STANDARD OPERATING PROCEDURE:

Performing a brain dissection

Note: To be undertaken only by trained personnel in conjunction with a current Safety Data Sheet (SDS) and site-specific risk assessment.

1. Introduction

Sheep or pig brain dissections are conducted to explore the structure and function of the different parts of the brain. Sheep or pig brains are similar in their composition but have a simpler structure than a human brain.

Sheep or pig brains suitable for dissection can be supplied as fresh, frozen or preserved specimens. They can be obtained from the meat sections of some supermarkets, butcher shops, abattoirs or a reputable biological supplier that has passed relevant health inspections.

Brains for dissection can be obtained some weeks beforehand and stored in the freezer, but they are best dissected semi-frozen as they hold their shape better making it easier to identify the different structures. If recently defrosted brains are being used, and the dissection is interrupted, they can be kept for a short time (no longer than 24 hours) in the coldest part of the laboratory fridge or placed in a freezer. There is potential for bacterial growth.

Preserved brains are fixed to prevent tissue breakdown and to render them firm to allow for easy dissection. No refrigeration is required. If using preserved brains, obtain and read the safety data sheet (SDS) from the supplier and prepare a site-specific risk assessment.

2. Context

- These instructions are for the use of experienced science teachers, technicians and students under close supervision.
- When planning a class dissection activity, it is best to discuss beforehand the type of dissection to be undertaken, and warn of the possibility that there may be some blood and odours present during the dissection.
- Demonstrating the dissection to students before they begin is helpful, not only for correct procedure but allows them to adjust to the appearance of the material, and any blood that may be present after dissection material has been washed.
- Let students know they don't have to participate in the dissection and can be excused from the class. Alternative arrangements can be made for students who don't wish to participate, by giving them worksheets to complete and relocating them to a private study area.

3. Safety notes

- A site-specific risk assessment should take into consideration the maturity of students carrying out the dissection and address risks associated with students using scalpels and other dissection equipment.
- Before the dissection it is recommended the teacher or laboratory technician trial the dissecting instruments (scalpels, scissors and pointed forceps) to establish that they are sufficiently sharp enough and to determine the most appropriate equipment for the task considering the student behaviour.

Fainting: signs and symptoms:

- Fainting may occur during this type of activity. Please read the first aid information in section 7 before conducting the dissection.
- Fainting is caused by a sudden drop in blood pressure. Common causes include heat, pain or distress and the sight of blood.
- The possible symptoms include the following.
    - 'Dizziness
    - Light-headedness
    - A pale face
    - Perspiration
    - Heightened anxiety and restlessness
    - Nausea
    - Collapse
    - Unconsciousness, for a few seconds
    - Full recovery after a few minutes'[i]

Handling specimens:

- If using preserved brains, it is important to take note of the preservative solution that the brains are in and the recommended precautions.
    - Rinse the preserved brains under running water immediately upon removal from the preservative solution.
    - Work in a well-ventilated area.
    - It is recommended that people wearing contact lenses should not dissect brains that are in preservative solution. The fumes from the solution can penetrate between the eye and contact lens causing irritation to eyes. It is recommended to wear prescription glasses instead with safety glasses over them OR prescription safety glasses.
- Consider issues such as allergies and chemical sensitivities from handling recently defrosted or preserved brains.
- If using frozen brains, partially defrost overnight in a refrigerator and use within 24 hours. Consistent with safe food handling procedures, all meat products should be stored below 5ºC prior to performing any dissections.
- Good hygiene practices should be observed at all times: Keep hands away from the mouth, nose, eyes and face during and after dissection and wash hands immediately after handling dissection material.

Safety with scalpels and dissecting instruments:

- Store all dissecting instruments securely.
- Care should be taken with sharps such as scalpel blades and scissors. Some school science departments restrict the use of scalpels unless specifically requested by a teacher, and prefer to only issue scissors, probes and forceps to students for dissections.
- Ensure students demonstrate responsible behaviour while using scalpels and other dissecting instruments.
- Scalpels should be provided in and returned to a lined container, blade end down
- Students should not walk around the lab with the dissecting instruments, in particular with a scalpel or pointed scissors, forceps or probes.

- To reduce the possibility of stab wounds or cuts from slippage always point sharp instruments such as scalpels and scissors away from yourself and others.
- Hold the instruments so that any sharp points or exposed sharp edges point down onto the dissection board or tray. If there is any slippage when using the instrument, the point/exposed edge will be absorbed by the board/foam or wax tray.

Scalpel blades:

- Only staff should carefully attach and remove scalpel blades using pliers, forceps or a commercial blade remover.
- The scalpel blade size and handle must be compatible e.g. number 4 handle and number 23 blades.
- Keep the blade in the foil wrapper and attach to the handle with the sharp side of the blade pointing away from the body.
- An alternative is to use disposable scalpels.

4. Regulations, licences and permits

Offal that has passed a health inspection by a meat inspector or produced from a butcher's shop, abattoir or biological supplier is suitable for dissection. In some jurisdictions all dissections need to be reported to the school animal ethics committee.

5. Equipment

- PPE – Lab coat/apron (it is recommended to use plastic disposable aprons), safety glasses and gloves.
- Scalpels (optional subject to a site specific risk assessment)
- Scissors, forceps, probes
- Dissecting board covered in newspaper or disposable foam tray
- Newspaper to protect bench and for wrapping biological materials after dissection
- Paper towel
- Disinfectant—hospital grade general-purpose disinfectant (the label on the front of the pack must state 'hospital grade', which is a general purpose hard-surface disinfectant which will kill micro-organisms).
- 70% v/v ethanol
- Optional: model of human brain

6. Operating procedure

Preparation:

- If any blood is associated with the brains rinse them in cold running water.
- Prepare disinfectant solution according to manufacturer's instructions. Place disinfectant in a container ready for instruments to be placed at the end of the dissection.
- Ensure students have appropriate PPE.
- Distribute the instruments to students. Scalpels, scissors, forceps and probes should be counted out, and counted in when returned.

(Operating procedure cont.)

Examining and dissecting the brain:

1. Examine the outside of the brain by carefully placing the brain on the dissecting board flat side down so the white spinal cord at one end rests on the board.
2. If still attached, observe the dura mater which is the outer layer of the meninges membrane covering the brain. See figure 1.
3. Use forceps to gently peel away and remove the layers of the membrane. Identify the two hemispheres of the brain, the spinal cord, the cerebellum and the cerebrum. See figure 2.
4. Turn the brain over and using forceps gently peel away and remove any remaining membrane. Identify the medulla and pons. See figure 3.
5. Try to identify the olfactory bulb, which lies below the frontal lobe of the cerebrum and the optic chiasma, the x shaped-structure formed by the crossover of the right and left optic nerves. Note the optic nerves have been removed, but portions of the optic chiasma are visible. See figure 3.
6. Turn the brain back over and observe the surface of the cerebrum, notice the folds - the grooves are known as sulci and the ridges are called gyri. Identify the medial longitudinal fissure, which separates the right and left hemispheres of the cerebral cortex. See Figure 4.
7. Try to locate the 4 lobes of the cerebrum; the frontal lobe which controls motor functions, the parietal lobe which receives and processes sensory information, the temporal lobe which is located in the region near the ears which receives and processes sounds and smells and the occipital lobe at the back of the brain which is responsible for vision. See Figure 5.
8. Locate the cerebellum, which is just below the occipital lobe of the cerebrum. The cerebellum has an outer cortex, which is folded and it is incompletely divided at the top by a central ridge called the vermis. The cerebellum controls muscle coordination.
9. Use a scalpel to carefully slice through the brain along the centre line (longitudinal fissure), starting at the cerebrum, and down through the cerebellum and brain stem. Separate the two hemispheres of the brain. See figure 6.
10. With the cut side facing up try to locate the following: the corpus callosum, third and fourth ventricles, thalamus, hypothalamus, pineal body, pituitary gland, pons and medulla. See figure 7.
11. Observe the cut surface of the cerebellum and identify the white matter of the cerebellum forming a branched treelike pattern called the arbor vitae as shown in figure 7.
12. Cut one of the hemispheres in half and identify the inner white matter and the outer grey matter. See figure 8.

(Operating procedure cont.)

Clean up:

- Make sure all instruments are returned.
- All parts of the brain, as well as the disposable foam tray (if used), must be wrapped in newspaper and placed in a dedicated plastic garbage bag along with gloves and disposable aprons (if used). When all waste material is collected, double bag for disposal. Freeze material if unable to dispose of immediately.
- If blood is present on dissecting boards, scissors, forceps, probes, dissecting pins and scalpels they be immediately soaked in disinfectant. Otherwise wash equipment in hot soapy water and rinse or place in a dishwasher to minimize handling.
- After washing, dissecting instruments can be soaked in 70% v/v ethanol for 20 minutes as an optional additional disinfectant and to avoid rusting
- Dry all equipment thoroughly.
- Disinfect workplace and wash hands thoroughly.

7. Trouble shooting/emergencies

- **If fainting occurs:** If students start to feel faint, dizzy or nauseous during the dissection lie them down (if possible) and elevate their feet. They can get up slowly after ten minutes. Sending them outside for some fresh air can also help. If they don't recover quickly, always seek urgent medical attention. '***Do not sit the patient on a chair with head between knees***[ii]
- First Aid: See latest SDS of any chemicals used for more detailed information.
    - **If swallowed:** Do not induce vomiting. Rinse mouth with water, and then give water to drink. Seek urgent medical attention
    - **If in eyes:** Hold open and irrigate with copious quantity of water for at least 15 minutes. Seek medical attention.
    - **If on skin/clothes:** If spilt on skin or clothes quickly wipe off with a dry cloth to absorb as much liquid as possible. Remove contaminated clothes and drench the area with excess water under a safety shower. Seek medical attention.
    - **If inhaled:** Remove to fresh air and seek medical attention if symptoms persist.
    - For further advice contact the Poisons Information Centre on 131126.
- First aid: cuts and lacerations should be washed under running water, then patted dry and covered with a clean paper towel or tissue in the first instance and referred to the school first aid officer for assessment.
- Any health concerns should be referred to the school first aid officer for assessment, accompanied by the relevant latest SDS if applicable. Follow your school's accident and incident policy and reporting procedures.
- See safety notes if it is necessary to remove broken or used scalpel blades.

8. Waste disposal

- Used and damaged scalpel blades must be placed in an approved sharps container after use.
- Biological material must be wrapped in newspaper, placed in a double plastic garbage bag and sealed for immediate disposal in the industrial bins.

9. Related material

- Risk Assessment.
- Manufacturer's Safety Data Sheet for disinfectant
- Manufacturer's Safety Data Sheet for preserved specimens

References:

[i] 'Fainting', Better Health Channel website, State Government of Victoria, https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/fainting (August 2014)

[ii] St John Ambulance Australia. 2011. *Australian First Aid. Barton, ACT*

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Southern Biological. n.d. *Safety note – Preserved specimens*, Southern Biological website, http://file.southernbiological.com/Assets/Products/Specimens/Preserved_Specimens/SafetyNotePreservedSpecimens.pdf (Accessed December 2017)

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Figures

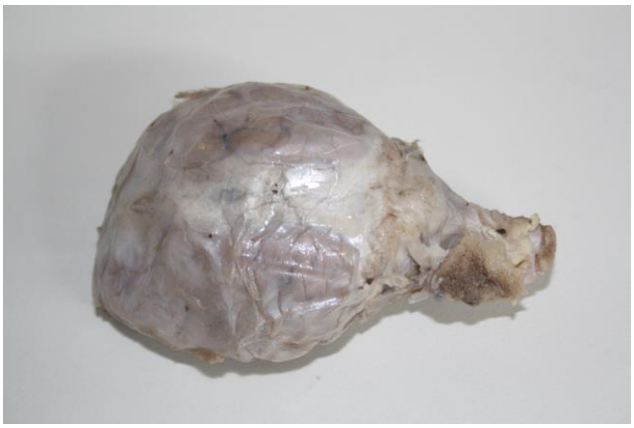

Figure 1: The connective tissue layer of the dura mater covering the sheep brain. (Image by K Szalai)

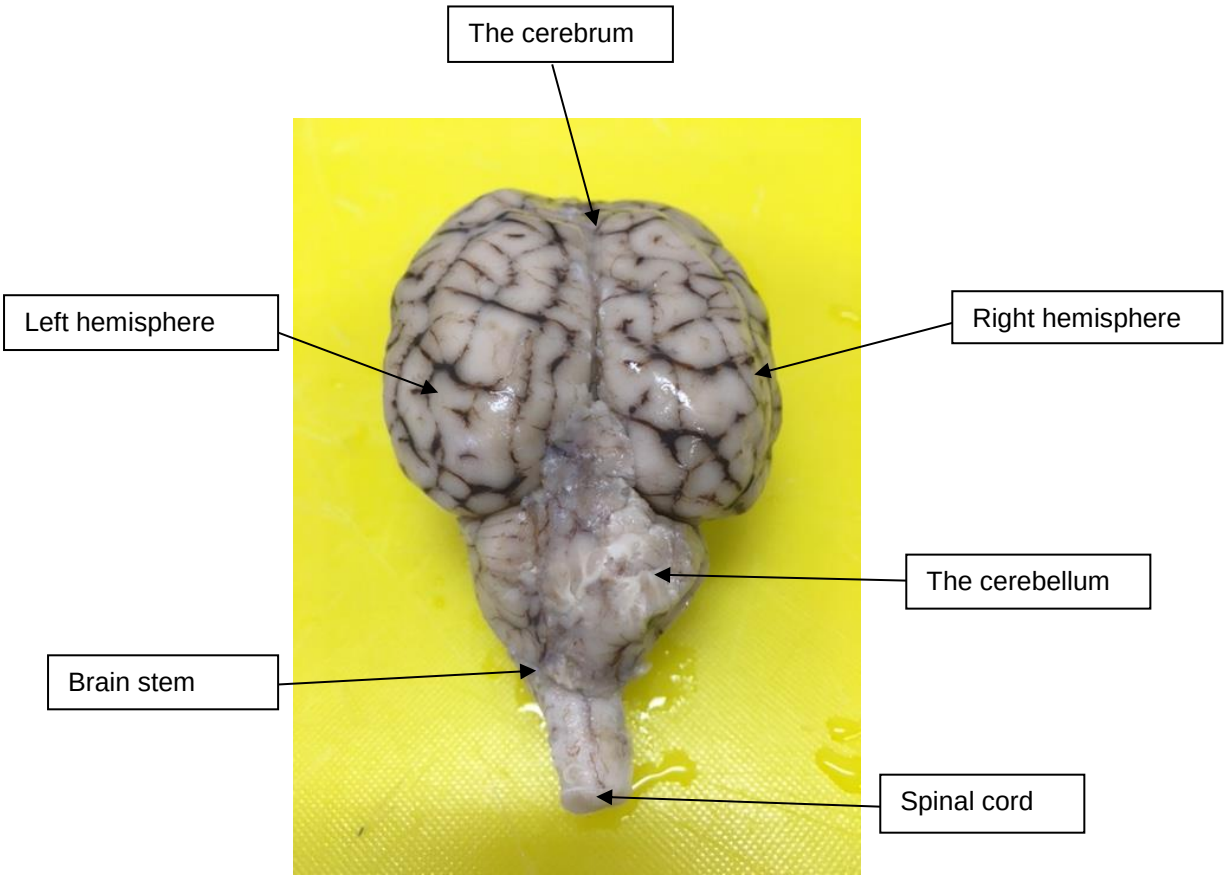

Figure 2: Dura mater removed showing the external structures of the sheep brain.
(Image by K. Szalai, 2017)

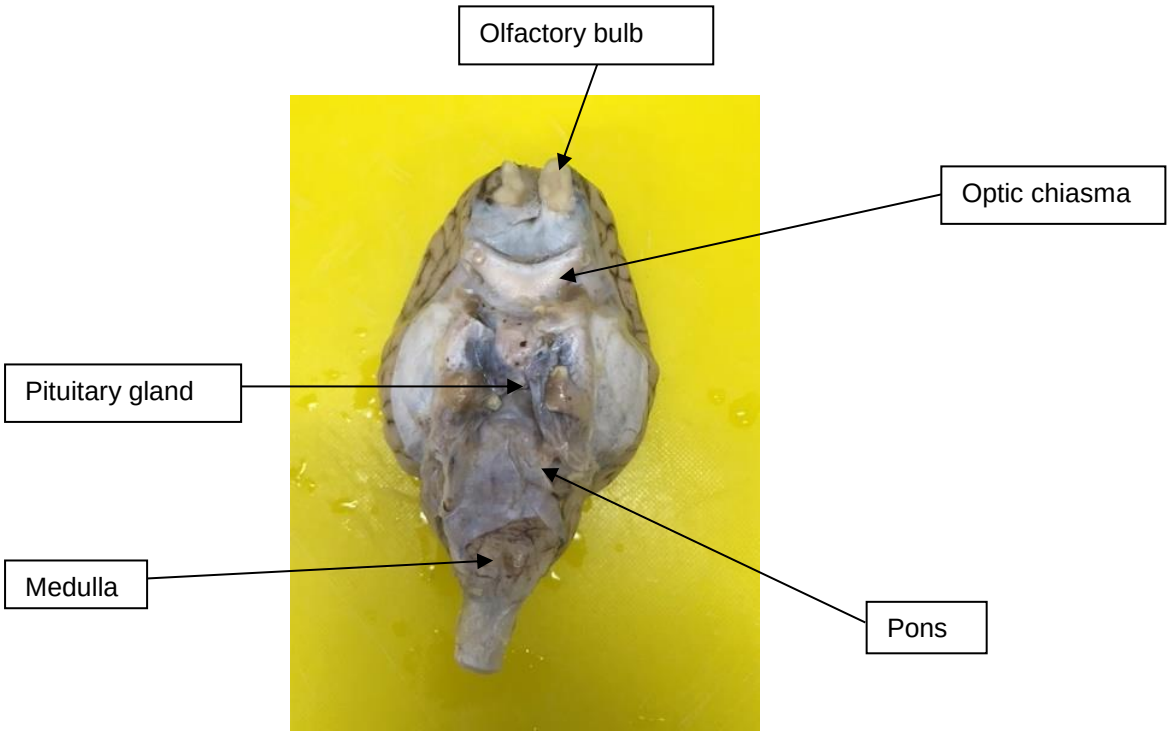

Figure 3: Underside of sheep brain showing external structures. (Image by K. Szalai 2017)

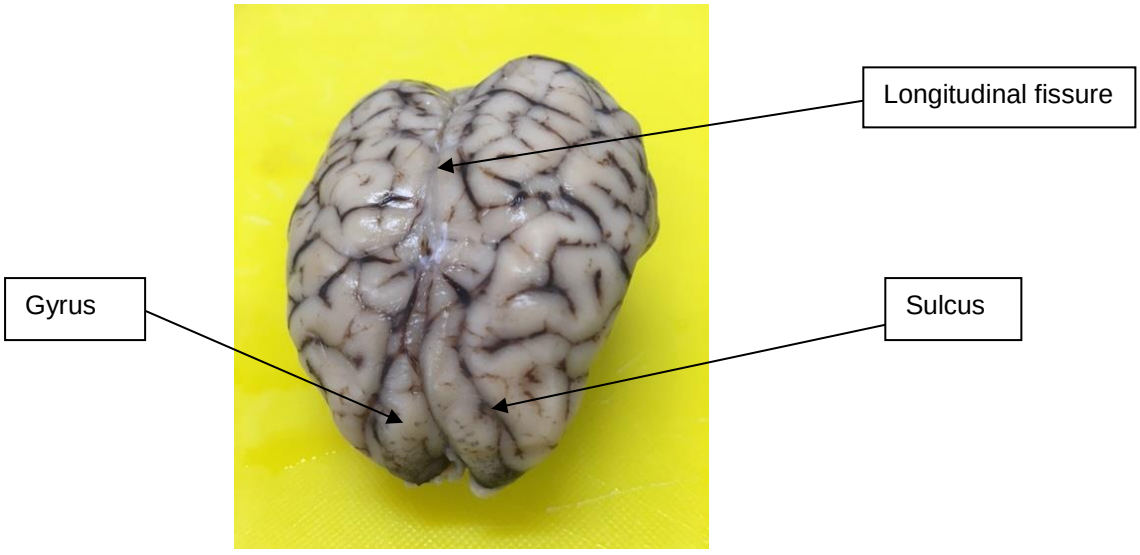

Figure 4: Shows; the longitudinal fissure separating the two hemispheres of the brain, grooves and ridges on the surface of the cerebrum. (Image by K. Szalai 2017)

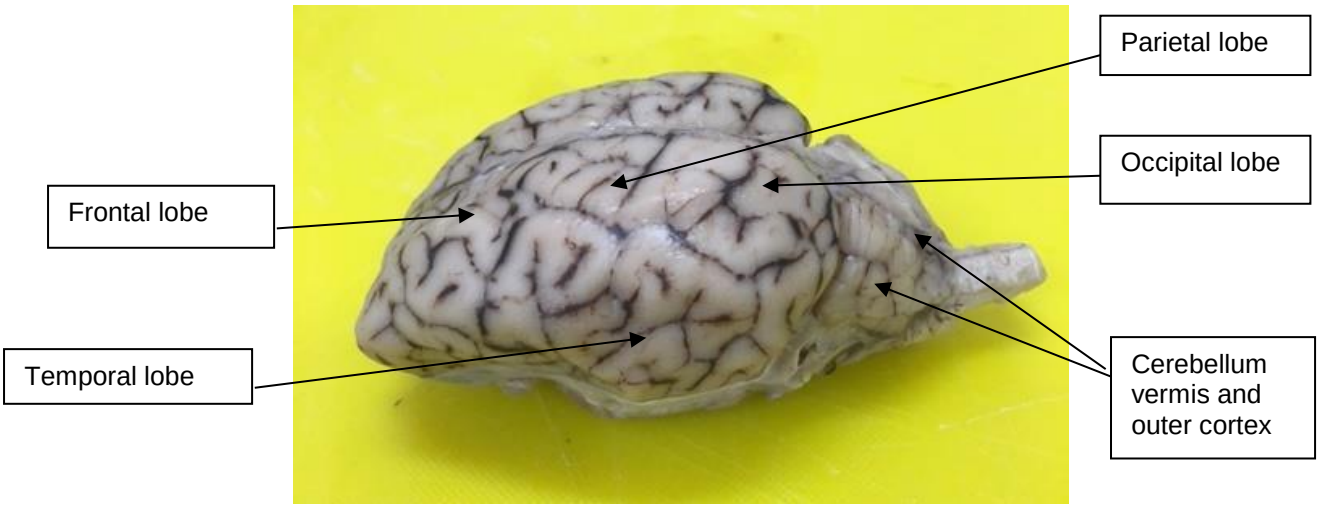

Figure 5: The external structure of the sheep brain showing the four lobes of the cerebrum. (Image by K. Szalai 2017)

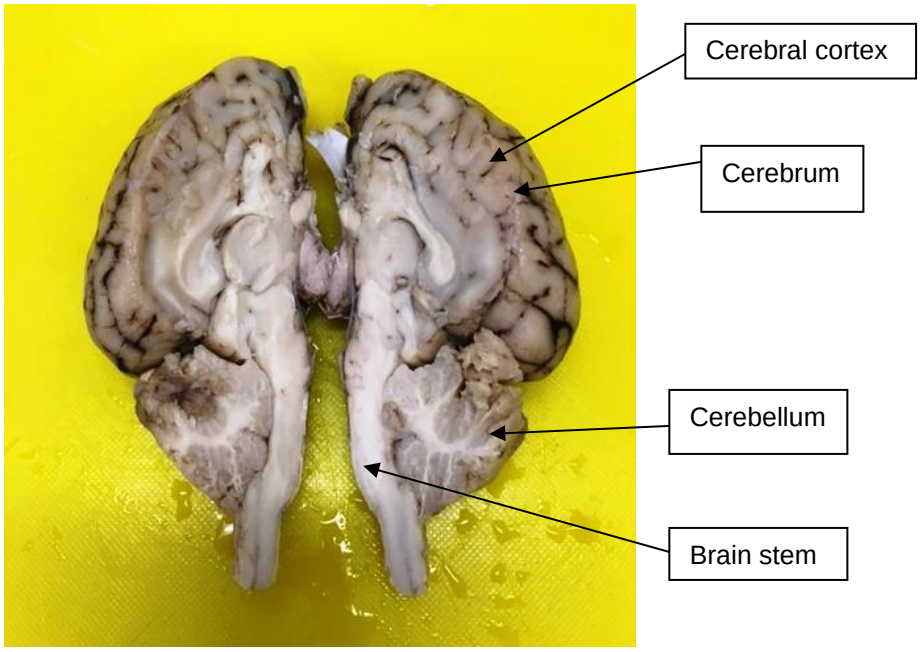

Figure 6: The two hemispheres of the sheep brain separated, dividing the cerebrum, cerebellum and brain stem into two longitudinal halves. (Image by K. Szalai 2017)

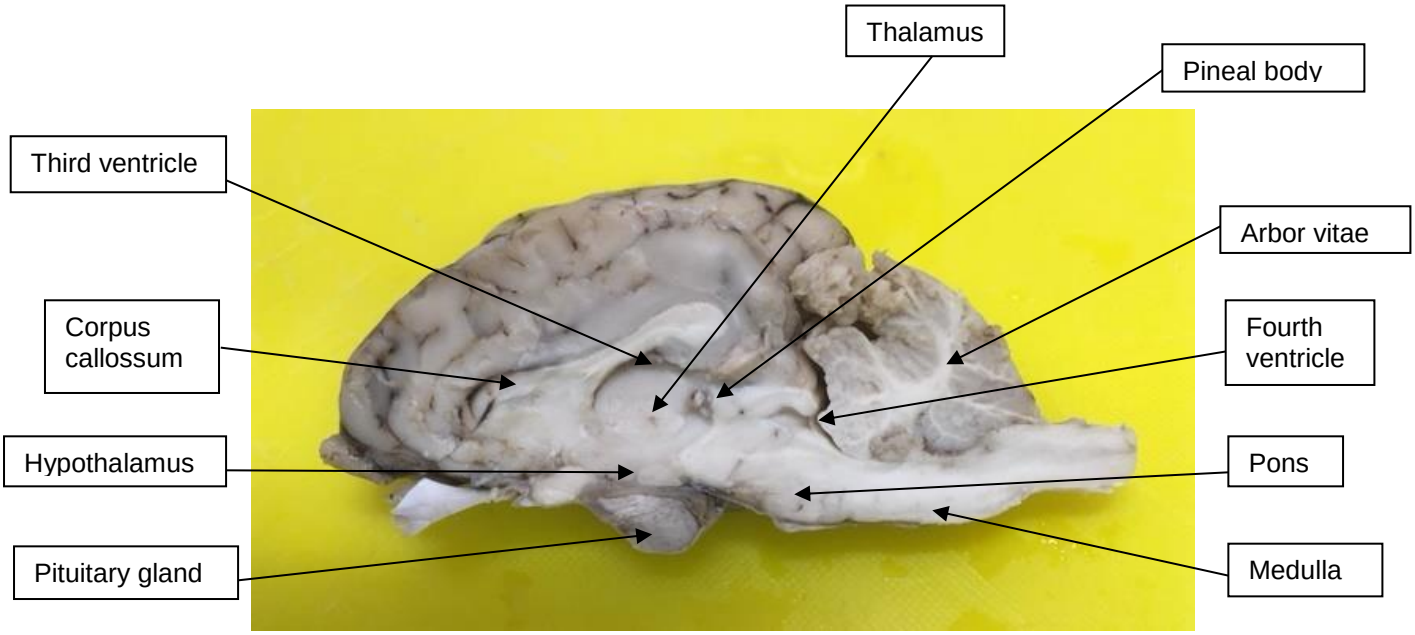

Figure 7: Sheep brain section showing the internal structures.
(Image by K. Szalai 2017)

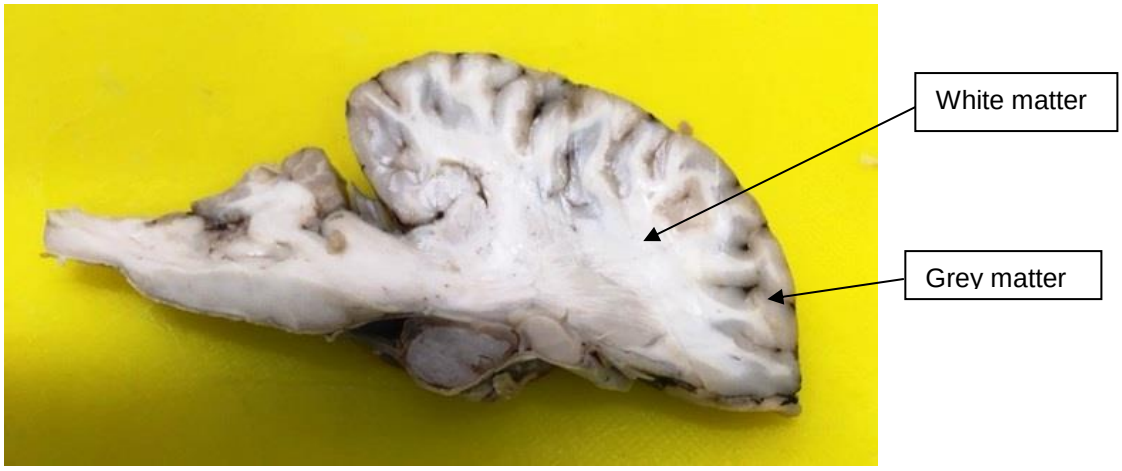

Figure 8: Cross section through the hemisphere of the sheep brain showing the inner white matter and the outer grey matter. (Image by K. Szalai 2017)

Glossary

Arbor vitae – the white matter of the cerebellum

Cerebellum – the part of the brain that controls balance and muscle coordination

Cerebrum – is the largest portion of the mammalian brain, divided into two symmetrical halves the cerebral hemispheres.

Corpus callosum – the large band of nervous tissue that connects the two cerebral hemispheres

Cortex – outer portion of the cerebrum

Dura mater – the tough outermost membrane of the three meninges that cover the brain

Frontal lobe – is the largest of the four major lobes of the cerebral cortex in the mammalian brain. It is located at the front of each cerebral hemisphere and controls motor functions.

Grey matter – the brownish-grey nerve tissue consisting mainly of nerve cell bodies within the brain and spinal cord.

Gyri – the folds of the cerebral cortex

Hemisphere – the brain is divided into left and right hemispheres. Each hemisphere provides a different set of functions

Hypothalamus – central area on the underside of the brain, controlling involuntary functions such as body temperature and the release of hormones

Medulla – part of the brain stem that controls autonomic functions such as breathing, digestion, and heart rate.

Mid brain – the short part of the brainstem just above the pons; it contains the nerve pathways between the cerebral hemispheres and the medulla. The center for visual reflexes, such as moving the head and eyes

Occipital lobe - is one of the four major lobes of the cerebral cortex at the back of the brain and is the visual processing centre of the mammalian brain.

Olfactory bulb – the structure located in the forebrain of vertebrates that receives neural input about odours detected by cells in the nasal cavity. The axons of olfactory receptor smell cells extend directly into the highly organized olfactory bulb, where information about odours is processed.

Optic chiasma – the crossing point of the optic nerves

Parietal lobe – is one of the four lobes of the cerebral cortex in mammalian brain and processes sensory information; taste, temperature, pain and touch

Pineal body – endocrine gland located in the roof of the third ventricle that secretes the hormone melatonin into the bloodstream.

Pituitary gland – a small oval gland at the base of the brain in vertebrates, producing hormones that control other glands and influence growth of the bone structure, sexual maturing, and general metabolism

Pons – a whitish band of nerve fibres on the surface of the brain stem between the medulla oblongata and midbrain

Sulci – shallow grooves or depressions, separating the folded surface of the cerebral cortex of the brain

Thalamus – a small structure within the brain located just above the brain stem between the cerebral cortex and the midbrain and serves as a sensory relay centre.

Temporal lobe - is one of the four major lobes of the cerebral cortex of the mammalian brain and is located in the region near the ears. It is involved in processing sensory information; sounds, smells and memory formation.

Ventricle – one of the four cavities in the brain filled with cerebral spinal fluid

White matter – is the whitish nerve tissue of the brain and spinal cord, consisting mostly of nerve fibres.