



Lesson Summary: Dissecting a sheep brain, students gain appreciation for the complexity of the brain. Students make observations, learning about the structure and function of brain regions, white and gray matter.

Grade Level 5-12

Lesson Length
1-2 class periods

Standards Alignment

Next Generation Science Standards

- 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
- MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
- HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- **Framework for K-12 Science Education:** Science & Engineering Practices 1,3,4,8

Minnesota Science Standards – Alignment Matrix brainu.org/resources/MNSTDS

National Science Standards – Project 2061: Atlas of Science Literacy reference

- a) Cells: Cell functions – basic needs and basic functions (p. 73, Atlas Vol. 1)
Research on student learning: “Preliminary research indicates that it may be easier for students to understand that the cell is the basic unit of structure (which they can observe) than that the cell is the basic unit of function (which has to be inferred from experiments).” (p.72, Atlas Vol. 1)

Objectives—Students will

- engage in scientific observations.
- identify the major parts of the brain and explain their functions.
- explain what comprise the white and gray matter.
- practice dissection and drawing techniques.

Assessment Options

- Collect and grade lab packets.
- Label the major parts and explain their functions on a picture of a sheep and/or human brain.
- Write a paragraph or draw a picture that explains the make up of white and gray matter of the brain.

Terms — important vocabulary that strengthen the lesson. Select terms according to the needs and abilities of your students.

- anterior – towards the head
- brainstem – the major route by which the forebrain sends information to and receives information from the spinal cord and peripheral nerves; controls respiration and regulation of heart rhythms
- caudal or posterior – towards the tail
- cerebellum – a structure located above or dorsal to the brainstem that helps control movement, balance, and muscle coordination



Teacher Guide

Sheep Brain Dissection

- cerebral hemispheres – the two halves of the cerebrum; the left hemisphere is specialized for speech, writing, language, and calculations; the right hemisphere is specialized for spatial abilities, face recognition in vision, and some aspects of music perception and production
- cerebrum or cerebral cortex – brain tissue seen from the side, top, front, and back that appears as tightly packed fat ridges and narrow folds; the outer cerebrum is responsible for all forms of conscious experience including perception, emotion, thought, and planning; *cortex* means bark in Greek - the bark of the cork tree looks a lot like the cerebral cortex of the brain
- corpus callosum – a large bundle of nerve fibers (myelinated axons) that link the right and left hemispheres of the brain
- dorsal – towards the back
- dura mater – tough, leathery outermost layer of the membranes surrounding and protecting the brain; lines the inside of the skull and drapes loosely around the spinal cord; Latin for ‘tough mother’
- frontal lobe – front region of the cerebrum concerned with cognitive processes that include planning, inhibition of instincts and drives, and declarative memory
- gyrus (pl = gyri) - the ridges or bumps of folded cortex
- hippocampus – c-shape band of fibers located within the brain responsible for formation of declarative memory, transfer of short-term to long-term memories, and has nerve fiber connection to the amygdala for emotional processing
- lateral – towards the outside
- medial – towards the middle
- meninges – three membranes (the dura mater and two other thin membranes) that cover and protect the brain and spinal cord against shocks, knocks, and vibrations; blood vessels run through the thin membranes before entering the brain
- myelin – compact fatty material that surrounds axons of many neurons; acts as an insulator to speed action potential movement down axons
- occipital lobe –located in the caudal region of the cerebrum; receives sensory information from the eyes
- olfactory bulb – anterior part of the brain concerned with the sense of smell
- optic nerve – nerve that connects the retina to the brain
- parietal lobe – located around the dorsal and medial region of the cerebrum that processes higher sensory and language functions
- pituitary gland – gland at the base of the brain that makes and releases growth, reproductive, and other hormones into the blood stream
- rostral or anterior – towards the front or nose
- spinal cord – bundle of nerve fibers, located inside the backbone, that connects the brain to different sensory and motor parts of the body
- sulcus (pl = sulci) – the valleys or spaces between the folds or gyri of the brain



- temporal lobe – located near the temples and ear region of the cerebrum concerned with smell, taste, hearing, visual associations, some aspects of memory, and a person’s sense of self
- ventral – towards the stomach
- ventricles – fluid-filled cavities inside the brain

Materials

- sheep brains, cut in half, with dura mater intact (one per group)
- dissecting tray or plastic plate
- scissors
- plastic knife
- dissecting probe or wood stick
- disposable, non-latex surgical gloves
- lab guide

Procedures

Engage — Why Do Dissection?

- Ask students why people who study science do dissections.
Dissections provide students with additional ways of learning through touch, supplemental to looking at pictures.
- Ask students why scientists might dissect a body even if they already know the parts and how they are connected.
- Develop appreciation and understanding of how scientists can learn about causes of death, effects of disease, and differences of organs and tissues among individuals and species.
- Ask students where they think dissection materials come from.

People must designate before they die that they want to donate their body to science. Animal bodies and organs are obtained from slaughterhouses or from companies who breed animals for science experiments.

Explore — Review Parts and Functions of the Brain

- Organize students to work in groups of 2 or 3, and send them get their supplies (1/2 sheep brain, non-latex gloves, scissors, plastic knife, dissecting probe/wood splint, and tray).
- Direct students to put a glove on their non-writing hand so that they can still write observations or assign one person to act as the designated recorder.
- Encourage students to discuss their scientific observations with their group. While the group discusses their observations, they can also write them down on their lab guide or in their notebook.
- Allow students time to share their observations with the class.



Develop Questions

Ask students to write 2-3 questions about the brain or its structures that pique their interest during the observation phase.

Explore — Complete Dissection Lab

1. Review with students the terms used to define anatomical directional relationships (dorsal, ventral, rostral, caudal, lateral, medial).
2. Ask each group to determine which half of the brain they have (right or left).
3. Direct students to put a glove on their writing hand and remove the dura mater. Tell students to try tugging on the dura mater.

- Ask students what their experience was with the dura mater.
- Ask why the brain benefits from having a dura mater (“tough mother” in Latin).

4. Tell students to cut through the brain with the plastic knife about 1 inch from the rostral end.

- Ask students what they think was located on or at the indented area.
- Tell students to poke the cut surface with the probing stick.
- Ask students how the dark surface compares to the light surface.

Explain that the light surface is tough because it contains bundles of axons that are covered with fatty material (myelin, white matter) and the dark material is softer because it consists of dendrites and cell bodies (gray matter).

- Review parts and functions of a neuron.
5. Show and help students remove the hippocampus.
 6. Allow time for students to complete **Comparing Sheep Brains to Human Brains** on page 4 of the student guide.

Explain

- Let students answer the 2-3 questions they developed before the dissection.
- Ask students to describe their reactions to doing the dissection lab.
 - What did they learn?
 - How did the lab help with learning about the brain?
 - What did they like or not like?

Expand — Extensions to Lesson

- Ask students to scrape the gray matter away from the white matter on the piece of cerebral cortex they cut off. If students scrape carefully along the white matter, they can get axon fibers to pull or peel away. Sometimes these can be traced over long distances.
- Direct students to gently scrape the edge of the wood stick over the surface of the cerebrum to remove the thin meninges and expose the brain’s ridges and folds (gyri and sulci).