

# Anatomy of the Central Nervous System

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## OBJECTIVES/RATIONALE

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New technologies and advances in science have led to a better understanding of the relationship of the brain, biological basis of behavior, and mental disorders. The student will identify parts and functions of the Central Nervous System (CNS).

TEKS: 121.26 (c) 1B

TAKS ELA 1, 4  
Science 1, 2

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## KEY POINTS

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- I. Cells of the Nervous System—Neurons
  - A. unusual shape
  - B. nerve fibers extend from cell body (soma)
    1. dendrites – branched fibers that receive neural impulses
    2. axons – transmits neural messages from cell body towards another neuron
- II. Two principal divisions of the nervous system:
  - A. Central Nervous System (CNS)
    1. brain and spinal cord
      - a. serves as control center for entire organism
      - b. integrates incoming information and determines appropriate responses
  - B. Peripheral Nervous System (PNS)
    1. made up of nerves outside the CNS
      - a. acts as communication lines to and from CNS
    2. made up of sense organs—eyes, ears, taste buds, olfactory receptors, and touch receptors
  - C. Understanding of mental disorders most often involves understanding of the structure and function of the CNS.
- III. Main Divisions and Structures of Brain
  - A. Cerebral Hemispheres
    - a. right and left halves of largest part of forebrain
      - i. each side is organized to receive sensory information mostly from contralateral (opposite) side of body & control muscles mostly on contralateral side
    - b. connected by two bundles of axons known as the **corpus callosum**
  - B. Cerebral Cortex
    - a. thin outer surface of the forebrain
    - b. largely made of cell bodies which are gray (thus—*gray matter*)
    - c. most highly evolved portion of brain
  - C. Cerebrum – forebrain; the largest, most anterior part of human brain
    - a. controls motor activities and interprets sensation
  - D. Lobes of the Cerebrum
    - a. Frontal Lobe
      - i. motor cortex – controls skeletal muscles
      - ii. Broca’s speech area – formation of words
      - iii. responsible for personality

- iv. damage to frontal lobe can cause changes in personality
    - b. Temporal Lobe
      - i. auditory area
      - ii. language memory and speech capacity
      - iii. damage can result in aphasia (partial or total inability to produce and understand speech as a result of brain damage caused by injury or disease)
    - c. Parietal Lobe
      - i. sensory association areas – impulses from skin such as pain and temperature are interpreted
      - ii. area for estimation of distances, sizes, and shapes
    - d. Occipital Lobe
      - i. primary visual area
      - ii. trauma can result in blindness
      - iii. lesions can cause visual hallucinations
  - E. Structures Under the Cerebral Cortex—Diencephalon
    - a. thalamus
      - a. relay station for all sensory information (except smell)
    - b. hypothalamus
      - a. helps maintain homeostasis (body temperature, body fluid, hormone secretion)
      - b. dysfunction can cause appetite, sleep, body temperature regulation problems
  - F. Pineal Gland – small gland posterior to thalamus
    - a. secretes the hormone *melatonin*
    - b. contributes to regulation of sleep-activity cycles
  - G. Pituitary Gland – attached to the hypothalamus
    - a. “master gland”
    - b. its secretions control timing and amount of hormone secretions by other endocrine glands (thyroid, adrenal glands, ovaries, testes, etc.)
  - H. Cerebellum – highly convoluted structure in the hindbrain
    - a. responsible for coordination of movements
      - i. makes movements smooth
      - ii. helps maintain muscle tone
      - iii. helps maintain equilibrium
  - G. Pons (bridge)
    - 1. forms bulge on anterior surface of brain stem
    - 2. the link (bridge) that connects various parts of the brain
  - H. Medulla Oblongata
    - 1. most posterior portion of brain stem
    - 2. vital centers of medulla:
      - a. cardiac center – controls heart rate
      - b. vasomotor center – helps regulate blood pressure
      - c. respiratory center – initiate and regulate breathing
      - d. center for reflex actions (vomiting, sneezing, coughing, and swallowing)
- IV. The Ventricles and Cerebrospinal Fluid (CSF)
- A. Ventricles-four fluid-filled cavities within the brain
  - B. Cerebrospinal fluid (CSF) is the clear, colorless fluid
    - a. CSF is contained within system of cavities called ventricles
    - b. CSF is produced mainly by structure called choroid plexus located in the ventricles
  - C. Functions of Ventricles & CSF
    - a. Protection: “buffers” the brain—acts to cushion blows to head and lessen impact

- b. Buoyancy: since brain is immersed in fluid, net weight of brain is reduced—therefore, pressure at base of brain is reduced
  - c. Excretion of waste products: one-way flow from CSF to blood takes potentially harmful metabolites, drugs and other substances away from brain
  - d. Endocrine medium for brain: CSF serves to transport hormones to other areas of brain
- V. spinal cord
- A. controls many reflex activities of body
  - B. transmits information back and forth from nerves of PNS to brain

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### ACTIVITIES

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- I. Dissect and identify sheep brain. (teams of two)
- II. Write definitions on backside of Brain Function Flashcards.

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### MATERIALS NEEDED

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Brain Dissection Scoring Sheet

Wards Biology Catalogue, 800-962-2660, [www.wardsci.com](http://www.wardsci.com) - Excellent catalogue for ordering sheep brains and dissection supplies.

Flash cards

<http://www.uofs.edu/sheep/> - sheep brain dissection site

<http://www.vh.org/Providers/Textbooks/BrainAnatomy/BrainAnatomy.html>. -human brain dissections; very detailed, but still a good site for enrichment

[http://www.uwm.edu/~tking/demo2\\_6.htm](http://www.uwm.edu/~tking/demo2_6.htm) - interactive site with identification & description of brain parts; students click on brain areas and get area identification and a description (they love this one)

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### ASSESSMENT

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Successful completion of rubric for brain dissection identification of parts and their functions.

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### ACCOMMODATIONS

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For reinforcement, the student will color the brain and spinal cord from the Aging and Research Site: *It's All In Your Mind*.

For enrichment, the student create a three-dimensional model of brain and brain stem.

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### REFLECTIONS

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# Brain Dissection Scoring Sheet—Oral Identification

Student \_\_\_\_\_

Date \_\_\_\_\_

	Accurately Identifies	Accurately States Function	COMMENTS
<b>Gyri/Sulci</b>			
<b>Cerebral Hemispheres</b>			
<b>Cerebrum</b>			
<b>Cerebral Cortex</b>			
<b>Cerebellum</b>			
<b>Frontal Lobe</b>			
<b>Temporal Lobe</b>			
<b>Parietal Lobe</b>			
<b>Occipital Lobe</b>			
<b>Spinal Cord</b>			
<b>Medulla Oblongata</b>			
<b>Pons</b>			
<b>Optic Nerve</b>			
<b>Optic Chiasma</b>			
<b>Olfactory Bulb</b>			
<b>Corpus Callosum</b>			
<b>Pineal Gland</b>			
<b>Lateral Ventricle</b>			
<b>Thalamus</b>			
<b>Pituitary Gland</b>			

TOTAL CORRECT \_\_\_\_\_ X 5 = \_\_\_\_\_  
score

## KEY

### Brain Dissection Scoring Sheet for Function

	Accurately Identifies	Accurately States Function
<b>Gyri/Sulci</b>		increase cerebral cortex surface area
<b>Cerebral Hemispheres</b>		receives information & controls muscles on contralateral side
<b>Cerebrum</b>		controls conscious activity
<b>Cerebral Cortex</b>		center of higher-level mental functions
<b>Cerebellum</b>		coordination & control of voluntary muscular activity
<b>Frontal Lobe</b>		fine motor movement, personality, planning, judgement
<b>Temporal Lobe</b>		hearing
<b>Parietal Lobe</b>		body sensations
<b>Occipital Lobe</b>		vision
<b>Spinal Cord</b>		conducts sensory & motor impulses to & from brain & peripheral nerves
<b>Medulla Oblongata</b>		center that controls respiration, heart & blood vessel function
<b>Pons</b>		bridge connecting medulla oblongata & midbrain
<b>Optic Nerve</b>		transmits visual impulses from eye to visual cortex of brain
<b>Optic Chiasm</b>		point where parts of optic nerves cross to opposite side of brain
<b>Olfactory Bulb</b>		interprets odors
<b>Corpus Callosum</b>		connects hemispheres of brain so right & left sides can communicate
<b>Pineal Gland</b>		thought to secrete melatonin (which is believed to play part in regulation of sleep)
<b>Lateral Ventricle</b>		one of four cavities in brain that contains cerebrospinal fluid
<b>Thalamus</b>		relays sensory impulses to cerebral cortex; site where crude sensations of pain, pressure, & temperature originate
<b>Pituitary Gland</b>		“master gland”; releases hormones controlling many body activities & Influences activities of many endocrine glands

**Flash Cards** (Have students write functions on back of cards. Students can work in groups of five and test in a “circle”. One student selects a card and holds it up for person to his/her left. That person must answer and then hold a card for the next person to his left. Students should go around the circle several times.)

CNS is comprised of:	PNS made up of:
Lay term for <i>neurons</i>	description of dendrites
description of axons	function & location of medulla
location & function of pons	Where is CSF produced?
What are ventricles?	Name the 2 parts of diencephalon.

function of thalamus

function of hypothalamus

Dysfunction of hypothalamus  
can cause:

3 functions of cerebellum

Name the largest part of  
the human brain.

3 functions of the cerebrum

The thin outer layer of  
cerebrum is:

The most highly evolved  
portion of the brain (the  
gray matter)

cerebral hemispheres are  
connected by:

Name the 4 lobes of brain.

The motor cortex controls:

The lobe responsible for personality.

Lobe with sensory association areas:

The parietal lobe has an area for estimation of:

Lobe which has primary visual area.

Lobe which has auditory area.

Lobe for language memory & speech capacity.

2 functions of the spinal cord:

Damage to occipital lobe can result in:

Damage to temporal lobe can result in: