper. Include a diagram that is labeled with the parts of the brain.

Math

Exercising your brain by playing games such as sudoku helps keep your brain sharp. Create a sudoku puzzle with a solution. Have a partner try to solve your puzzle.

Children wear helmets to protect their brains.

Protect Your Brain

According to the research of Dr. Ann Mckee, brain protection is the most important key to brain health. Shock-absorbing fluid and a hard skull guard your brain against injury. If you land on concrete, a fall from only two or three feet can crack your skull or bruise your brain. Swelling inside the skull quickly cuts off the brain's blood supply—and your brain can survive only a few minutes without oxygen. Wearing a properly fitted helmet during sports provides extra protection that may save your brain—and your life.

Your brain may be the most important part of your body. Exercise, get enough sleep, and wear protective headgear to help your brain operate smoothly for years to come!

Brain Training

Brain changes usually occur only in regions directly involved with your activity. However, research suggests that some "mental training" may cause broader changes. For instance, research at Harvard Medical School showed that people who practiced meditation for eight weeks had changes in brain regions used for learning, memory, and emotional control.

Physical exercise—especially exercise that raises your heart rate—also has brain-wide benefits. Dr. Arthur Kramer is the director of the Beckman Institute for Advanced Science and Technology at the University of Illinois, where he studies how exercise affects the brain. "Exercising is good for your body and your brain," Kramer says. "Research has shown that children who regularly exercise have better memories and attention and often do better on school tests."

Sleep is another key to healthy brain function. According to Dr. Ken Paller, director of the Cognitive Neuroscience Program at Northwestern University, evidence suggests that your brain replays memories during sleep. That may help skills and information "stick" in your memory. However it works, it's clear that getting too little sleep decreases your ability to learn and think.

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The Brain

What weighs only 2 percent of your total body weight but uses more than 20 percent of your energy? Answer: Your most complicated body part—the brain.

Your brain needs plenty of energy to fuel about 86 billion **neurons**. These brain cells carry the electrical **signals** needed for thoughts, memories, and feelings. They're the reason you can ride a bike and remember your teacher's name.

Signals travel through neurons to different parts of the brain and body.

Neurons form a **network** with more than 125 trillion connections. Your brain contains more neuron connections than there are stars in 1,500 Milky Way galaxies! This complex wiring system enables your brain to act as the control center for your entire body.

Different parts of the brain activate when doing different activities. The person's brain in this 3D MRI is solving a problem, such as doing a puzzle. The yellow in the brain is the active area.

Maintain Your Brain

Your brain is an amazing machine, and, like a machine, it operates best with proper care. How do you keep your brain in top condition?

For starters, use it! Exercising your brain helps it grow in the same way that muscles grow with physical exercise. Take violin players: they learn complicated finger movements for the left hand, and the brain area controlling that hand is larger than in most people.

If this sounds like science fiction, think again: experimental mind-controlled devices already exist! Electrodes detect the brain signal, which is decoded by a computer. The information can be used to control a mechanical device. Researchers hope this technology can be used to help people with disabilities move and communicate better.

This technique could also be used to send brain signals from one person to another. In early experiments, one person's "brain signal" for finger movement traveled over the Internet to another room. There, a special device delivered the signal to a second person. His finger moved—following instructions from another brain.

In an experiment at the University of Washington, one researcher (left) was able to send a brain signal over the Internet to another researcher (right), causing his finger to move on the keyboard.

Three Brains in One

Neurons connect the brain to the rest of the body, delivering instructions to muscles and bringing back information from your senses. They also connect the three main parts of the brain: the **brain stem**, **cerebellum**, and **cerebrum**. Each brain part controls specific body activities.

Brain Stem

The brain stem is sometimes called the *lizard brain*. That's because it does pretty much the same thing in lizards as in you: controls body processes that are essential for survival. Day and night, your brain stem keeps your breathing, digestion, heartbeat, and other automatic body processes running smoothly.

Cerebellum

Every time you move your body, your cerebellum is at work coordinating muscle movements. It adds "targeting instructions" when other parts of your brain send a movement signal using information such as your body's current speed and position. With the cerebellum's guidance, you can touch your nose in one smooth motion. Without it, the movement would be jerky, or you might even miss your nose completely!

The cerebellum also stores memories of muscle movement. Muscle memories become stronger with repetition, which is why practice helps some movements—like playing guitar or skateboarding—become automatic.

Cerebrum

The cerebrum is the largest part of the brain. This is where most high-level brain activity takes place, including thought, speech, learning, and emotions. The cerebrum also **interprets** information from the senses. Sensory information reaches the brain as electrical signals, which the cerebrum interprets as sounds, images, and other sensations. It compares the results with your stored memories and attaches meaning. A stream of electrical impulses becomes a purple bus or a crowing rooster.

You may be surprised to learn that ignoring things is an important part of the cerebrum's job. To understand why, take a moment to notice everything your senses are communicating to you. Your senses constantly flood the brain with information! By screening out some things, the cerebrum helps you focus on what remains.

Two medical professionals review an fMRI.

Unlike electrical signals, changes in blood flow can be detected deep inside the brain.

An fMRI allows scientists to detect the precise brain regions used when you sing, laugh, or startle—with far more detail than an EEG can provide.

Mind Control!

The ability to detect brain signals raised another question: is it possible to decode these signals? If a computer could **decipher** a brain's electrical signals, people might learn to control an artificial limb or a robot through a brain-computer interface.

Word Wise

- EEG is short for *electroencephalogram* (ih-LEK-troh-en-SEH-fuh-luh-gram).
- fMRI stands for *functional magnetic resonance imaging.*

"Seeing" Brain Activity

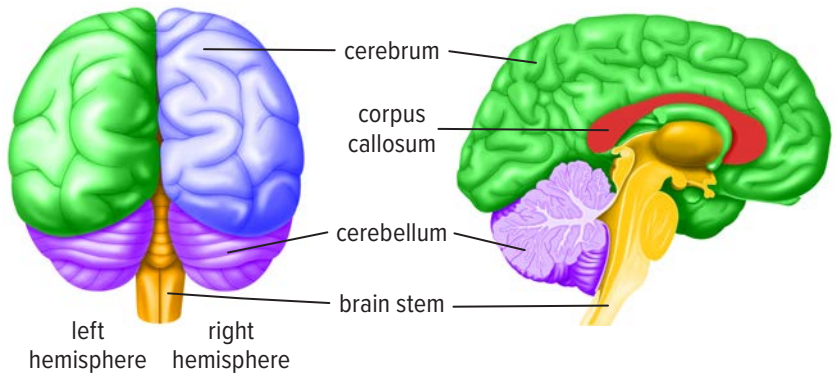
For a clearer understanding of brain function, they needed a way to study healthy brains. A German scientist created a machine that could measure the electrical activity in the brain. This machine, called an *EEG*, provided a partial solution.

Everything you do—running, singing, thinking, and more—begins with tiny electrical signals in your brain. An EEG measures these signals through **electrodes** placed on the head's surface. Researchers can "see" brain activity when you walk, talk, read, and more.

Unless electrodes are surgically implanted inside a person's skull, though, an EEG can detect only signals near the brain's surface. Observing activity deeper in the brain was difficult and potentially dangerous until a test called an *fMRI* became available.

Unlike an EEG, which measures electrical activity, an fMRI identifies active brain regions by measuring blood flow. This gives an indirect measurement of brain activity because electrically active neurons require more oxygen. Since blood is your body's oxygen delivery system, brain areas with more blood flow generally have more electrically active neurons.

Parts of the Brain



Right Brain, Left Brain

If you could look inside your head, you'd see that the cerebrum is divided into two halves, called **hemispheres**. A bundle of nerves called the **corpus callosum** connects the hemispheres and carries messages between them. The hemispheres control opposite sides of the body. Your left hemisphere sends the signal to raise your right hand; your right brain is in control when you shake your left foot. Although some tasks can be done by either hemisphere, the two are not identical. The right brain usually controls creativity, artistic skills, and interpreting what you see. The left brain generally controls speech, writing, and math skills.

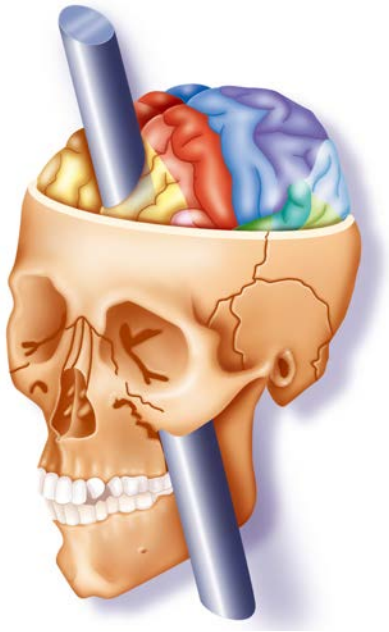
Each brain hemisphere has four sections, or **lobes**, and each lobe has specific jobs. However, scientists didn't realize this until the 1800s, when a doctor recorded the strange story of Phineas Gage.

Studying the Brain

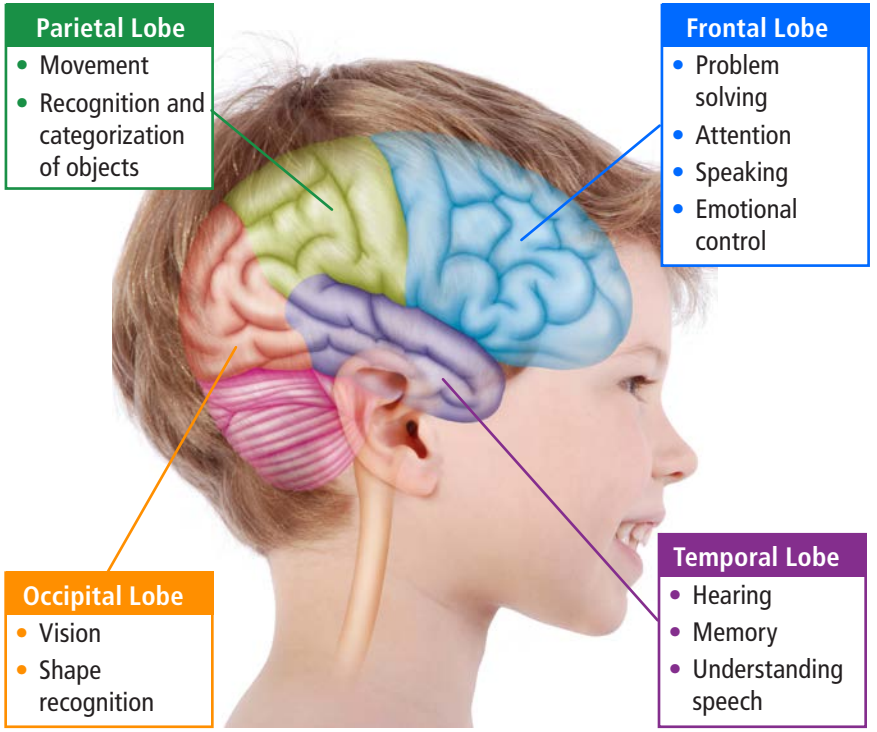
Phineas Gage was injured in 1848 when an accidental explosion shot a three-foot iron rod straight through his head. Amazingly, Gage survived. The hole in his head didn't affect his memory or his ability to think, but it changed his personality. Gage became rude, thoughtless, and stubborn, so different from his old self that his friends said he was "no longer Gage."

Gage had lost a portion of his frontal lobe, a part of the cerebrum that governs emotions and attention. His injury gave scientists one of the first clues that specific brain regions control specific brain functions.

Phineas Gage holds the iron rod that went through his left eye and frontal lobe.



Functions of Different Brain Lobes



Brain Mapping

Doctors studied Gage's case for many years. Then, in 1914, World War I began. Large numbers of soldiers suffered brain injuries, and the injuries to certain brain regions consistently caused the same symptoms. With this information, doctors were able to begin creating maps of brain regions and their functions. Trying to learn about the brain by studying brain injuries was much like trying to learn about cars by studying broken engines: scientists could identify essential brain regions, but that was about it.