

UNIT ONE

THE NERVOUS SYSTEM

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SUMMARY

KEY POINTS

UNIFYING CONCEPTS

FULL BODY TRACING

In the Full Body Tracing students work together as a class to create a model of the nervous system. The outline of a student's body is traced on a large piece of paper. A cardboard cut out of the brain and spinal cord are placed in the outline to represent the central nervous system. Two colors of yarn, representing the motor and sensory nerves, are used to create motor and sensory pathways of the peripheral nervous system.

- All our thoughts, movements, sensations and emotions are controlled by the nervous system.
- We have a Central Nervous System (brain and spinal cord) and Peripheral Nervous System (nerves extending from the spinal cord to limbs, trunk, face, organs and throughout.)
- Sensory nerves communicate information from the body to the brain and motor nerves, from the brain to the body.

- Models help us understand and explain the world.*
- Systems are made of parts which connect to create the whole.*
- The brain receives informational signals from all parts of the body. The brain sends signals to all parts of the body to influence what they do.*
- Humans have systems for digestion, circulation, movement and coordination. These systems interact with one another.*
- Describe the basic structure and function of human body system.*

CLAY BRAINS

In the Clay Brain lesson students work individually to create a scale model of the human brain and learn about the functions of each part..

- The brain is divided into the left and right hemispheres which control opposite sides of the body.
- Other major brain parts include the corpus callosum, the cerebellum and the brain stem. Each has a special function: keeping the body alive, keeping the body balanced and allowing body systems to communicate.

- Models help us understand complex structures. Such representations can never be exact in every detail.*
- Children can begin to view the body as a system, in which parts influence one another. Parts do things for other parts and for the organism as a whole.*
- Describe the basic structure and function of human body system.**

MAGIC WAND

The Magic Wand lesson teaches localization of function of the cortex. Students reenact the experiments of Dr. Wilder Penfield. They observe the movements and sensory responses of a human subject being stimulated and observe what parts of the brain correspond to different sensations and movements.

- The left hemisphere controls the right side of the body; the right hemisphere controls the left side.
- Sensory and motor function are controlled by specific regions of the cerebral cortex.

- Scientific inquiry includes the process of following specific steps to verify findings. Students practice skills of observation, collecting and recording data, analyzing results and forming conclusions.*
- Humans have distinct body structures. Our brain structures correspond to different body functions.*
- Describe the basic structure and function of human body system.**

* Source: National Science Standards

** Source: National Health Standards

LESSON 1

Lesson Overview

Engage (5 minutes)

- Pairs of students practice closing eyes and being touched silently by a partner. How do you know where you were touched when nothing was said?
- During discussion, two student volunteers create a full-body tracing outline. (One traces the other who is lying on paper.)

Explore (10 minutes)

- Discuss how we know we feel something; use a question and answer method to discuss the role of the nervous system in the experience of being touched. Hand out human body outlines.

Explain (20 minutes)

- Explain motor and sensory nerves, central and peripheral nervous system. Hang the tracing and have volunteers add central and then peripheral nervous systems to a large outline of the human body. Students recreate the model at their desks.

Expand (10 minutes)

- Think of other examples of movement and touch sensations. How does our nervous system function within our bodies?

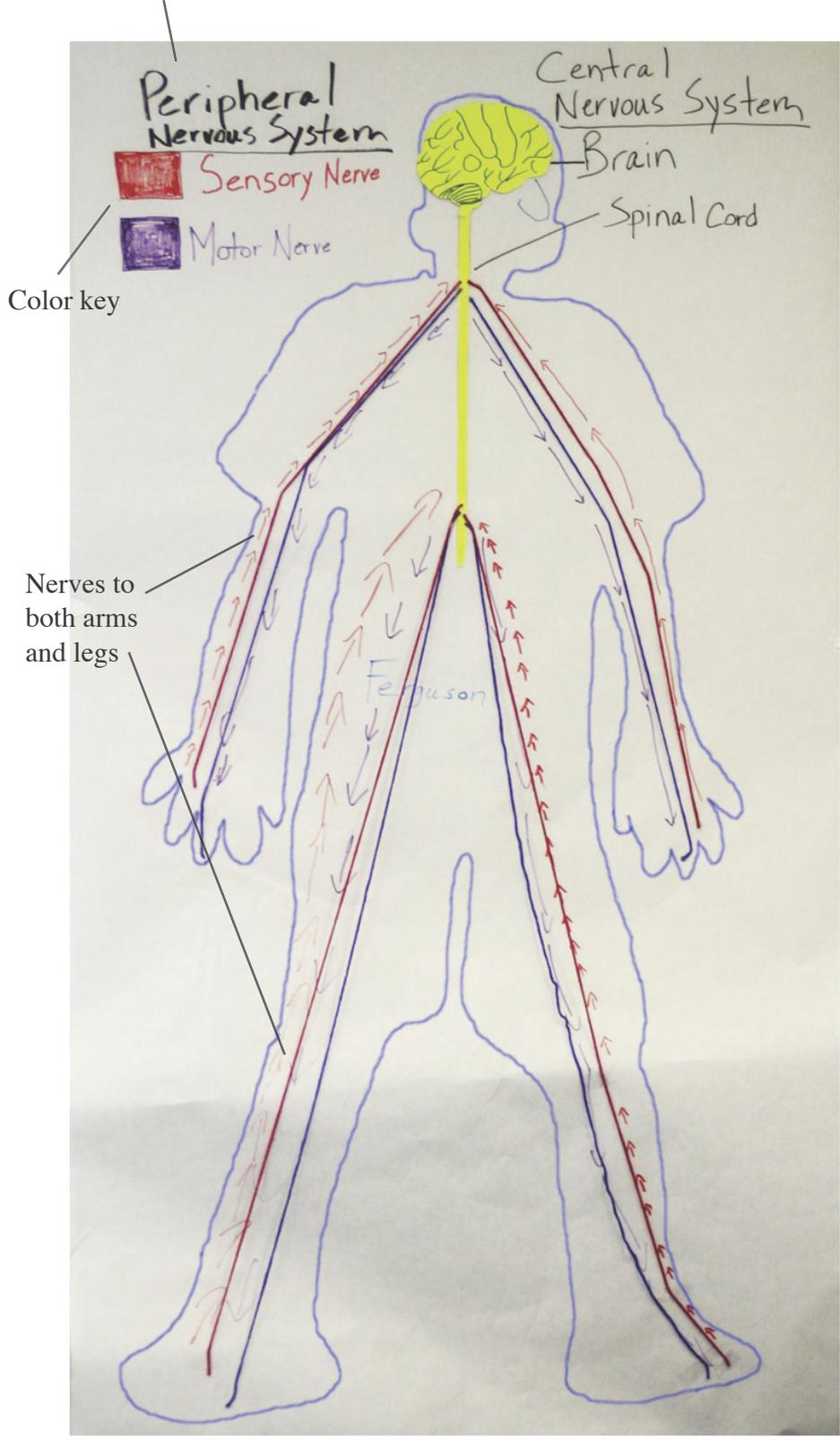
Evaluate (10 minutes or while assembling large diagram)

- Students draw and label the nervous system on their handout of a human body. Label the three major parts of the nervous system.
- **Part II:** Complete or write sentences using the words *motor nerves* and *sensory nerves*.



Supplies: Two contrasting colors of yarn, a roll of paper, tape, two contrasting color markers and a student handout per student.

Here is an example of a finished full-body image, complete with the nervous system created by a fourth grade class.



This model can be simplified according to time constraints. Be sure to include one motor nerve, one sensory nerve, and their labels.

FULL BODY TRACING

FULL BODY TRACING

Background

The Full Body Tracing

The first lesson of this unit introduces different parts of the nervous system by constructing a model of the nervous system with a full body tracing. Students will learn how the brain sends and receives messages via the nervous system. Any part of the body that can move or feel is connected to the nervous system.

The Central Nervous System (CNS) is made up of the brain and the spinal cord. The vertebrae of the spine encase and protect the soft neural tissue of the spinal cord, just like the skull protects the brain.

The motor and sensory nerves running throughout the body make up the Peripheral Nervous System (PNS). The PNS sends message to and from the CNS. The CNS controls the body by sending messages that flow through the motor nerves to control muscles. Sensory nerves relay messages about touch, pressure, temperature, pain, sound, vision, smell, and taste to the CNS. Thus, motor nerve messages travel from the CNS out to the muscles in the body and sensory nerve messages travel from nerve endings in the body back in to the CNS.

Motor and sensory nerve messages do not share the same pathways in the body. They are like one-way streets, traveling in only one direction. Another division of the Peripheral Nervous System is the Autonomic Nervous System (ANS), which usually controls muscles without conscious awareness. These muscles control heartbeat, breathing, blinking, pupil dilation, and digestion. The specific locations in the brain that control the different parts of the body will be discussed in the following lessons.



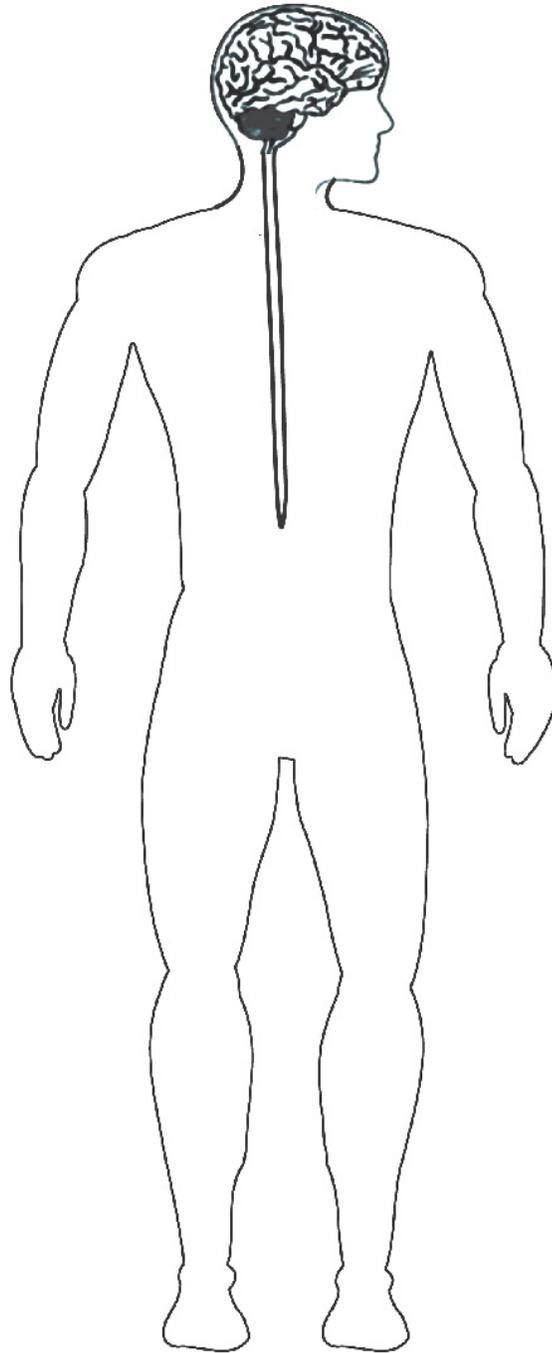
Name _____

Class _____

The Nervous System

1. Choose two colors of marker or pencil.
2. Draw lines with arrows on them showing motor nerves carrying messages out to the muscles, and sensory nerves carrying information from the outside world to the brain.
3. Complete the color key below with your colors and labels (motor nerve, sensory nerve).

This person is looking to their left. Which hemisphere do we see?



Key

<input type="checkbox"/>	_____
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Full Body Tracing: Summary

FULL BODY TRACING



STEP 1: Choose a student to be traced and one to do the tracing.



STEP 2: While this is happening, discuss the experience of touch. How do we know when we are touched if we do not see it happen?

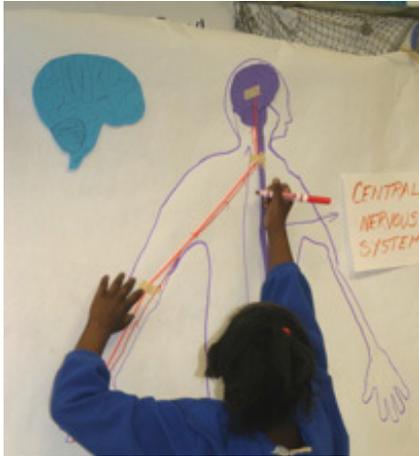


STEP 3: Volunteers place paper models of the brain and spinal cord in the full body tracing while the class begins filling in their own scale version on a handout.

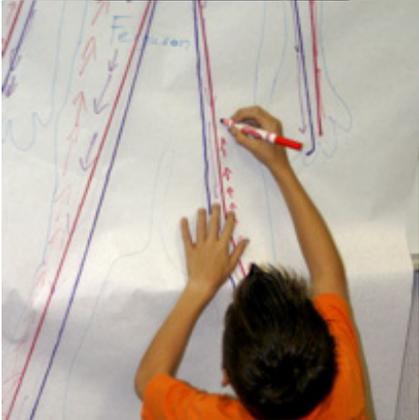


STEP 4: At their desks, students complete a 2D version of the model being created at the front of the room.

FULL BODY TRACING



STEP 5: Add yarn and labels to the model. Use one color for the motor nerves and another color for sensory nerves.



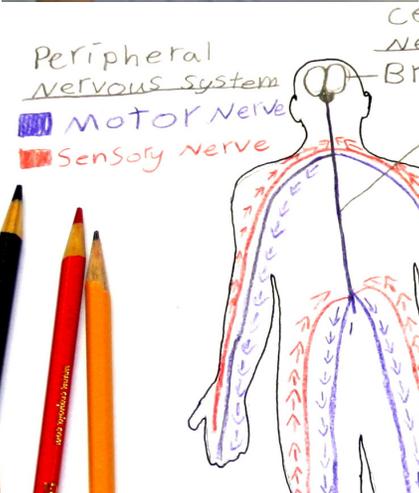
STEP 6: Add arrows showing the direction the messages travel.



STEP 7: Create a color key and label the Central and Peripheral Nervous Systems.

Vocabulary Terms:

- Brain
- Spinal Cord
- Nerves
- Nervous System
- Motor and Sensory nerves



Assessment:

Students complete a scale drawing of the nervous system with parts labeled, arrows and a color key.

LESSON 2

Lesson Overview

Always a popular activity, the clay brains lesson introduces the parts of the brain and the function of the parts. This activity challenges students to really study the 3D brain models and become familiar with the parts of the brain through simultaneous tactile and auditory experiences. As students hear about the parts of the brain, they also shape them with their hands.

Engage (10 minutes)

- Display a model human skull. 1/4 inch thick skull protects the brain; protect your skull and brain by wearing a helmet.
- Display several life-sized brain models. Introduce names for the different structures of the brain.
- Point out the Greek and Latin roots.
- Students will be making brain models out of clay!

Explore/Explain (25 minutes)

- Pass out supplies to each student.
- Student volunteers read each paragraph. Class follows along and assembles models. Circulate and explain as needed.
- Encourage students to refer to the model brains for guidance, and to use proper vocabulary when asking questions.

Evaluate (10 minutes)

- Use the worksheet checklist to check and correct models. Or, have students create labels attached to toothpicks, to stick into the appropriate part of the brain models. See photo on next page for an example.



Supplies: Four differently colored clay chunks stored in a plastic zip-close bag per student and model brains.

Optional: adhesive address labels, toothpicks

CLAY BRAINS



The clay brain lesson lends itself to a large span of content. Students can simply mold the five basic parts or go on to add localization of function, depending on their interest and abilities.

Background

In the Clay Brain lesson, students learn more about the brain and its major structures. The average adult brain weighs about 3 pounds (1300-1400 grams). Like snowflakes, no two human brains are exactly alike, although they do have common structures and configurations. Brain size doesn't equal intelligence. Someone with a five-pound brain would not necessarily be "smarter" than a person with a two-and-a-half-pound brain. Albert Einstein had a smaller than average brain, for instance. It's more a matter of circuits of brain cells operate. An elephant has a fifteen-pound brain, but few elephants have made significant scientific discoveries.

The brain is made up of many different structures. Like the Earth, the cerebrum (top part of the brain) is divided in two hemispheres. The word 'hemisphere' means 'half of a circle' in Latin. There are many interesting things to learn about the cerebral hemispheres. The left hemisphere controls the right side of the body, and the right hemisphere controls the left side of the body. While the hemispheres are similar in appearance, they are not identical and have different functions.

In most people, the left hemisphere is used for language, speech, In most people, the left hemisphere is dominant for language, speech, writing, math, and logical reasoning. The right hemisphere is dominant for music, spatial awareness, art, intuitive thought, and imagination. A bridge-shaped band of nerve fibers called the corpus callosum (which means 'body of hardness' in Latin) connects the two hemispheres. There are millions of nerve fibers in the adult human corpus callosum that send messages back and forth between the hemispheres. The nerve fibers in the corpus callosum allow the hemispheres to communicate with each other. Since the two hemispheres have different and complementary functions, it is important for them to communicate for optimal mental performance.

The cerebral hemispheres are covered by tissue called the cortex, which controls movement, sensory processing, and thinking. The cortex (meaning 'bark' in Latin) is only about 2-3 mm thick. The 'wrinkles' on the cortex are called gyri (pronounced jie-rye), which is Latin for 'roll' or 'fold'. One such roll is called a gyrus. The grooves between the gyri are called sulci (pronounced sul-sigh). This is the Latin term for furrow, like the lines in a farmer's field. The singular form of sulci is sulcus. The surface of the brain is folded so that more tissue can fit inside the skull. If the cortex were ironed flat, it would be about the size of a pillowcase.

The structure that looks like a little brain underneath the hemispheres is called the cerebellum. The cerebellum helps to coordinate movement, balance, and thinking. Appropriately enough, cerebellum means 'little brain' in Latin. In front of the cerebellum is the brain stem. The brain stem is a collection of different structures that connects the brain to the spinal cord. The brain stem is kind of the 'automatic pilot' of the brain. It helps regulate the autonomic nervous system, controlling functions like breathing, heartbeat, blinking, blood pressure, and the pupillary reflex.

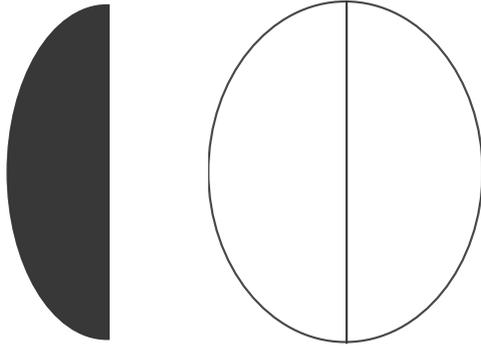
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Assessment: Label the parts and the functions of each part. Make toothpick labels and a list with functions of each part. Create an annotated illustration to go with the model. Or, make a color key with parts and functions defined.

How to Make a Clay Brain

Today we are going to build a brain out of clay. To do this, we will need to make the different parts of a brain. The first part is called a **hemisphere**. The Earth has two hemispheres. So does the brain. Make one side of your hemisphere flat, so that your hemispheres fit together like the picture below.

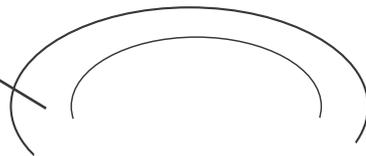


Two Hemispheres

Hemisphere is a Greek word that means half (hemi) of a round shape (sphere). Scientists use Greek and Latin words to describe different shapes and structures. These are very old languages that scientists like to use to describe things they discover or observe.

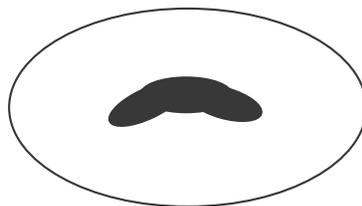
After you make one hemisphere, make another one the same size. The outside of the hemisphere is called the **cortex**. The cortex protects the inside of the brain, and helps with such things as thinking, movement, sight, hearing and the sense of touch. The right hemisphere controls the left side of the body, and the left hemisphere controls the right. Each hemisphere has separate jobs.

The cortex is the outer layer of the hemisphere.



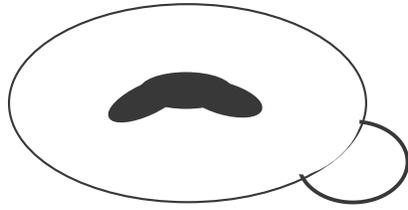
This is a Latin word that means "bark", like the bark of a tree. The cortex protects the inside of the brain the way that bark protects the inside of a tree.

A bridge called the **corpus callosum** connects the two hemispheres. These strange sounding words mean "hard body" in Latin. Put a small piece of clay, shaped like a "C", in the middle of one of your hemispheres before you press them together.



Now we need to make the **cerebellum**. The cerebellum is made up of the two rounded shapes that look like a little brain at the back of the cortex.

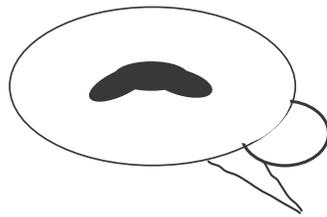
Roll up two smaller balls of clay. Squish them together a little, because unlike the hemispheres, the cerebellum is not made up of two separate pieces. Choose which end of the brain will be the back, and attach the cerebellum to the back of the brain, underneath the hemispheres (refer to the model). The cerebellum helps us with balance and coordination.



Cerebellum means 'little brain' in Latin.

Next we'll make a **brain stem**. The brain stem connects the brain to the spinal cord. The brain stem controls body processes that we don't think about such as breathing, blinking and heartbeat.

The brain stem connects to the bottom of the brain. Pinch the clay so it attaches well, underneath the brain and in front of the cerebellum. Look at the model if you are not sure where to put your brain stem. In your body, the brain stem connects to the spinal cord.



Gyrus is a Latin word that means 'roll' or 'fold'.

Shapes that look like wads of gum cover the outside of the cortex. Just one of these wads is called a **gyrus**. Two or more are called gyri. Between the gyri are lines or grooves. Our final step is to make gyri. Roll up clay "snakes" and press them onto each hemisphere. *Remember*, the hemispheres are connected only at the corpus callosum, so be sure the gyri stay on one hemisphere and do not cross over. In these clay brains, we are making gyri as a separate feature, but really the cortex is entirely made up of gyri.

Congratulations! You have built a brain! Can you name the different parts of your brain? Show someone your brain and point out the different parts.

Here is a checklist of the parts your brain should have:

- Right hemisphere
- Left hemisphere
- Corpus callosum
- Cerebellum
- Brain stem
- Gyri

Take your brains home and show the different parts to someone. How many of the parts did they know? Try and use the Greek and Latin words you have learned today. Everyone in your family will know they have a scientist living with them!

CLAY BRAINS

How to Build a Brain: Summary



STEPS

Start with three or four colors of clay or play dough.

Create two equal sized hemispheres, each about an inch in diameter. Mold them into an egg shape.

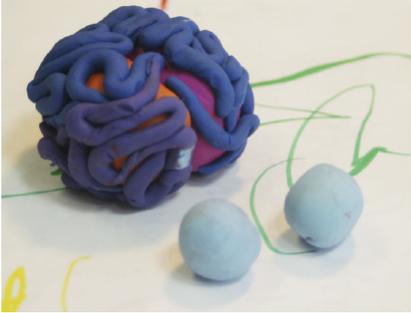
Press each egg shape into the desk to flatten one side. Form them so they fit together. Do not press so hard that they stick. Open them apart again.

Make a small curved cylinder with pointed ends and add it between the hemispheres. This is the corpus collosum. It acts as a bridge between the hemispheres.

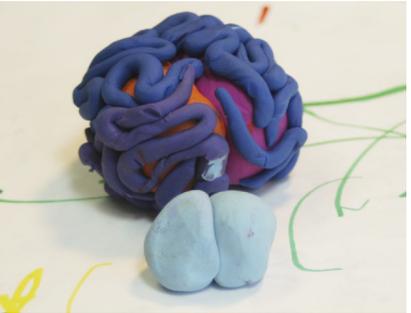
Add the corpus collosum to the model. The corpuscollosum is the “hard body” which connects the left and right hemispheres helping them communicate.



The gyri (blue rolls) can be added now or after the cerebellum. Roll and mold long “worms” to wrap onto the cortex as gyri; the sulci are the grooves between the gyri.



The cerebellum is now added to the hind, lower part of the brain. The cerebellum coordinates messages in and out of the brain, and helps with balance and motor coordination.



The cerebellum has two hemispheres. They appear connected and should be pressed together until they fuse. The long, thin horizontal folds can be carved in with a toothpick.



Lastly, add the brainstem. The brainstem helps with automatic functions of heartbeat, breathing and coordination..

You’re finished! Often, the atmosphere is ripe for brain jokes. “What a lovely brain you have!” Please hold up your brain to show the class.

Assessment ideas: Label the parts and the functions of each part. Make toothpick labels and a list with functions of each part. Create an annotated illustration to go with the model. Or, make a color key with parts and functions defined.

3

Lesson Overview

Note: This lesson lends itself to different approaches. Students can either be shown the structures in advance and told what parts of the body they control, then do the acting out as a way to reinforce the content, or, the class can observe human subjects (student volunteers) responding to pretend electrical stimulation with the Magic Wand, observe the movements, take notes, and try to determine through their observations which area of the brain controls which part of the body. Both methods are detailed on the following pages.

N

Lesson Plan Version 1: Magic Wand Demonstration

Engage (5 minutes)

- Ask: *We have learned that we have sensory and movement centers in our brain - but where are they exactly?* Using a brain model, review terms: cortex, brain stem, cerebellum.
- The brain is compartmentalized; different parts of the brain have different jobs. The lower parts of the brain have jobs we don't tend to think about. The brain stem, for example, helps with breathing, blinking and heartbeat. A little higher up, the cerebellum helps us with balance and coordination.

O

Explore (10 minutes)

- Guess which part of the brain has the movement and sensory centers.
- Different parts of the cortex are responsible for seeing, moving, feeling, and hearing. Remember, each hemisphere controls the opposite side of the body. Students point out where they think these functions occur.

S

Explain (15 minutes)

- Display poster of the brain, highlighting the movement and touch cortices, the visual cortex, and the hearing cortex. (Continued next page)

S

NUMBER OF THE AREA	WHAT HAPPENS WHEN STIMULATED?	NAME OF THE AREA
1		
2		
3		
4		
5		
6		

E

Supplies: Giant Functional Brain, Magic Wand and handouts.

L

E

MAGIC WAND

- Explain the functions of these cortices.
- Briefly describe how Dr. Wilder Penfield used electric current to stimulate different areas in the brains of conscious patients.

Expand (10 minutes)

- Worksheet 1: 3/4 view of the brain with six empty boxes.
- Write the function of each cortical area in the boxes.
- Display the ‘magic wand’ used to stimulate the six areas of the brain.
- Point to the numbered area on the large brain poster, and then ‘stimulate’ the same area on the head of a volunteer student and have them move or describe sensations as listed in the answer key for actors.
- Repeat with numerous volunteers, varying the number and hemisphere stimulated. Use the giant functional brain instead of a poster if available.
- Ask the class if the student is correctly responding to the stimulation.
- The volunteer student may ask a fellow student for help with the correct response. Keep going until everyone has a handle on it. Then, have students come up in pairs to be stimulator/stimulatee.

Evaluate (15 minutes)

- Worksheet 2: cross-section of the brain with cortical areas shaded. Write the responses to the stimulation for the different regions of the cortex.
- Color each cortical area a different color. Create a corresponding color key. (Hint: Avoid using black since numbers cannot be seen.)



Lesson Plan Version 2: Magic Wand Experiment

Engage

Ask: How do we know what part of the cortex is in charge of what part of the body? Tell the story of Dr. Wilder Penfield and of his experiments. Tell them we will be reenacting that experiment today. Show the Magic Wand.

Explore

- Choose six student volunteers. Assign each a number, give them the Answer Key for Actors, and have them step outside to learn their roles.
- *Ask: When we electrically stimulate parts of the brain, what happens?*
- Touch the back of the head of the first volunteer and say you are stimulating area #1. The volunteer pretends to see a flash of light even with eyes closed. As you touch the hearing gyri, the volunteer will pretend to hear a sound, and so forth. See the brain poster answer key for points to touch and reactions to expect.
- Students observe the experiment, and recording their observations on the worksheet.

Explain

- Students review their answers.
- Do you see a pattern in your answers? Can you determine which area of the brain is the motor cortex? Where is the sensory cortex? Auditory? Visual?

Expand

- Show a picture of the homunculus, the illustrated human cartoon map of the somatosensory cortex.
- Ask why some parts of the illustrated human seem to be drawn in an exaggerated way. Prompt: Are your lips more sensitive than your elbows? *How does that correlate with the area dedicated to the lips on the illustration?*

Evaluate

- *Ask: Do your results match those of Dr. Penfield?*

Background

The Magic Wand lesson deals with localization of function on the cerebral cortex. It took scientists a long time to figure out that different parts of the cortex performed specific tasks. Early efforts to ‘map’ the brain included the early 19th century pseudo-science of phrenology, where the bumps on a person’s head were thought to give insights into their intelligence and character.

While phrenology didn’t pan out as a career choice, others were making deductions based upon observations of patients who had suffered strokes and other brain traumas. A French doctor named Paul Broca had a patient who had suffered a stroke and subsequently could not say anything but the word “tan”. After the patient died in 1861, Dr. Broca discovered that a specific area on the left hemisphere was damaged. This speech center is now referred to as Broca’s Area. In 1874, a German doctor named Carl Wernicke made a similar discovery involving a patient who could speak but not understand words. This language comprehension center (located in the left hemisphere, behind the ear) is now called Wernicke’s Area.

The next major step in mapping the cortex occurred in the 1940's, when a neurosurgeon named Wilder Penfield performed experimental surgery on patients with severe epilepsy. Epilepsy is caused by episodes of unregulated electrical activity in the brain, which often produce seizures of varying intensity. Dr. Penfield operated on patients who were still conscious, stimulating various parts of their brains with small amounts of electric current. Using a local anesthetic, Dr. Penfield would make an incision through the scalp and skull to expose the brain. The cortex has no pain receptors, so the patient felt no pain during the electrical stimulation. Systematically, different areas of the patient's brain were stimulated and marked with little numbered or lettered pieces of paper. Physical responses such as movement of different body parts and sensory experience were noted. The patient answered questions about what they might have felt, seen, heard, or thought. These operations laid the foundation for our current understanding of the functional divisions of the human cerebral cortex.

The Magic Wand lesson focuses on four major cortices. The first is the primary motor cortex, which is located on a single large gyrus near the midpoint of the brain. Stimulation of the primary motor cortex causes involuntary muscle movement. The mechanics of sending these messages (called neurotransmission) will be addressed in later lessons. Specific points along the motor cortex control specific muscles in the body. Interestingly, the points at the top of the motor cortex control the muscles of the lower body. The points that control the face and head are located at the bottom of the motor cortex. Remember, the left hemisphere controls our body's right side, so the left motor cortex controls the muscles on the right side of the body.

Directly behind the primary motor cortex is the primary somato-sensory cortex. This cortex controls our sense of touch. The organization of the somato-sensory cortex mirrors that of the motor cortex, with the lower body's sense of touch controlled at the top of the gyrus, the face and head at the bottom. On both the motor and somato-sensory cortices, either hemisphere controls midline structures like the nose and lips.

The auditory cortex is located directly behind the ears (finally something in the brain that makes sense!). However, when the left auditory cortex is stimulated, a buzzing is most often heard as if the sound were directed toward the right ear. In Dr. Penfield's experiments, stimulation of the auditory cortex had the most curious results. Many different sounds were heard in one or both ears, or not heard at all. This happened because everyone's brain is unique. No two brains reacted exactly the same way to the stimulation.

Where would you guess the primary visual cortex was located? If you said at the very back of the brain, you are right! Information from our retinas has to travel through the optic nerves, eventually reaching the back of the brain. Another interesting aspect of vision is that our eyes actually 'see' things upside down because of the shape of the lens and the way light is bent between the lens and the retina. Our primary visual cortex turns the image right side up again.

When Dr. Penfield stimulated the patients' visual cortex, they saw a variety of lights, shadows, and colors instead of specific objects. There were also a wide variety of responses concerning which hemisphere stimulated which field of vision. During the lesson, we simplify this by saying the patient sees a flash of light, without mentioning the affected right or left field of vision.

The centers for taste and smell are very small in humans and are located near each other, at the bottom front of the cerebral cortex. These cortices are functionally connected to nearby structures called the amygdala and the hippocampus that are associated with emotions, learning and memory. This may be one reason why tastes and smells can easily trigger vivid memories.

This lesson emphasizes The Nature of Science as a human endeavor. Science is collaborative: scientists work in teams, or alone, but they all communicate extensively with others.

Name _____

Observation Sheet for Experiment

NUMBER OF THE AREA	WHAT HAPPENS WHEN STIMULATED?	NAME OF THE AREA
1		
2		
3		
4		
5		
6		

The Scientific Method

EXPERIMENTAL STEPS:

1. BACKGROUND INFORMATION

Previous studies by other Scientists had indicated some functional specialization in the cortex. However, no one yet understood which parts of the brain had which job.

2. HYPOTHESIS

Dr. Wilder Penfield wondered if different areas of the brain had specific jobs. He thought they might.

3. METHOD

To test his idea, he electrically stimulated patients' brains while they were awake. They felt no pain. He watched them and listened as they described what was happening in their bodies.

3. OBSERVATIONS

He wrote down what they said or did. When he wrote these things down, he was recording his observations.

4. DATA COLLECTION AND RESULTS

Dr. Penfield saw that when he electrically stimulated different areas of the brain, he got different responses in the body. And, from patient to patient, if he stimulated the same exact area, he observed the same response.

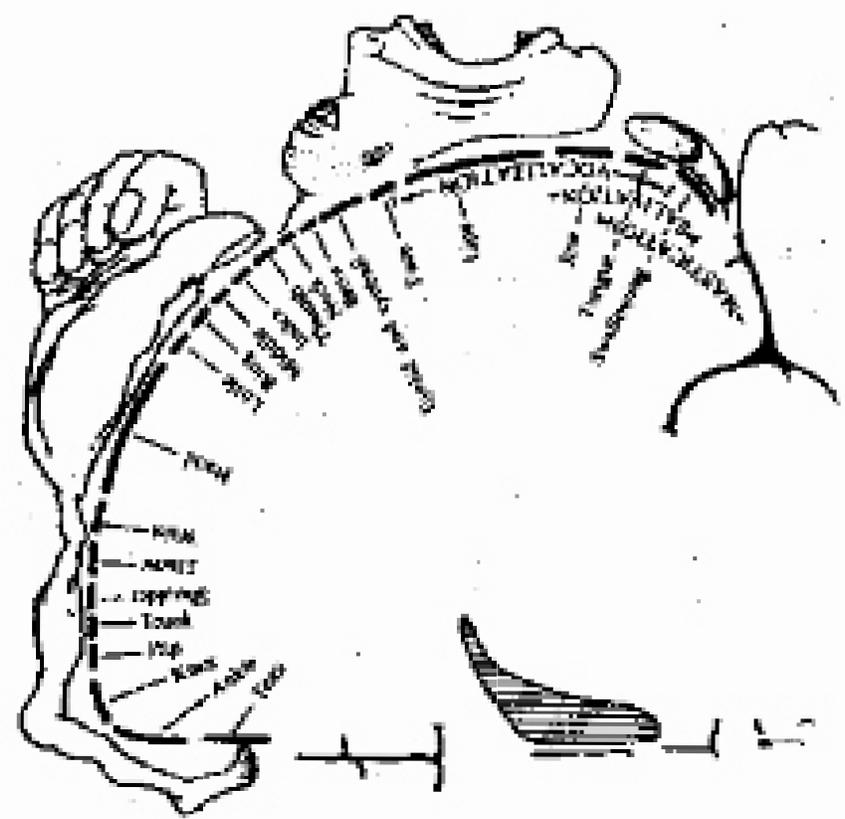
5. CONCLUSIONS

After recording observations, he studied his results and came to some conclusions. He concluded that different areas of the brain have different jobs, and that these areas are the same in everyone. For example, the sense of sight is controlled in an area at the back of the cortex.

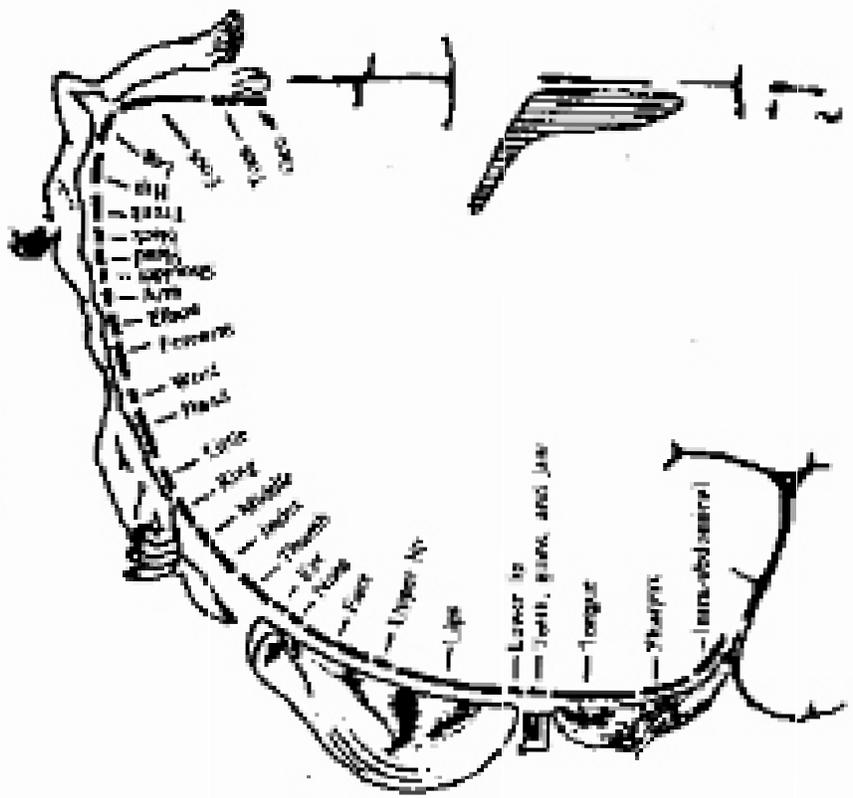
Answer Key (and roles for actors)

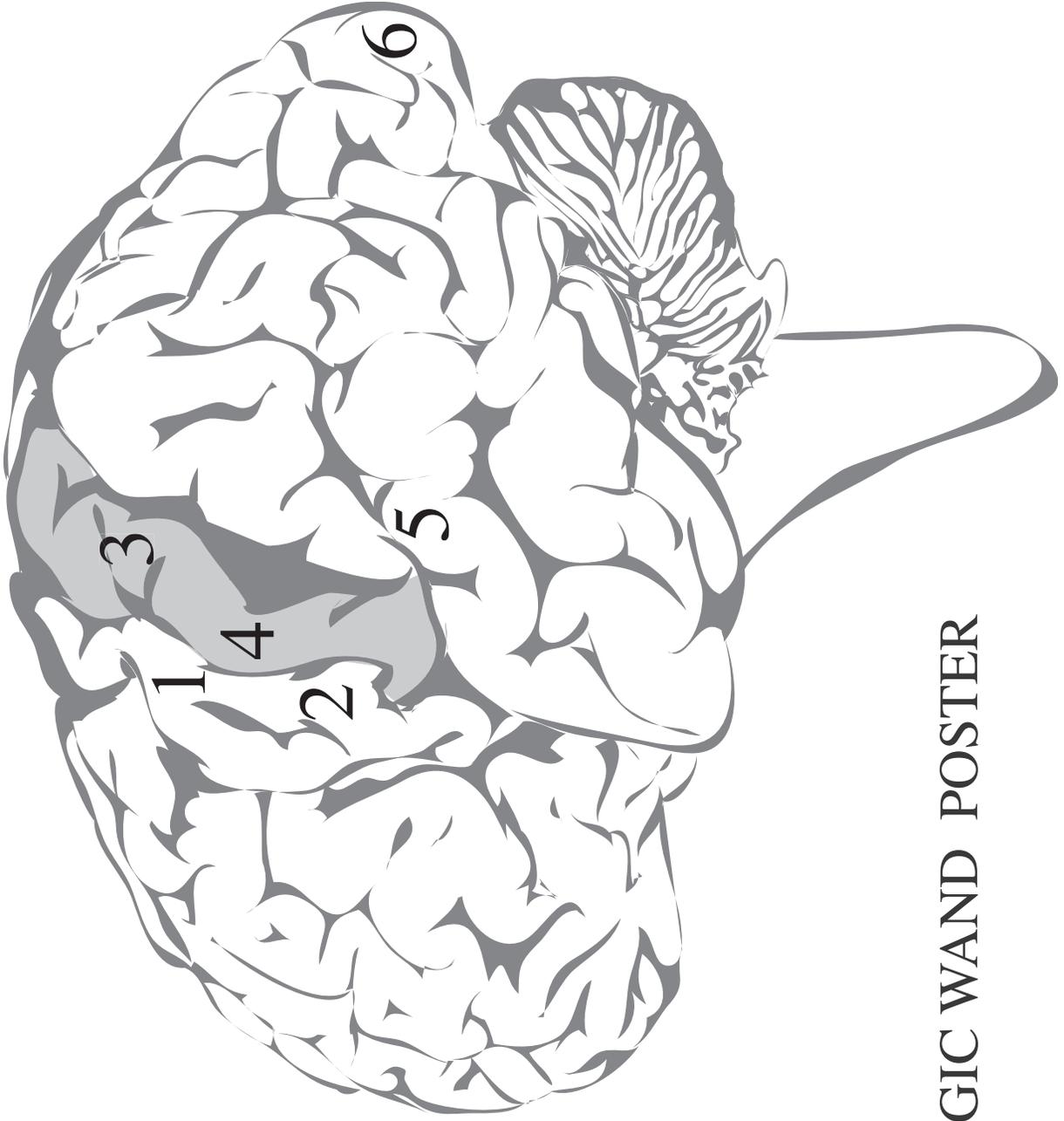
NUMBER OF THE AREA	WHAT HAPPENS WHEN STIMULATED?	NAME OF THE AREA
1	HAND MOVES	MOTOR CORTEX - HAND
2	MOUTH MOVES	MOTOR CORTEX - MOUTH
3	HAND FEELS TOUCH	TOUCH CORTEX - HAND
4	LIPS TINGLE	TOUCH CORTEX - MOUTH
5	HEAR A BELL SOUND	HEARING CORTEX
6	SEE A FLASH OF LIGHT	VISION CORTEX

Mother



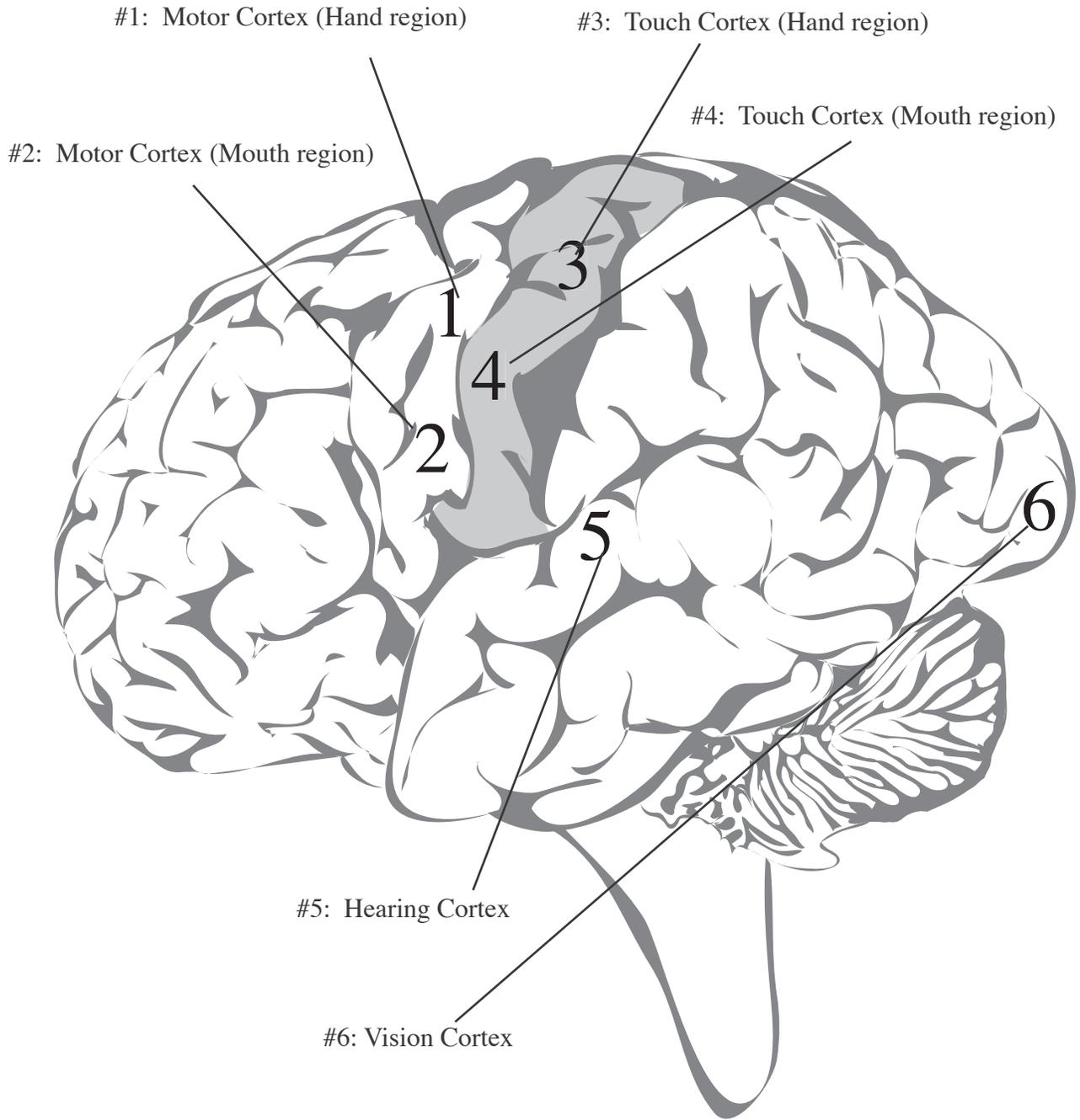
Sow





THE MAGIC WAND POSTER

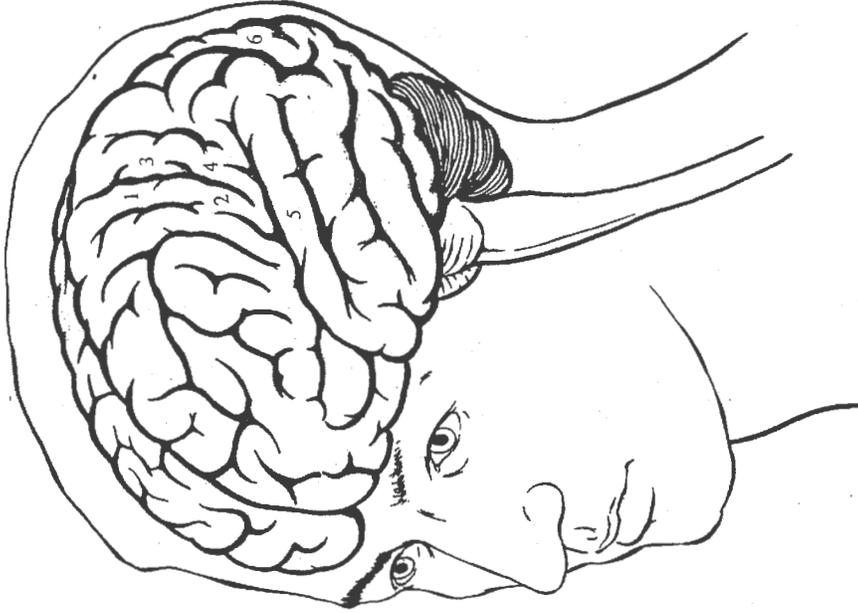
KEY to Magic Wand Skit



Name _____

Observation Sheet for Experiment

NUMBER OF THE AREA	WHAT HAPPENS WHEN STIMULATED?	NAME OF THE AREA
1		
2		
3		
4		
5		
6		

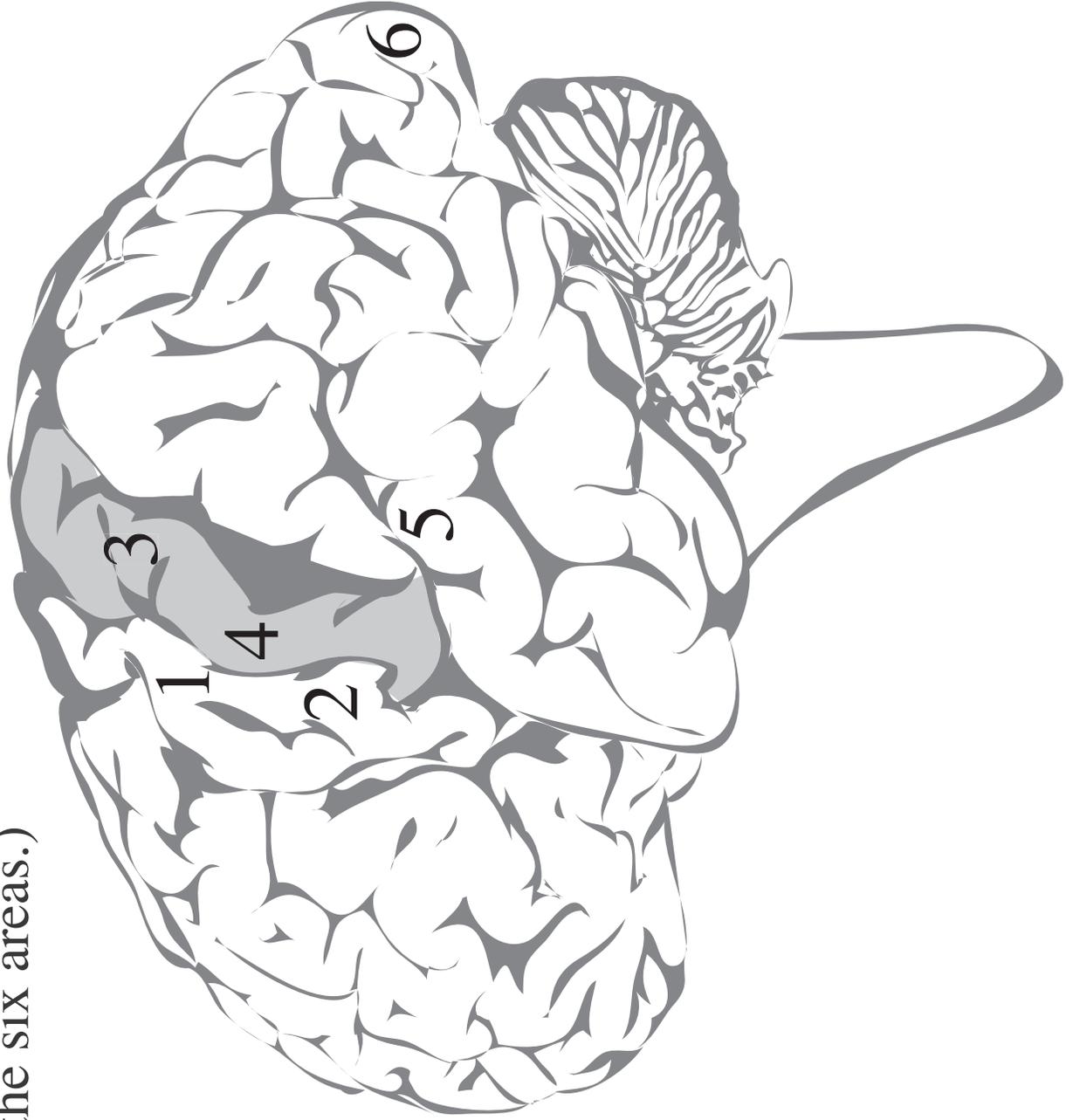


Below are the terms that Dr. Wilder Penfield used. Use this list of terms to complete the third column. Match the action you saw with the term he used. There are four (4) choices and six (6) boxes to complete.

- Movement is associated with the MOTOR CORTEX
- The sense of touch is associated with the TOUCH CORTEX
- Sight related activity is associated with the VISUAL CORTEX
- Hearing activity is associated with the HEARING CORTEX

NAME _____

(Color the six areas.)



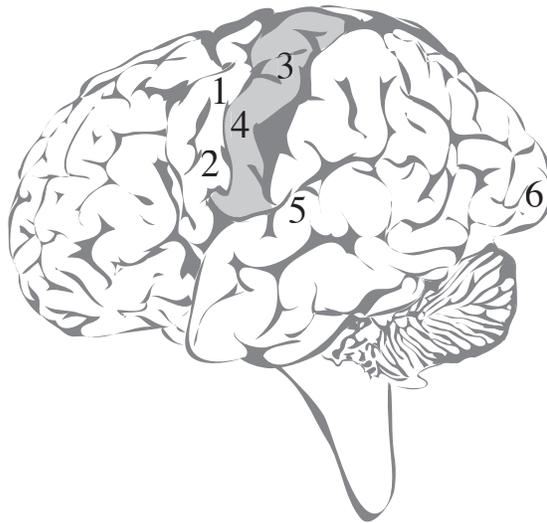
MAGIC WAND

The Magic Wand: Summary

KEY ELEMENTS



Begin with a demonstration of the functional areas of the brain, or tell the story of Dr. Wilder Penfield. Here, the instructor uses the Magic Wand and demonstrates how the giant functional brain fits in the skull



Hang the functional poster showing six areas of the brain that Dr. Penfield tested. These are the areas to be tested by the students.

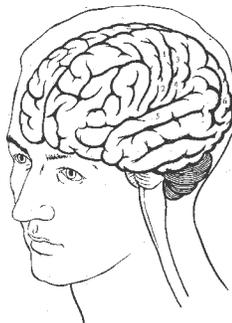


Student volunteers act as subjects and testers as they magically stimulate each of the six areas of the brain as indicated on the poster. The wand represents the electrical stimulus used by Dr. Penfield to test and discover which areas of the brain controlled which parts of the body.

MAGIC WAND STIMULATION OF THE HUMAN BRAIN

Name: _____ Date: _____

Points of Stimulation:	Observations:
1	
2	
3	
4	
5	
6	



Students fill out a handout as they observe the responses of the subjects to the “electrical” stimulus.

Preparation for Assessment

The fourth lesson is a review of the concepts covered so far. Collect, grade and return their work to use as a study sheet.

Alternate Assessment

There is an alternate assessment option. Students act out performances of the Magic Wand activity that they prepare in pairs. This reviews the magic wand lesson and the functional areas of the brain. This approach gives non-paper test takers an opportunity to share what they know. This is a more challenging assessment to administer, since it requires time to watch and record each performance for content and accuracy.

Students might also draw a brain, color and label functional areas. The example here has two functional areas highlighted.

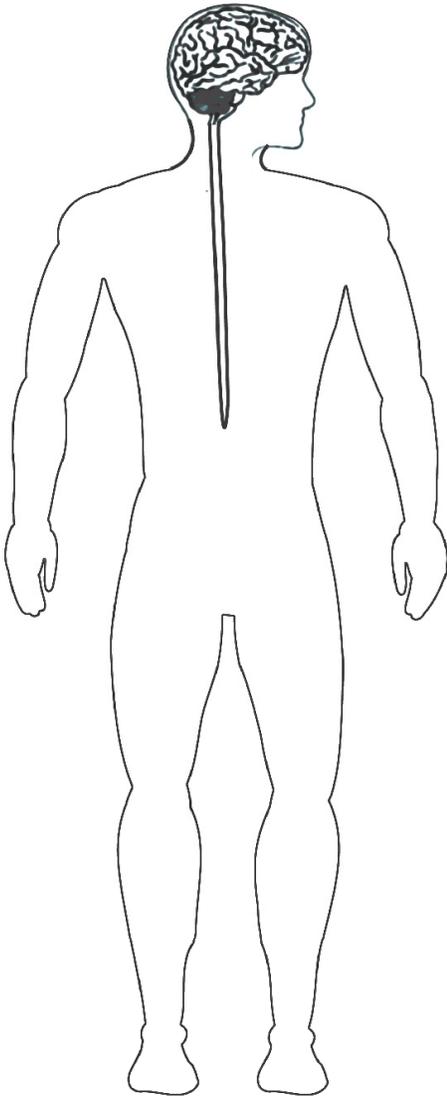


REVIEW

REVIEW SHEET

NAME: _____

Think first! Where do the nerves end? In which direction do the messages travel?



1. Label the brain and spinal cord.
2. Draw and label a line to show a sensory nerve from the leg. Draw arrows showing the direction that the messages travel.
3. Write a sentence answering, "What is the job of sensory nerves?"

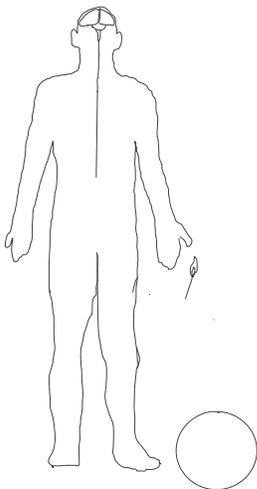
4. Draw and label a line to a motor nerve going to the hand. Draw arrows showing the direction that the messages travel.

5. Write a sentence answering, "What is the job of the motor nerves?"

6. This system is called _____

7. What kind of message will tell the hand about the flame? _____

8. What kind of message will tell the foot to kick the ball? _____

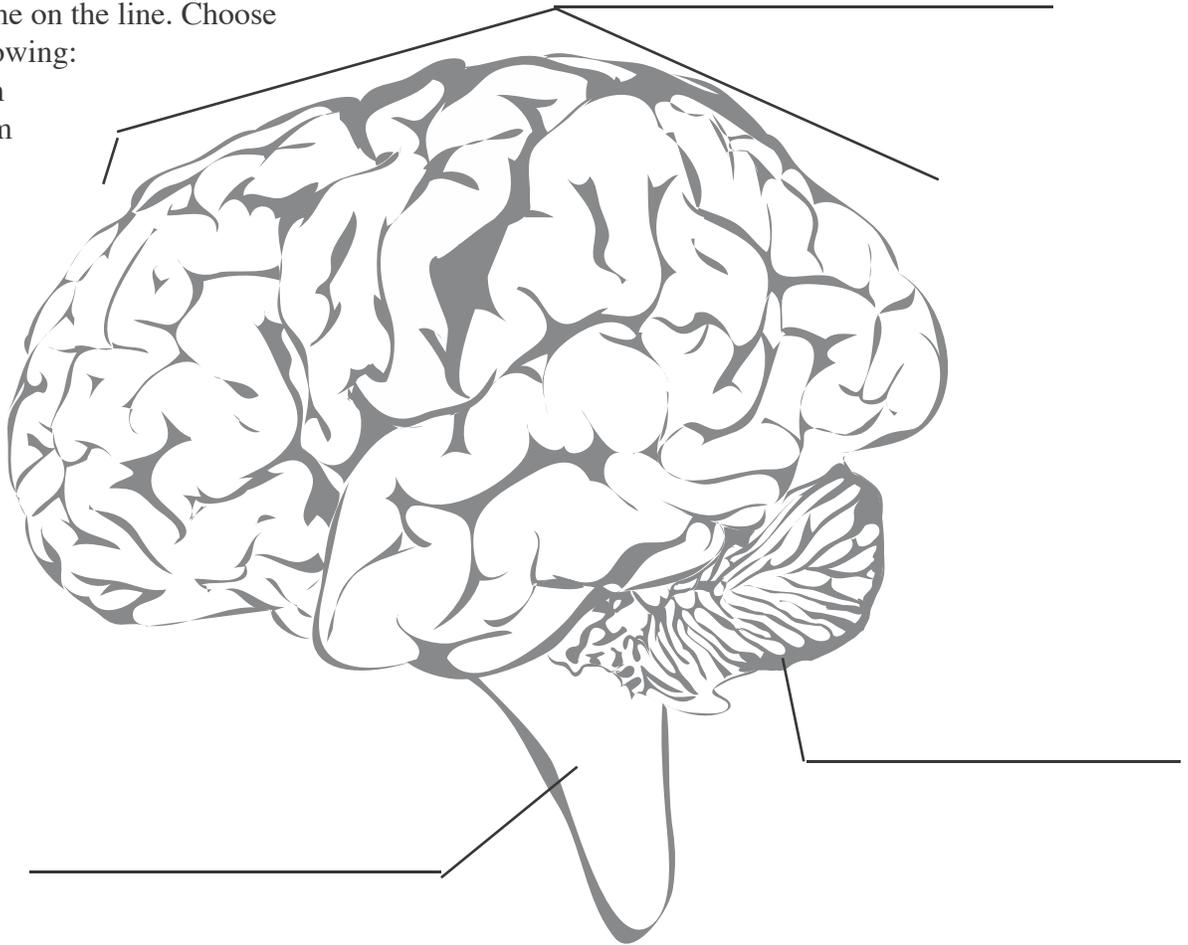


Fill in the blank.

Label the three major parts of the brain.

Write the name on the line. Choose from the following:

- brain stem
- cerebellum
- cortex



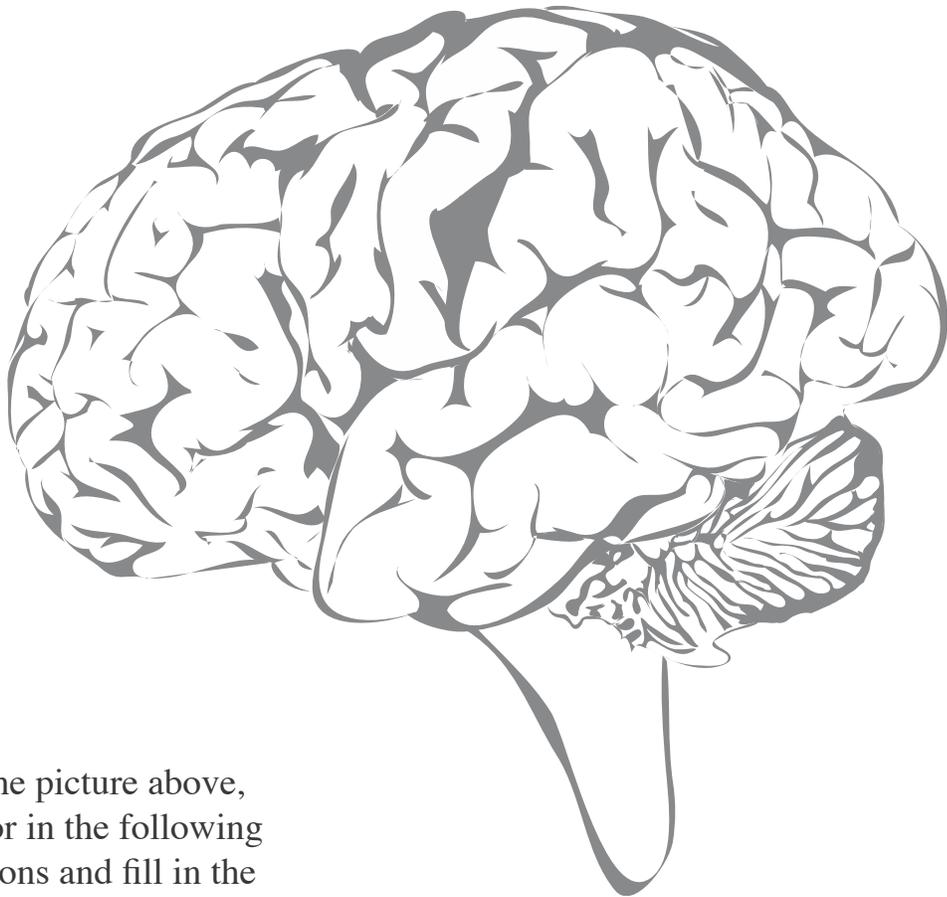
Write a sentence listing one or two jobs performed by each of the three major parts of the brain.

Example: The _____ is in charge of _____ and _____.

1. _____

2. _____

3. _____



In the picture above,
color in the following
regions and fill in the
squares to create a color
key.

- | | |
|--------------------------|---------------|
| <input type="checkbox"/> | • motor gyrus |
| <input type="checkbox"/> | • sound |
| <input type="checkbox"/> | • vision |
| <input type="checkbox"/> | • touch |

