WHAT YOUR BRAIN CAN DO

Module 2

Guide to Module 2:

Brains in a Box: What Your Brain Can Do

Introduction

During the second *Brain Power!* mission, students learn about four major parts of the brain and their functions. The students work in small groups to create a three-dimensional model of the brain made of Play-Doh. Using the trading cards supplied in the module, students discover what each part does.

This mission has the following goals:

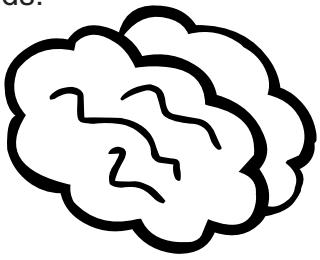
- To give students an opportunity to visualize the brain;
- To make students aware that the brain has different parts that perform different functions;
- To help students understand that the brain is the control center for the body.

Learning Objectives

- Students learn that the brain has different parts.
- Students create a model of the brain showing its four major parts.
- Students identify the function of each of these parts of the brain.

Relationship to the *National Science Education Standards*

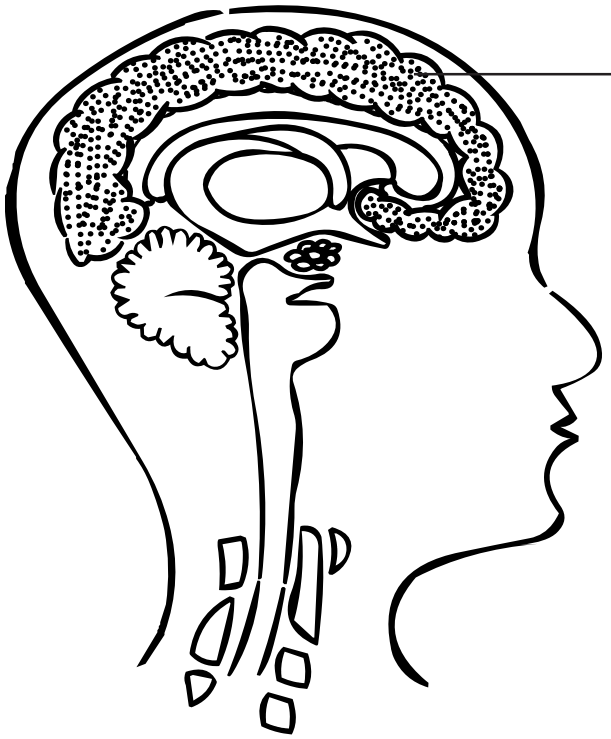
This mission aligns with several standards identified in the NSES: unifying concepts and processes, life science content standards, and standards for science as inquiry. The charts on the next page identify how the mission aligns with each of these standards.



UNIFYING CONCEPTS AND PROCESSES	
Levels K–4	**How Mission Is Aligned**
Systems, order, and organization	The mission introduces students to the idea that the brain is one system that is part of a larger system–the human body–and that both systems work together to enable people to function.
LIFE SCIENCE STANDARDS	
Levels K–4	**How Mission Is Aligned**
Characteristics of organisms	This mission introduces students to the concept that all animals have some kind of brain and that there are similarities and differences among the brains of different organisms.
SCIENCE AS INQUIRY	
Levels K–4	**How Mission Is Aligned**
Abilities necessary to do scientific inquiry	Students go through the steps of scientific inquiry: observing, making predictions, completing an investigation to test their predictions, and drawing conclusions.

Background

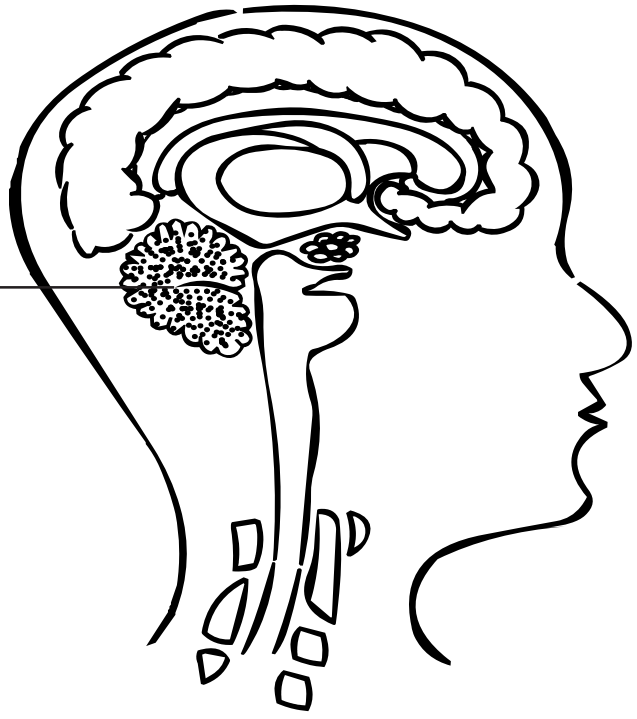
In module 2, students will be asked to identify and learn about four parts of the brain: the cerebral cortex, composed of the right hemisphere and the left hemisphere; the cerebellum; the brain stem; and the limbic system. These parts are explained in more detail on the next page.



Cerebral cortex: left hemisphere and right hemisphere

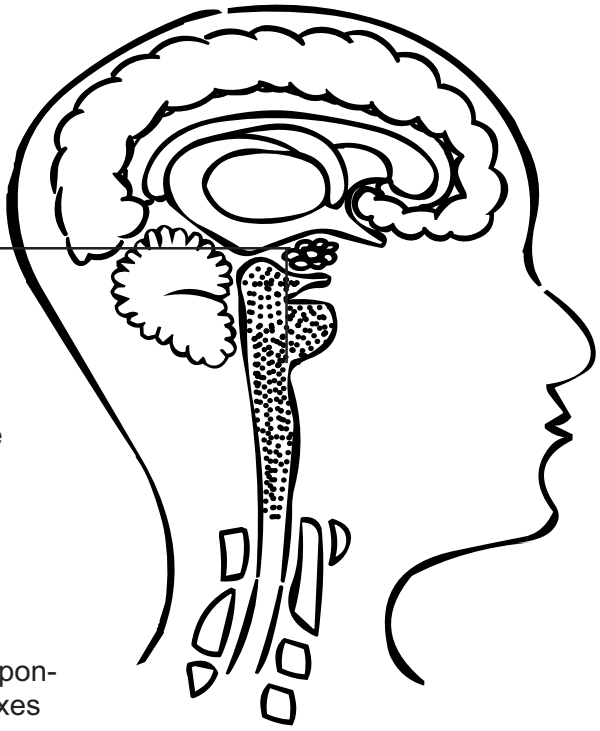
The brain's largest part, the *cerebral cortex,* makes up almost 90 percent of the brain. It has two hemispheres. The *left hemisphere*, which controls the right side of the body, is largely responsible for analytical thinking, such as solving problems and comparing information needed to make decisions. It also is the brain's language center.

The *right hemisphere*, which controls the left side of the body, is largely responsible for artistic expression and understanding relationships in space. A bundle of fibers called the *corpus callosum* serves as a bridge to pass messages back and forth between the two hemispheres.



Cerebellum

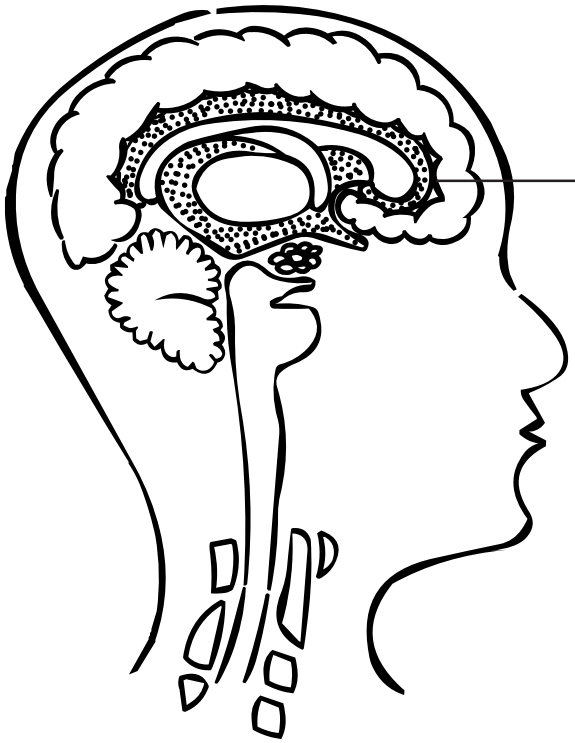
The cerebellum controls posture, movement, and the sense of balance. Such activities as playing ball, picking up objects, and playing musical instruments fall under its domain.



Brain stem

The brain's most primitive part is the brain stem. The two main parts of the brain stem are the *pons* and the *medulla*. The pons contains fibers that link the cerebral cortex with the cerebellum and the spinal cord. It also controls sleep, awakening, and dream impulses.

The *medulla* controls heart rate, respiration, and blood pressure. The brain stem also is responsible for body temperature control, simple reflexes (like coughing and sneezing), and digestion.



Limbic system

The two main parts of the *limbic system* are the *hippocampus* and the *amygdala*. The hippocampus is mainly responsible for learning and memory. The amygdala plays an important role in emotional behavior. The limbic system is greatly affected by drugs.

Materials

Five or six boxes with tops
Play-Doh (four colors)
Trading cards of brain parts
NIDA Junior Scientists videotape
Instruction sheets
Log sheets

Preparation

1. Make sure you have four different colors of Play-Doh or clay for this activity. If you don't have any available, follow the recipe below to make your own:
   a. In a saucepan, heat 2 tablespoons of vegetable oil. Add 1/2 cup of flour, 2 teaspoons of cream of tartar, and 1 cup of water.
   b. Cook for 3 minutes, stirring constantly.
   c. Divide the mixture into four parts. Use food coloring to make each part a different color.
   d. Let the dough cool, then store in plastic wrap in the refrigerator.
   e. Make one batch of this Play-Doh for each group.

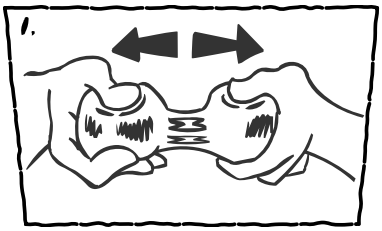
2. Put the four different colored clumps of Play-Doh in each of the boxes.

3. Divide the students into groups to complete this activity.

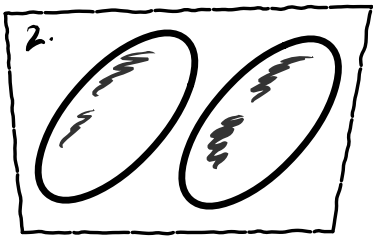
4. This activity will take 2 days to complete. On the first day, show the students the video and have them build their models of the brain. On the second day, hand out the log sheet. Students can work on labeling the parts, discussing what each part does, and filling in the log sheet.

Procedure

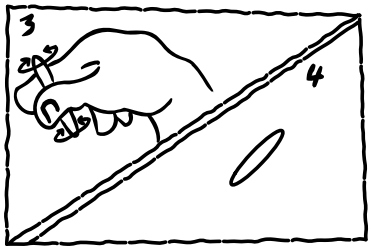
1. Before dividing the class into groups, show the first part of the videotape. If you don't have a VCR, read the introductory story at the back of this module. Turn the video off at the appropriate time and ask the children what they think they are supposed to make with the Play-Doh. After helping them figure out that they will be making a model of the brain, lead a brainstorming session about what the brain does. You might want to refer to the students' ideas from the earlier brainstorming session.
2. After eliciting ideas from the children, turn the video back on and have them view examples of what the brain does.
3. Divide the class into groups. Give each group a box and a set of trading cards. Explain the mission—to build a simple model of the brain and to find out what each part does. Point out that the trading cards have all the information they need to finish the activity.
4. To build the models of the brain, students should do the following:



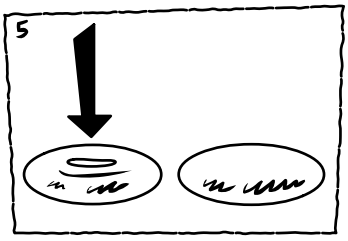
First, make the hemispheres of the cerebral cortex. Take a large clump of Play-Doh. Split it into two parts. Roll each part into an oval.



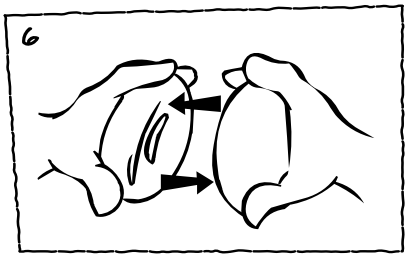
These two ovals are the hemispheres of your model brain. Students can make wrinkles on the hemispheres with their fingernails to make the brain look more realistic.



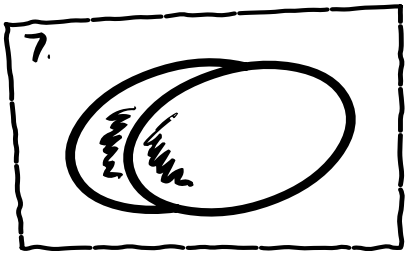
Next, make the limbic system. Using a different color of Play-Doh, make a small piece that is shaped like a bean.



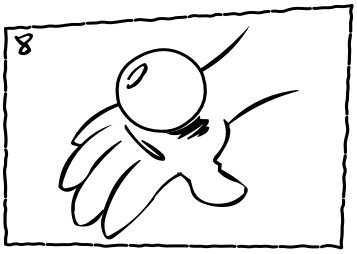
Lay the bean shape on one of the hemispheres.



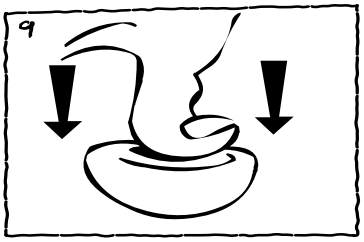
Put the two hemispheres together with the bean inside, like a sandwich. Press them together.



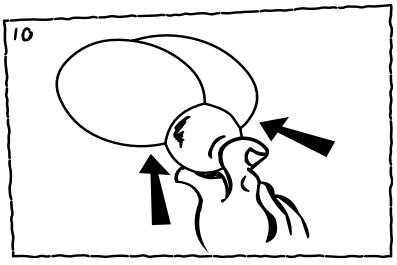
The limbic system is located deep inside the cerebral cortex.



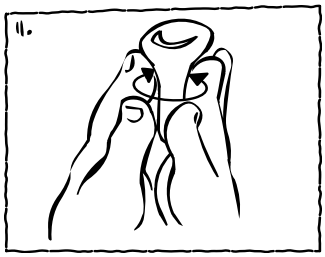
Third, make the cerebellum. Using a third color, make a ball about one-third the size of each hemisphere.



Flatten the ball slightly with your thumb.

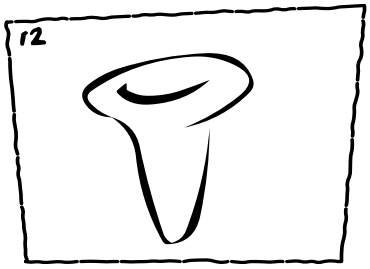


Put the ball on the bottom and underneath the hemispheres. The cerebellum is at the lower back end of the hemispheres.

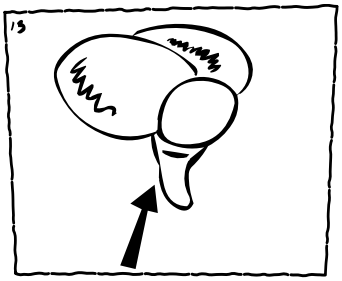


Finally, make the brain stem.

It would be helpful to have one or two parent volunteers or instructional assistants in the class when the students are making their models.



Using the fourth color, make a shape that looks like a small trumpet.



Stick the trumpet at the bottom of the cerebellum. The brain stem leads into the spinal cord at the back of the brain.

5. Give the students between 15 and 20 minutes to complete the activity. At the end of that time, each group should have a model of the brain.
6. On the second day, have each group use the trading cards to label each part of the brain. Ask each group to identify at least one function of each part.
7. Have each student complete the log sheet.
8. **CONGRATULATIONS! YOUR CLASS HAS COMPLETED THE SECOND MISSION.**

Have the students save their model brains. They will need them for module six.

Discussion Questions

1. Ask the students if they have any other ideas they want to add to the class list of what the brain does.
2. Discuss with the students their impressions of this mission. Were they surprised that the brain does so many things? Did they know about the brain before the mission? What other questions do they have about the brain?
3. Then ask students the following question: How do they think information gets to the brain? Keep a record of their responses. Conclude by telling the class that they will be learning more about how information travels in the next module.

Extensions

The following activities provide a link to other areas in the curriculum. They also help reinforce what was learned during the module and make use of the trading cards.


Language arts


Art


Reading


Math


Science


Drama

1. Have the students, either individually or in groups, draw a picture of the brain. Have them label each part and identify at least one function of each part.

2. Have the students, either individually or in groups, write a couple of sentences in response to the following prompt: “My brain is amazing because...”

3. Divide the class into pairs. Have one student give clues to the other about each part of the brain. Students may want to act out what that part of the brain does. Have students use the trading cards to play.

4. Have students, either individually or in groups, create new trading cards about the brain. They can be on different parts of the brain, scientists who study the brain, or different activities the brain enables us to do.

Assessment

1. As students work on this activity, look for evidence of the following:
   a. Are students grasping that the brain is one organ that performs a range of functions?
   b. Do students understand that the brain is the “control center” of the body?

2. Put each student’s log sheet in his or her student portfolio.

Additional Activities

Below are some additional activities that can be used after completion of the second mission. These activities are extensions to many other areas of the curriculum.

1. Make a class poster of the brain. Encourage the students to be creative and to use materials of different textures, such as felt, cotton, beads, and foam. Try to make the picture of the brain as accurate as possible. Make sure the parts are labeled.

2. Play a "game show" using questions about the brain. Students can take turns being the player. The rest of the class can be the audience, which is sometimes called on during the game. (The player has the option of polling the audience, having two possible choices taken away so that it's easier to guess correctly, or choosing a friend from the audience to help answer the question.) Make sure that everyone has a chance to be the player. Some sample questions are listed below.

1. The cerebral cortex is responsible for the following activities:
- **a**. Breathing
- **b.** Emotions
- **c.** Thinking
- **d.** All of the above

2. The limbic system is responsible for the following activities:
- **a.** Solving problems
- **b.** Seeing and hearing
- **c.** Balance
- **d**. Emotions

3. Why is the brain stem important?
- **a.** It controls breathing and heart rate.
- **b.** It helps out with balance.
- **c**. It is responsible for problem-solving.
- **d.** It enables us to talk.

4. A PET scan is useful because it shows:
- **a.** The outside of the brain.
- **b.** Just the parts of the brain.
- **c.** Which parts of the brain are working.
- **d.** The colors of the brain.

5. Phineas Gage had an accident that made him:
- **a.** Nasty
- **b.** Nice
- **c.** Smart
- **d.** Dumb

Answers: 1-c; 2-d; 3-a; 4-c; 5-a

3. Have your students put on a class play about the brain. Different students can play different parts of the brain, while other students can act out what the different parts do. Encourage the students to let their imaginations go!

4. Conduct a class brainstorming session about how we should take care of our brains. Help students understand that by taking care of our bodies—eating right, getting enough exercise, getting enough sleep, for example—we are also taking care of our brains. You might want to draw a class Venn diagram, with one side labeled "What You Should Do to Take Care of Your Brain" and the other side labeled "What You Should Do to Take Care of Your Body." Then the students will be able to clearly see how taking care of your body means that you also are taking care of your brain.

5. Have your students try to figure out this math problem: A baby's brain weighs 1 pound. By the time a child turns 6, however, the brain has reached its full size and weighs 3 pounds. How much bigger is a full-sized brain than a baby's brain? How long did it take to grow to full size?

6. Play brain "Simon Says." For example, you could say: "Simon says that if the left side of your brain helps with thinking, hop on one foot." The children will enjoy moving around while learning about the different parts of the brain.

Resources

The lists below include resources for teachers and students.

Resources for Teachers

National Institute on Drug Abuse (NIDA)
www.drugabuse.gov, 301-443-1124
This Web site contains information about drug abuse and a section designed specifically for parents, teachers, and students.

National Clearinghouse for Alcohol and Drug Information (NCADI)
www.health.org, 1-800-729-6686
NCADI is the world's largest resource for information and materials concerning substance abuse. Many free publications are available here.

Eisenhower National Clearinghouse (ENC)
www.enc.org
This Web site provides useful information and products to improve mathematics and science teaching and learning.

Greenfield, S. A. *The Human Brain: A Guided Tour*. New York: Basic Books, 1998. Written for a lay audience, provides a holistic view of the brain as an integral part of the body; part of the Science Masters Series.

Wade, N., ed. *The Science Times Book of the Brain*. New York: Lyons Press, 1998. A collection of articles about the brain from the science section of the *New York Times*.

Sylwester, R. *A Celebration of Neurons: An Educator's Guide to the Human Brain*. Alexandria, VA: Association for Supervision and Curriculum Development, 1995. The book discusses the structure and function of the brain, and explains how we think, dream, digest food, and much more.

A Brief Tour of the Brain
www.physics.syr.edu/courses/modules/MM/Biology/biology.html
Pictures and descriptions of the history of neuroscience and different parts of the brain.

Are We Unique?
www.fi.edu/qa97/spotlight5/spotlight5.html
Page from the Franklin Institute Web site talks about the science of the human mind.

Brain Briefings
www.sfn.org/briefings
Part of the Society for Neuroscience Web site; gives scientific information on different parts of the brain and brain disorders.

Resources for Students

Friedman, D. *Focus on Drugs and the Brain.* Frederick, MD: Twenty-First Century Books, 1990. Part of the "Drug-Alert Book" series; gives a good overview of the brain, neurotransmission, effects of drugs on the brain, and addiction.

Rowan, P. *Big Head! A Book About Your Brain and Your Head.* New York: Alfred A. Knopf, 1998. Gives an overview of the different parts of the brain; includes detailed color pictures and transparencies.

Neuroscience for Kids
http://faculty.washington.edu/chudler/neurok.html
Contains information on the brain and neurotransmission, activities, experiments, pictures, and other resources for students and educators.

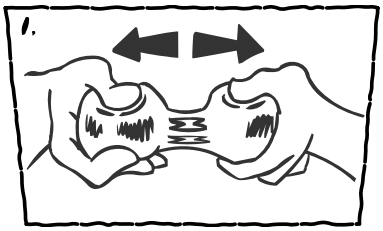
Bill Nye the Science Guy
www.nyelabs.com/splash.html
See Episode 34 on the brain.

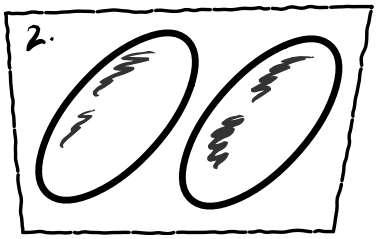
Student Instruction Sheet

Module 2: Brains in a Box: What Your Brain Can Do

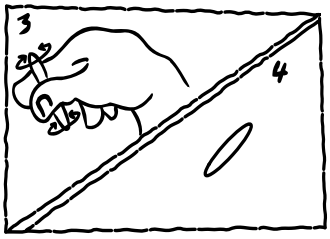
1. Do you have your box and a set of trading cards? If so, then you are ready to start.

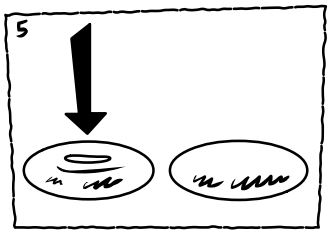
2. Open your box and take out one clump of the Play-Doh. Split it into two parts that are the same size. Roll each part into an oval. These two ovals are parts of your brain called hemispheres. You can use your fingernails to make wrinkles on the hemispheres.

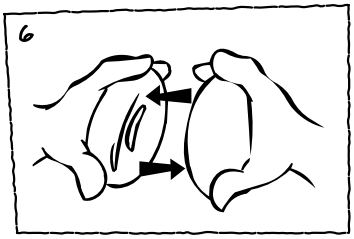




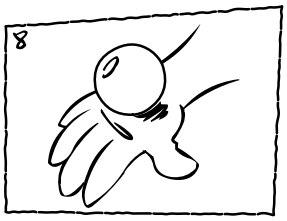
3. Make the next part of the brain, called the limbic system. Use a different color Play-Doh. Make a small piece that is shaped like a bean. Lay the bean down on one of the hemispheres. Press the two hemispheres together.

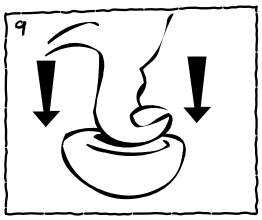


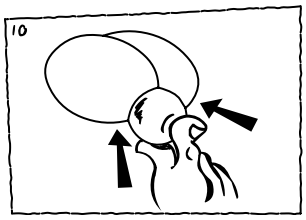




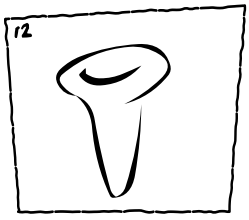
4. Now make the third part of the brain, the cerebellum. Use a third color of Play-Doh. Make a ball one-third the size of one of the hemispheres. Flatten the ball a little with your thumb. Put the ball on the bottom and underneath the hemispheres.

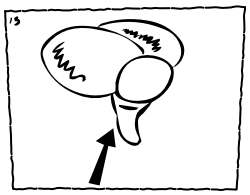






5. Make the brain stem. Use a fourth color and make a shape that looks like a trumpet. Stick the trumpet at the bottom of the cerebellum.





6. Fill out the log sheet.

7. **CONGRATULATIONS! MISSION 2 IS NOW COMPLETED.**

If you do not have a VCR, read this story to your class to introduce the mission.

Introductory Story for Module 2

"Hi again. Welcome back to the *Brain Power!* clubhouse. You've already met Brain Teaser and Brain Trust, but you haven't met us. I'm Beth, better known as 'Brain Storm' because I'm full of ideas. Meet my good pal, Juan, nicknamed 'Brain Wave.' He got his nickname because he's always on a roll—on his skateboard or anything else that moves."

"Hi, all," said Brain Wave. "Look what I found outside our door. A box."

"Oh, goody, a present," said Brain Storm. "Does it have my name on it?"

"Nope. It must be for all of us. Let's open it."

"What are these lumps of Play-Doh for?" asked Brian Storm. "I haven't used this stuff in years."

"Wait, there's something at the bottom of the box. It's a tape recorder. Let's turn it on and see if we can find out what's going on here."

"Hello, Brain Storm and Brain Wave. This is Corty, your friendly brain, speaking. NIDA has a mission for the *Brain Power!* Club."

"Wow! A mission—for us," said Brain Storm.

"You have just received Play-Doh in a gift-wrapped box," continued Corty. "When you make something with the Play-Doh, it becomes one amazing thing that is truly a gift."

"I wonder what it is," said Brain Wave.

"You're probably wondering what it is," said Corty. "Here are some clues. Take some deep breaths. (*The kids in the class can do this.*) Now sing the scales (*do, re, mi, fa, so, la, ti, do*) and tumble across the floor. Can you answer this? 4+5? 6+8?"

(Pause as the class does all this)

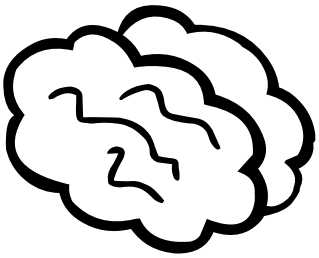
"If you can figure out what all these activities have in common, you'll know what the Play-Doh becomes. Oh, and be sure to use your brains."

"Gosh, Brain Wave. Do you have any idea what we're supposed to make?" asked Brain Storm.

"No, but I bet all those kids out there know. Come on, guys. Help us out. Make something wonderful with the Play-Doh—something that represents an amazing gift," Corty said. "I know you can do it."

"That's right," replied Brain Storm. "So go for it, and remember, *Brain Power!* rocks the world."

Log Sheet



Name: _____

What parts of the brain I learned about

What I know about each part

What else I would like to learn about the brain

BRAIN POWER NEWS

Parent Newsletter

Volume 1, Number 2

What Your Brain Can Do

Your child has just completed module 2 of the National Institute on Drug Abuse (NIDA) Junior Scientists Program. He or she put together a three-dimensional model of the brain, identified its four key parts, and learned about what each part does.

Our goal is to show children how amazing the brain really is. Most children this age know that the brain helps them think, but they don't realize that the brain is also responsible for just about everything else, too—from regulating heartbeat and breathing to controlling emotions and artistic expression. By teaching them about "*Brain Power!*," we hope that they will think twice about doing anything that might harm their brains.

The Brain Is Truly Amazing

Here's a quick summary of what your child learned about the brain:

Part of the Brain	Function
Left hemisphere, cerebral cortex	Responsible for analytical thinking such as solving problems and comparing information needed to make decisions. It also is the brain's language center.
Right hemisphere, cerebral cortex	Responsible for artistic expression and understanding relationships in space.
Cerebellum	Controls posture, movement, and the sense of balance. Such activities as playing ball, picking up objects, and playing musical instruments fall under its control.
Brain stem	Controls heart rate, breathing, blood circulation, and digestion.
Limbic system	Responsible for emotions and also involved in memory and memory storage. Drugs can change how the limbic system works.

continued

Science at Home

Ask your child what he or she learned about the brain. See how many parts he or she can identify. Throughout the day, as you perform different activities together, ask your child which part of the brain is being used. Then ask your child to draw a picture of the brain and label it.

What Does Your Child Think?

Have your child draw or write something about the brain.

Additional Resources

The books and Web sites listed below have more information about the brain.

National Institute on Drug Abuse (NIDA)
www.drugabuse.gov, 301-443-1124
This Web site contains information about drug abuse and a section designed specifically for parents, teachers, and students.

National Clearinghouse for Alcohol and Drug Information (NCADI)
www.health.org, 1-800-729-6686
NCADI is the world's largest resource for information and materials concerning substance abuse. Many free publications are available here.

Friedman, D. *Focus on Drugs and the Brain.* Frederick, MD: Twenty-First Century Books, 1990. This book is part of the "Drug-Alert Book" series. It provides a good overview of the brain, neurotransmission, the effects of drugs on the brain, and addiction.

Rowan, P. *Big Head! A Book About Your Brain and Your Head.* New York: Alfred A. Knopf, 1998. An overview of the different parts of the brain. Includes detailed color pictures and transparencies.

Simon, S. *The Brain: Our Nervous System.* New York: Morrow Junior Books, 1997. An overview of the brain and neurotransmission, with a focus on the function of the brain.

Neuroscience for Kids
http://faculty.washington.edu/chudler/neurok.html
This Web site contains information on the brain and neurotransmission, activities, experiments, pictures, and other resources for students and educators.

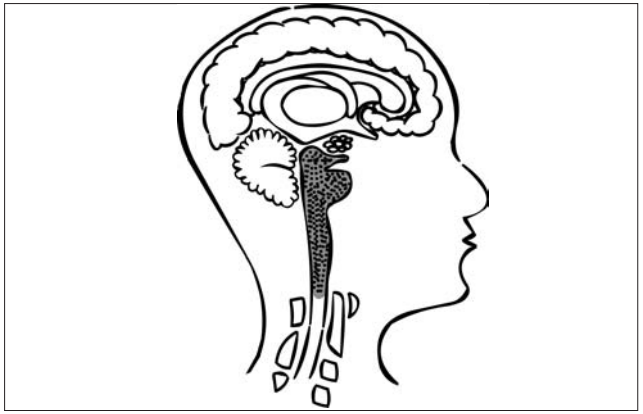
How Your Brain Works
www.howstuffworks.com/brain7.htm
Pictures and descriptions of the history of neuroscience and different parts of the brain.

Are We Unique?
http://sln.fi.edu/qa97/spotlight5/spotlight5.html
This subpage from the Franklin Institute Web site talks about the science of the human mind.

Bill Nye the Science Guy
www.nyelabs.com/splash.html
See Episode #34 on the brain.

Brain Briefings
www.sfn.org/content/publications/brainbriefings
This page is part of the Society for Neuroscience Web site. It provides scientific information on different parts of the brain and brain disorders.

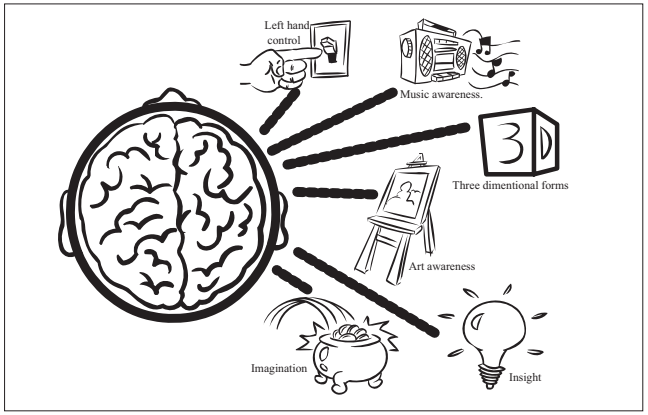
BRAIN STEM



The brain stem tells your body to do all the things you need to do to live—breathe, pump blood, sleep, wake up, and digest food. Most of the time, you don't even know it's doing all that work! Your brain stem is only 3 inches long. Can you find it?

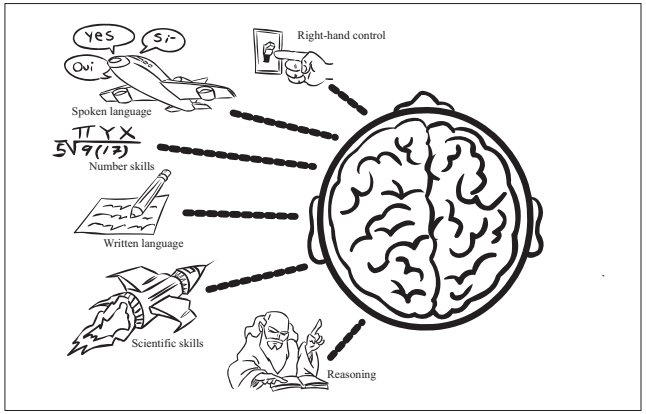
The brain stem is in the back, just above where the head and the neck join.

RIGHT HEMISPHERE



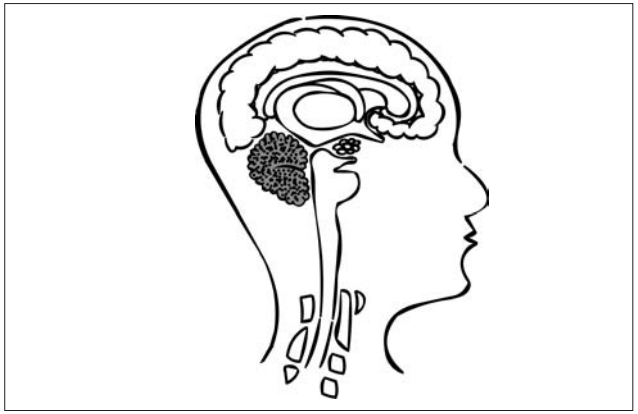
The right half of your brain is your artistic side. This is where your talent for painting or drawing comes from. The right half of the brain also controls movement on the left side of the body.

LEFT HEMISPHERE



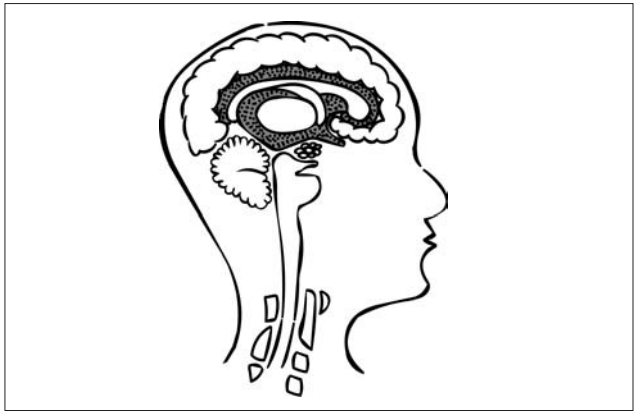
The left half of your brain is your thinking side. This is where your talent for math and talking comes from. The left half of the brain also controls movement on the right side of the body.

CEREBELLUM



Cerebellum means "little brain." The cerebellum helps you jump, walk, play ball, and pick things up. It controls all of your movements and balance. Your cerebellum is the reason you don't fall over all the time!

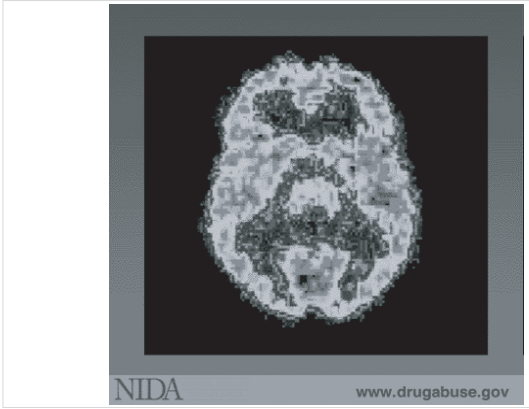
LIMBIC SYSTEM



The limbic system is a special spot deep inside the brain. The limbic system is where your emotions live. Can you name some emotions? Memories also live in the limbic system.

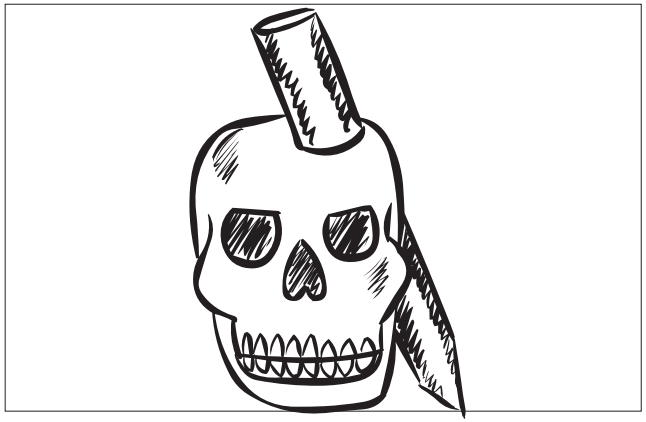
There are many emotions, like happiness, sadness, anger, embarrassment, and joy.

PET SCAN



PET scans are special pictures of the brain. These pictures let doctors and scientists look inside a person's brain. In this picture, the dark spots are the parts of the brain that are working hardest.

PHINEAS GAGE



Phineas Gage worked on the railroads. He was in a terrible accident. A railroad track exploded, and a spike entered his brain. Phineas lived, but he became a different person. He went from being nice to being nasty. Why do you think this happened?

The spike damaged Phineas' brain—probably part of the limbic system, which controls emotions.

JUAN, BRAIN WAVE

Meet Juan, a member of the Brain Power Club. Juan's club name is Brain Wave. When there's a mission for the club, Juan is always the first in line. Juan's favorite things to do are riding his skateboard and completing missions from the NIDA Junior Scientists Mission Control Center!

BETH, BRAIN STORM

Here's Beth, a member of the Brain Power Club. Beth's club name is Brain Storm! Beth uses her imagination to help complete the missions. Beth's favorite thing to do is to daydream about being a scientist someday!

WHAT YOUR BRAIN CAN DO

Left hemisphere: Problem solver, decision maker, and talker

Right hemisphere: Artistic center, memory of where places are

Cerebellum: Controls posture, movement, and balance

Limbic system: Emotion and memory, which are greatly affected by drugs

Brain stem: Controls heart rate, center for breathing, blood circulation, and digestion