

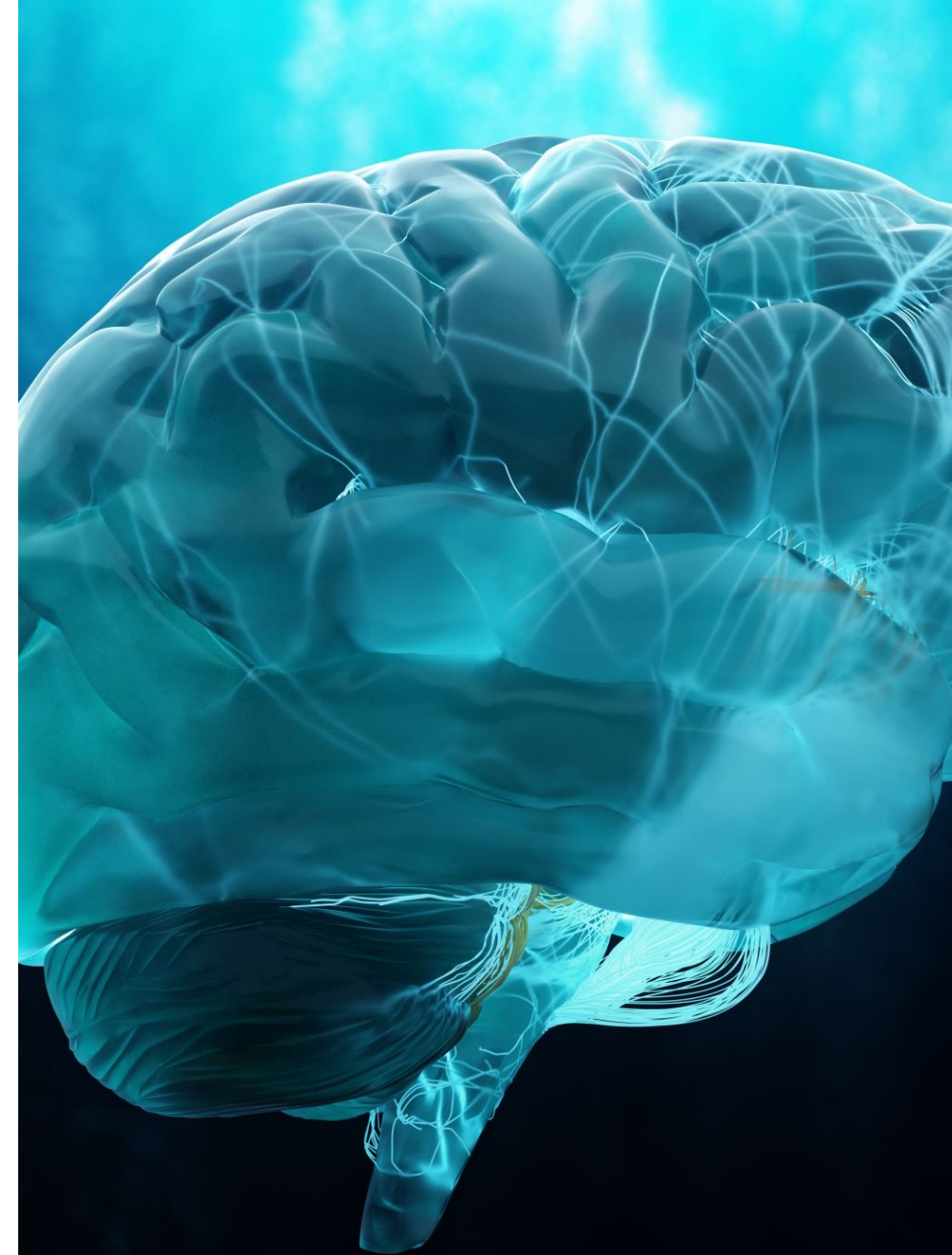


LAB 2: NERVOUS SYSTEM

Protocol slides
PCB 3702L
FIU

LAB 2 PROTOCOL OBJECTIVES

1. Identify brain structures while performing brain dissection.
2. Explain the mechanism involved and perform pupillary, patellar and ciliospinal reflexes.
3. Explain the mechanism involved and perform smell and taste reflexes.
4. Explain the mechanism involved in balance.



CLINICAL APPLICATION: ENCEPHALITIS

- Inflammation of the brain
- Mostly caused by viral infections, although it can also result from bacterial, fungal, or autoimmune factors

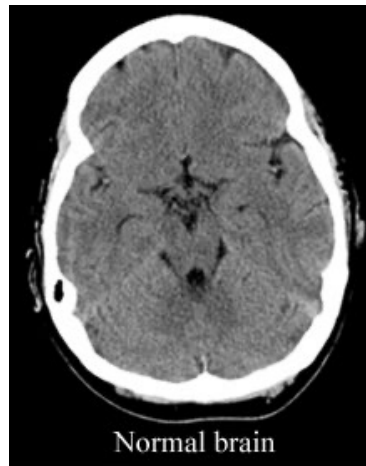


Figure 1

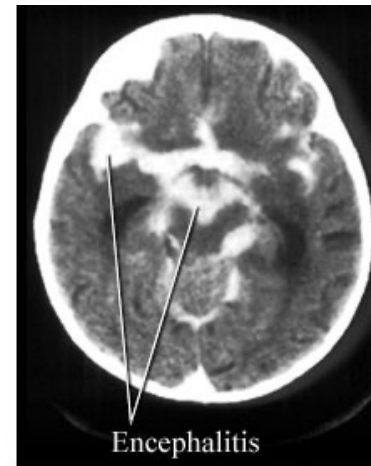


Figure 2

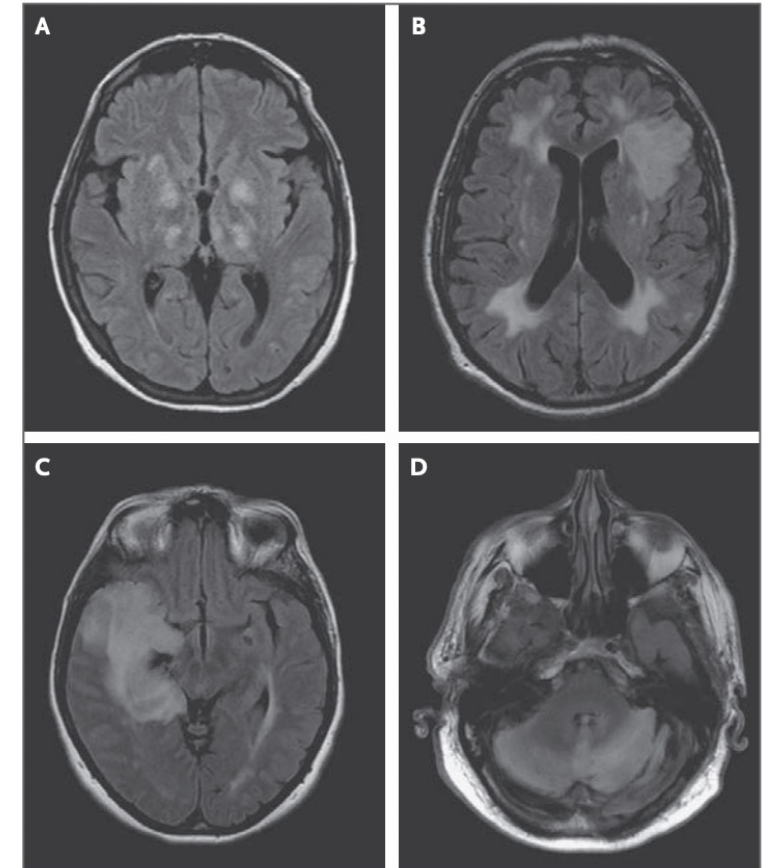
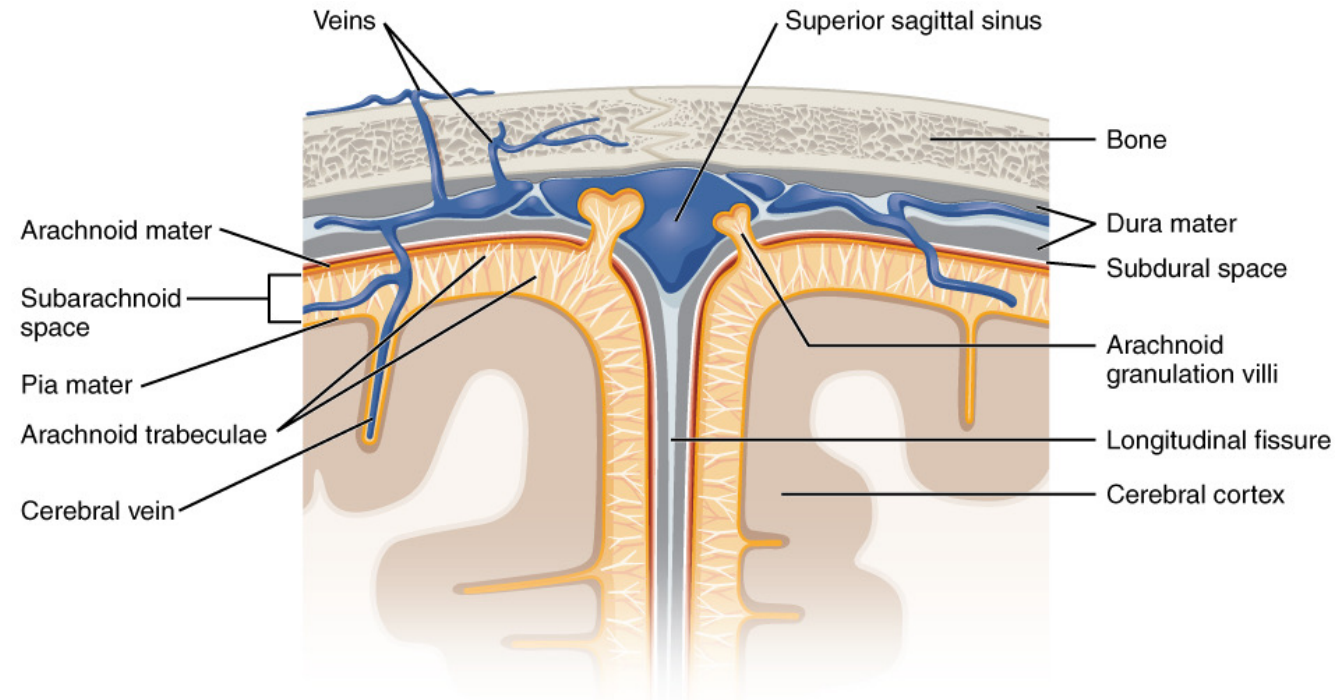
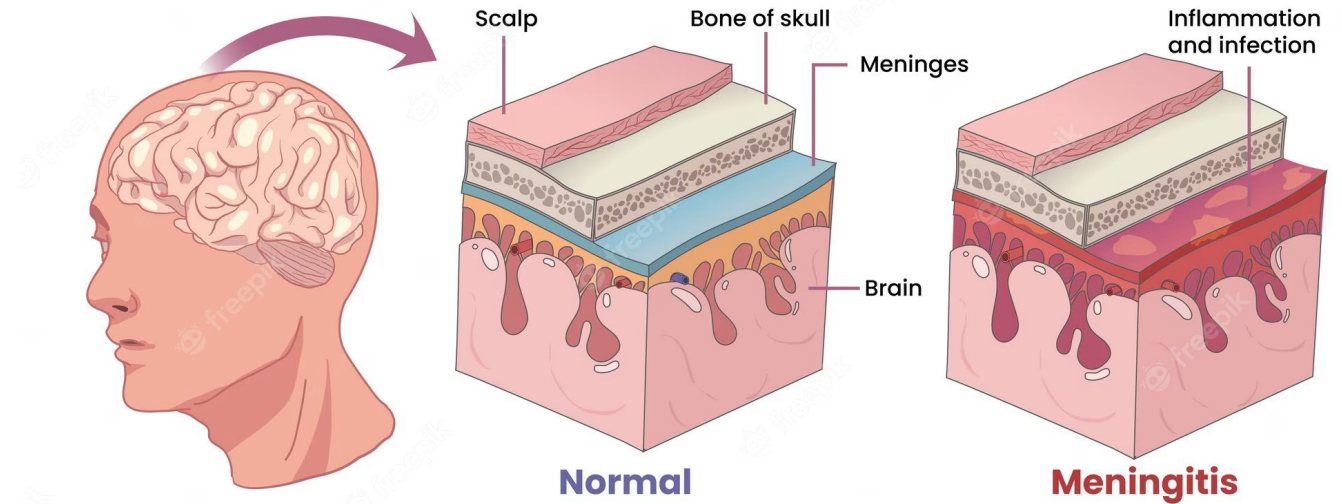


Figure 1. MRI Patterns in Patients with Viral Encephalitis.

Axial T₂-weighted, fluid-attenuated inversion recovery (FLAIR) images show increased signal in the thalami and lentiform nuclei in a patient with West Nile virus encephalitis (Panel A), a left frontal operculum infarct in a patient with varicella zoster virus vasculitis and preexisting periventricular white-matter changes (Panel B), increased signal in the right temporal lobe in a patient with herpes simplex virus encephalitis (Panel C), and increased signal in the cerebellar hemispheres (more pronounced in the left hemisphere) in a patient with cerebellitis presumably due to Epstein-Barr virus (Panel D).

CLINICAL APPLICATION: MENINGITIS

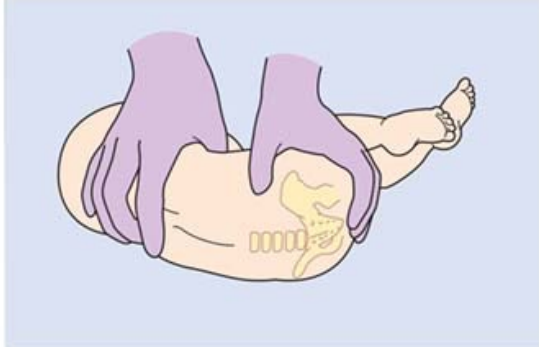
- Inflammation of the protective membranes covering the brain and spinal cord
- Usually caused by a bacterial or viral infection
- A doctor confirms a diagnosis of bacterial meningitis with a spinal tap, what is the name of the fluid that he draws?
 - CSF!!!



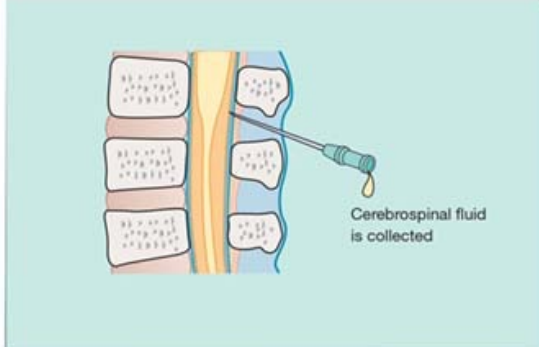
CLINICAL APPLICATION: LUMBAR PUNCTURE

- A lumbar puncture, also called a spinal tap, is performed in the lower back (lumbar region) and can be done for various reasons
- Meningitis is often diagnosed using this technique because individuals with meningitis typically exhibit low sugar (glucose) levels, an increased white blood cell count, and elevated protein levels in their CSF

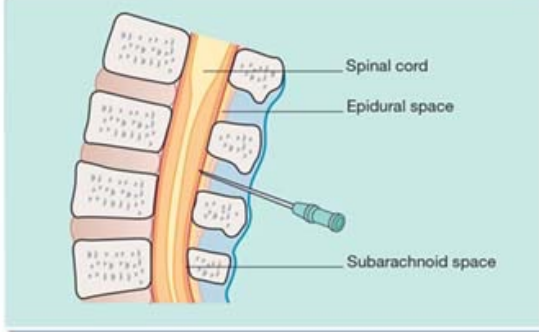
Position of child for lumbar puncture



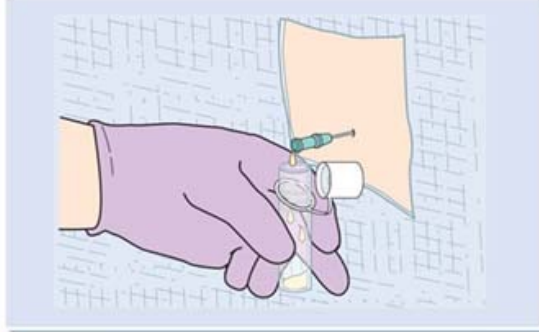
Collection of CSF and position of spinal needle



Subarachnoid space



Collecting CSF

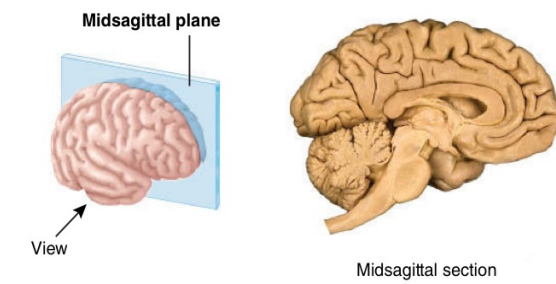
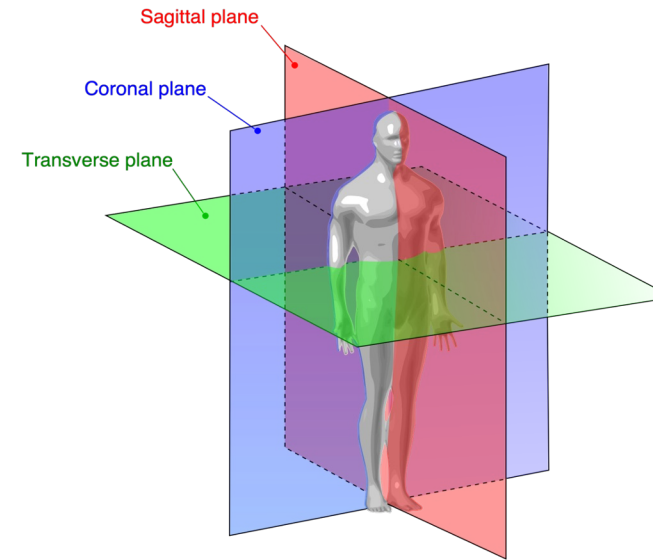


Lumbar puncture needle size

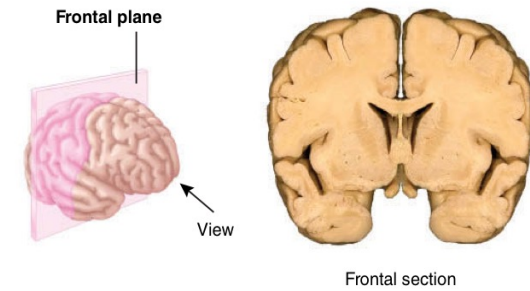
Age of child	Height of child (cm)	Size of needle (length) (cm)
Preterm neonate	< 50	2
< 2 years	50–80	3
2–5 years	80–120	4
5–12 years	120–150	5
> 12 years	150–180	6

PLANES AND SECTIONS

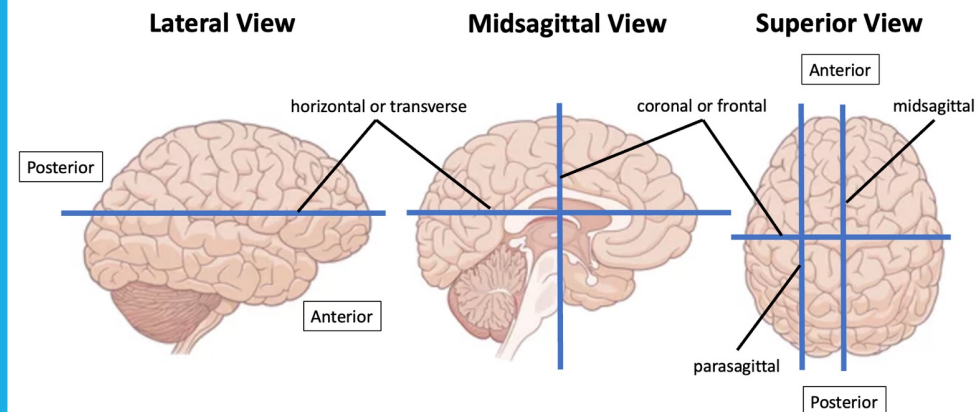
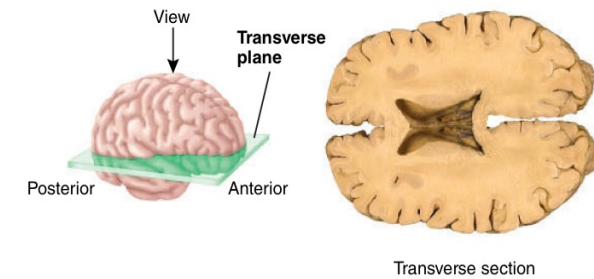
- **Midsagittal Plane:** Passes through the body's midline, dividing it equally into left and right sides.
- **Parasagittal Plane:** Splits the body into unequal right and left sides.
- **Frontal/Coronal:** Divides the body or structures into front (anterior) and back (posterior).
- **Transverse/Axial:** Divides the body or structures into superior (upper) and inferior (lower) portions.



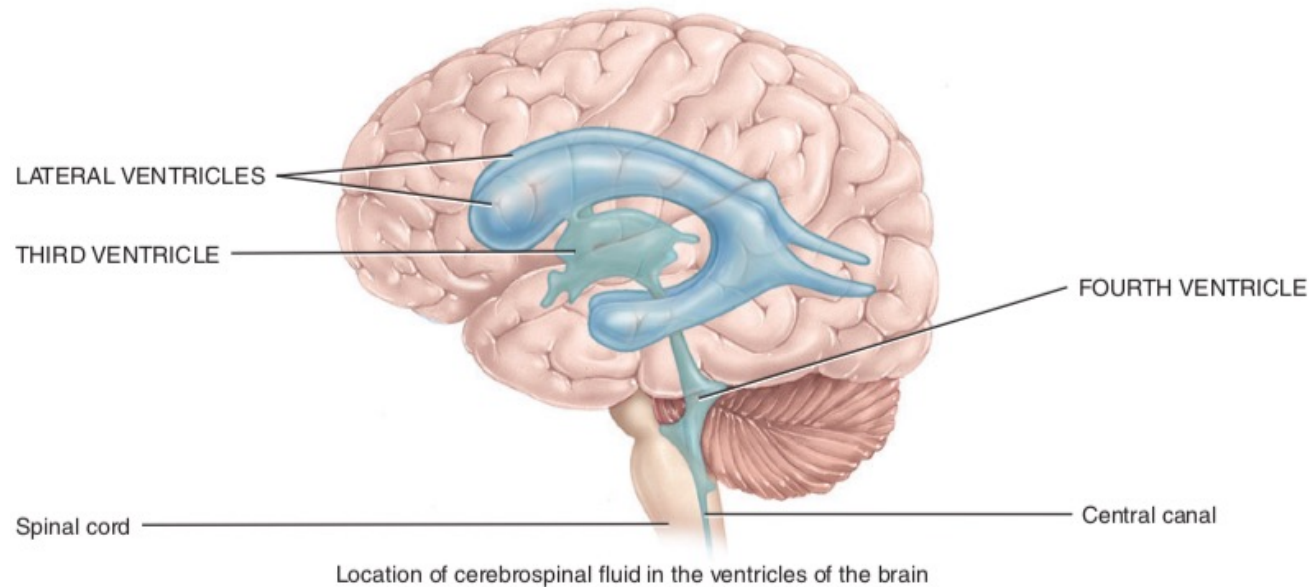
(a)



(b)

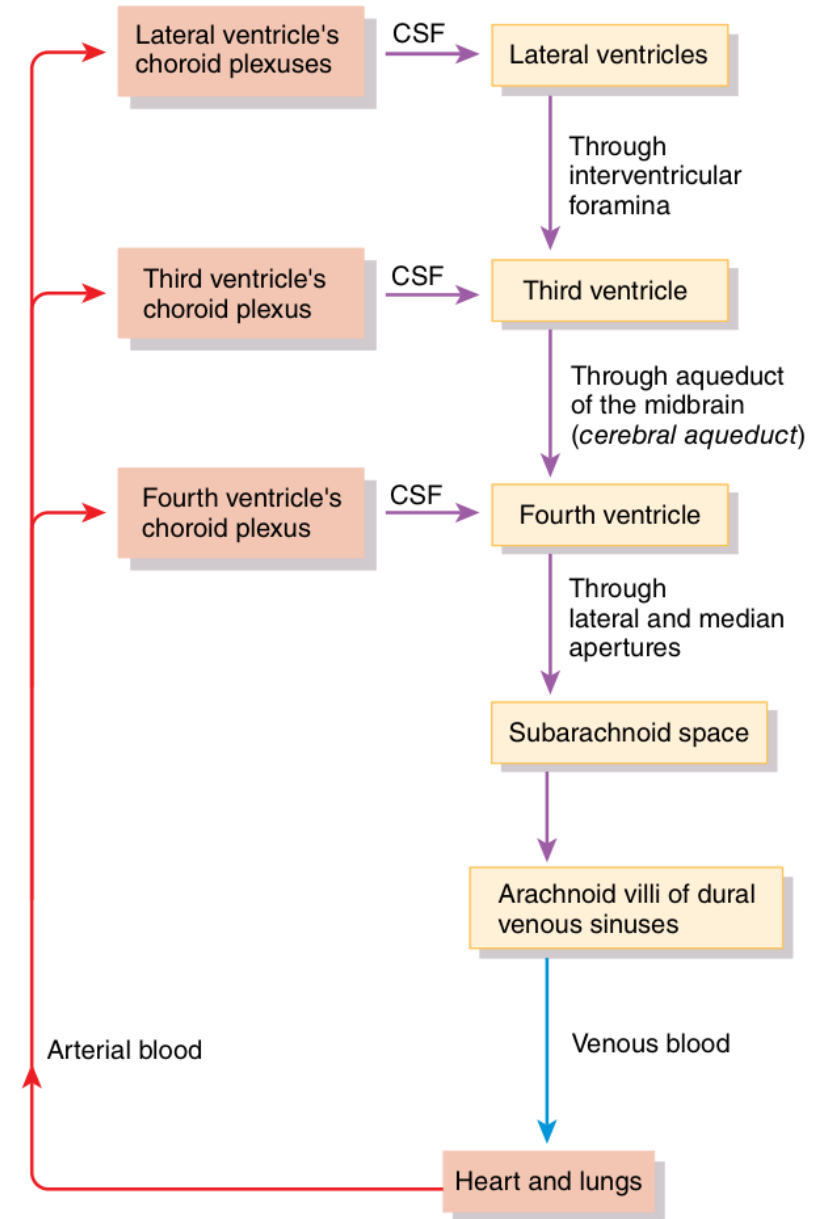


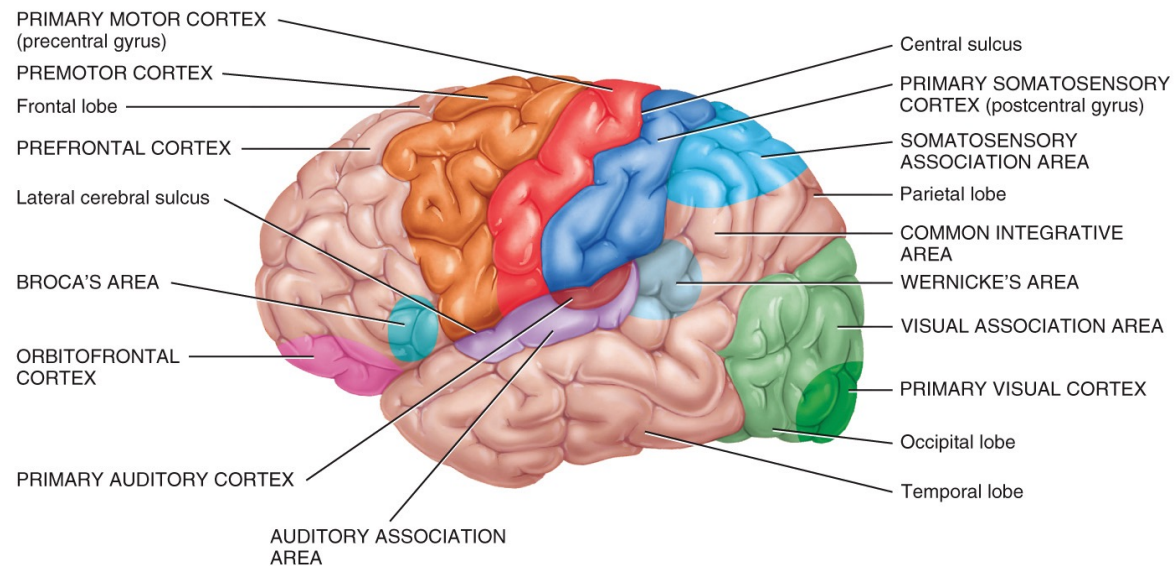
VENTRICLES OF THE BRAIN



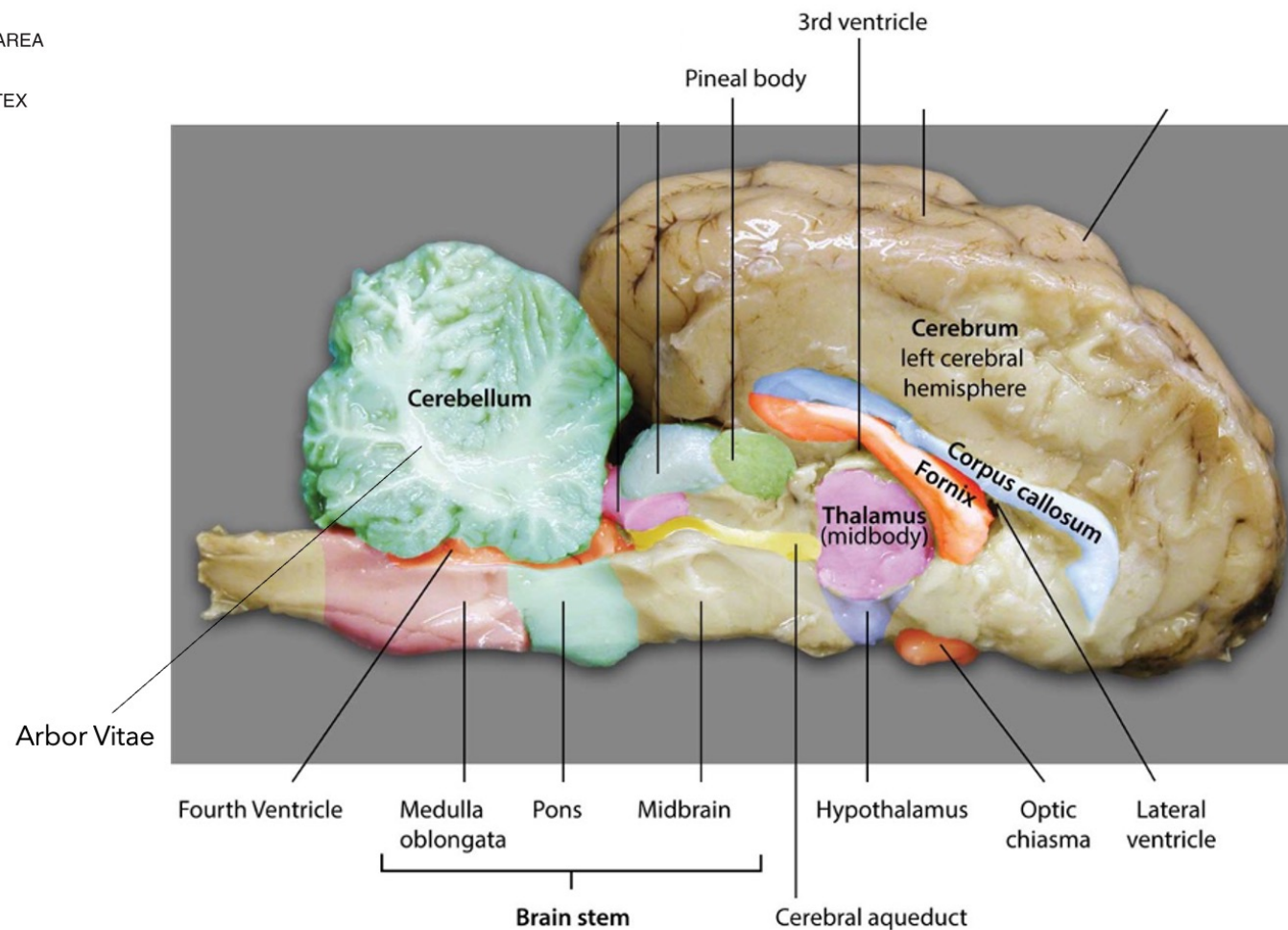
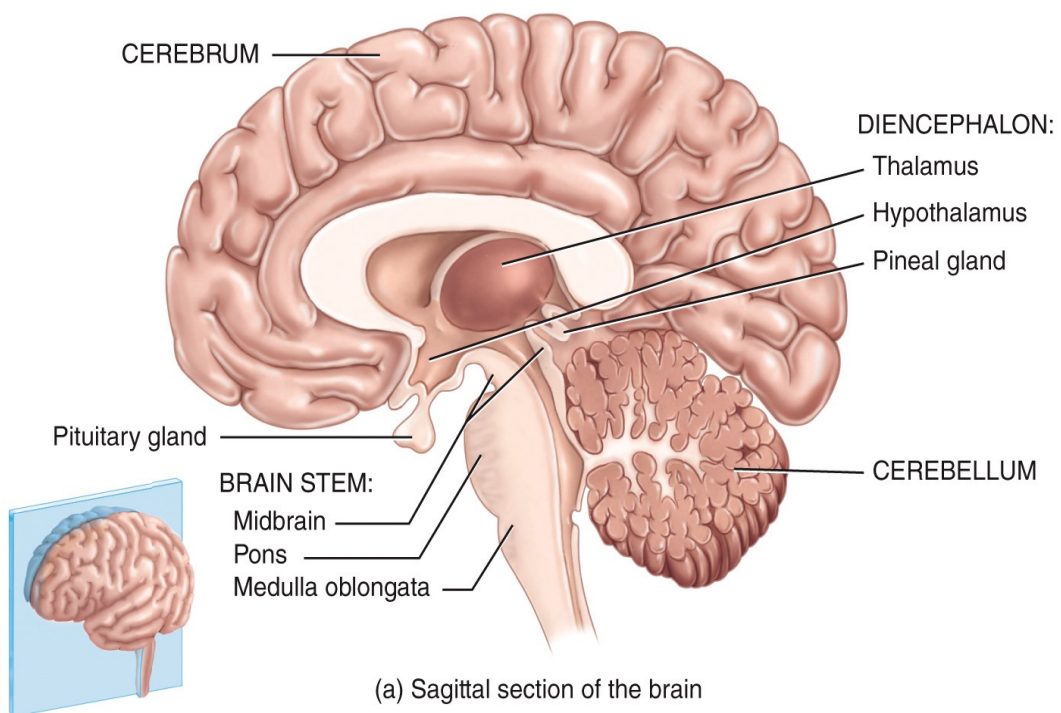
The flow of CSF through the ventricles:

Lateral Ventricles → Interventricular Foramen → Third Ventricle → Aqueduct of Midbrain → Fourth Ventricle



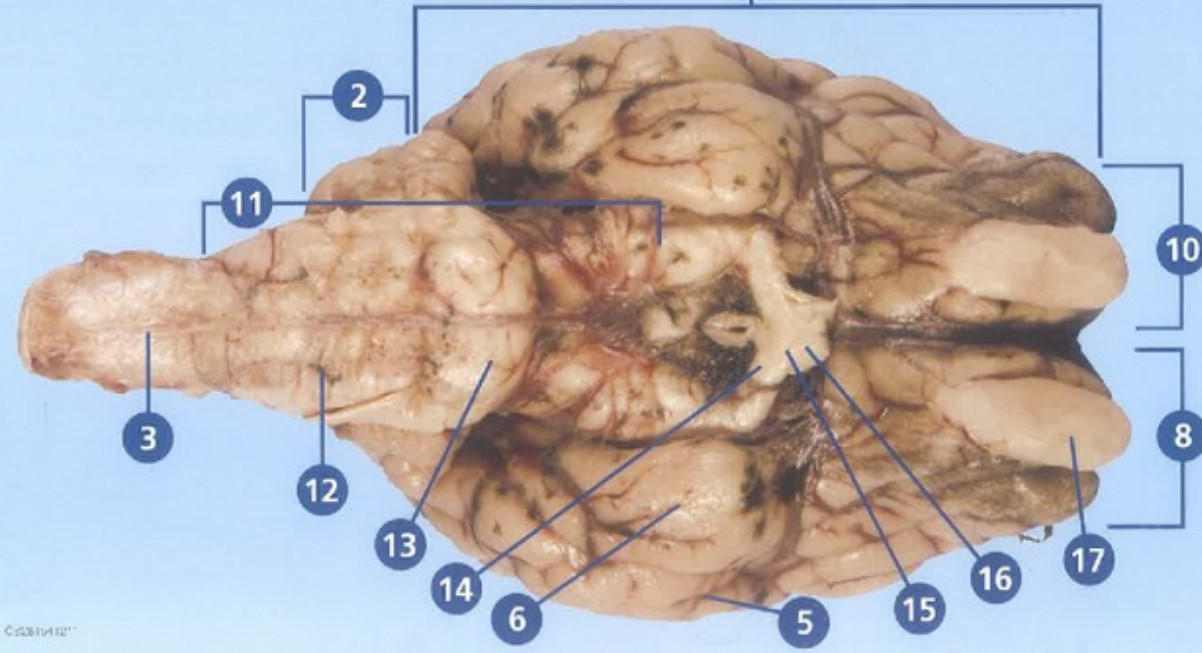
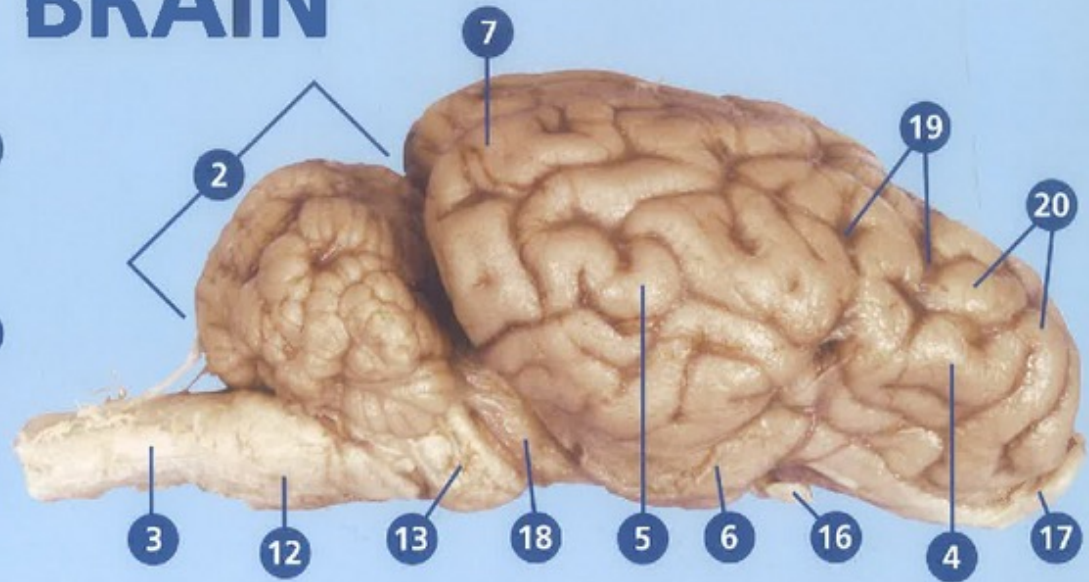
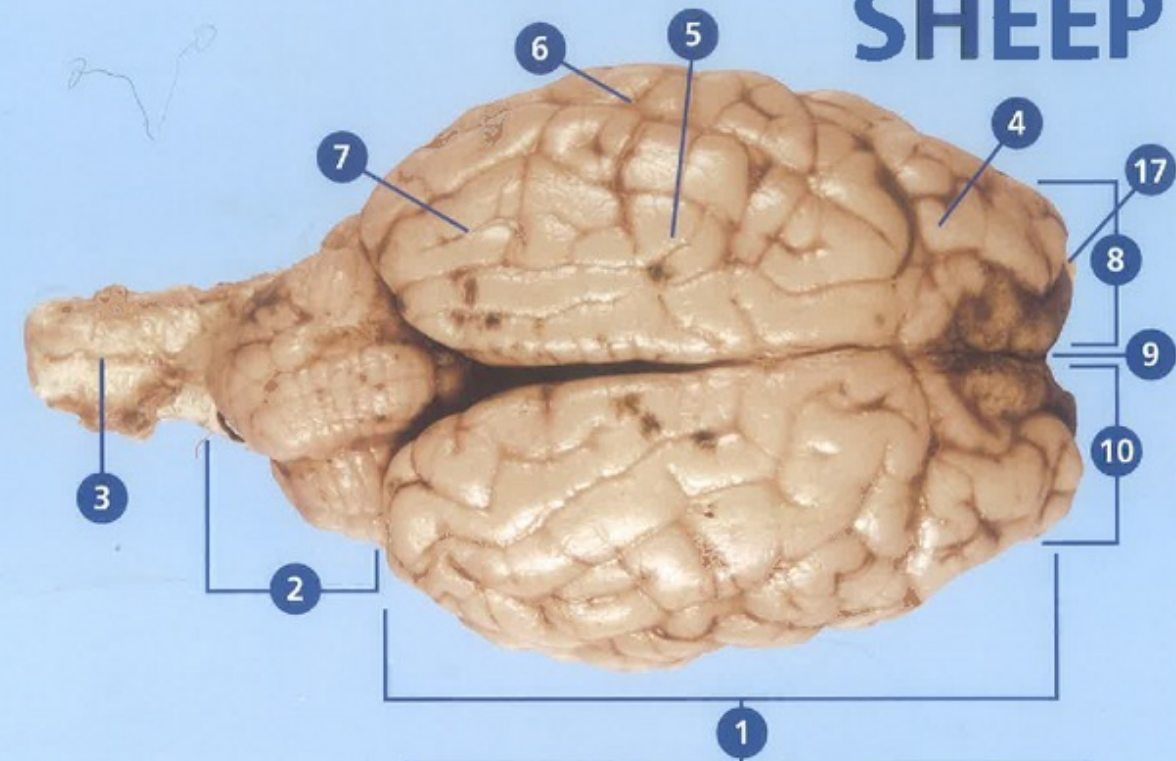


HUMAN BRAIN vs. SHEEP BRAIN

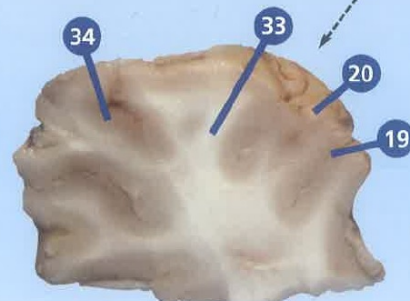
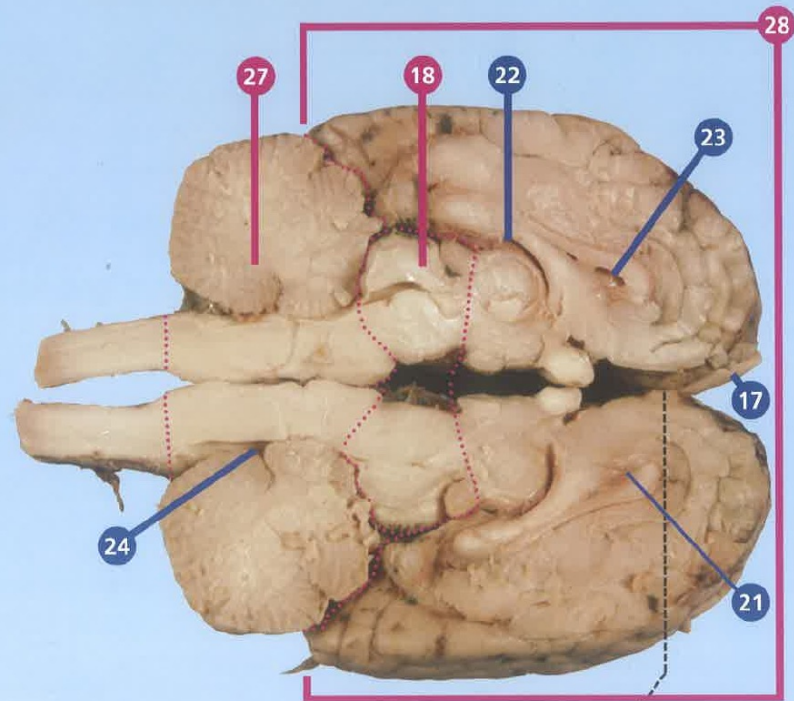
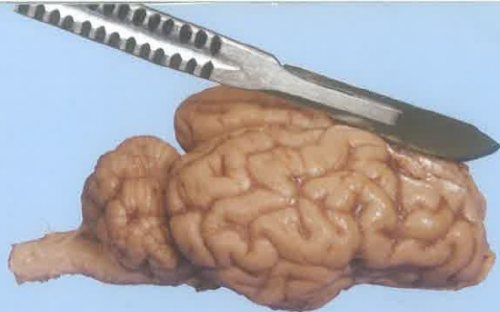


Sheep brain, sagittal section, medial view

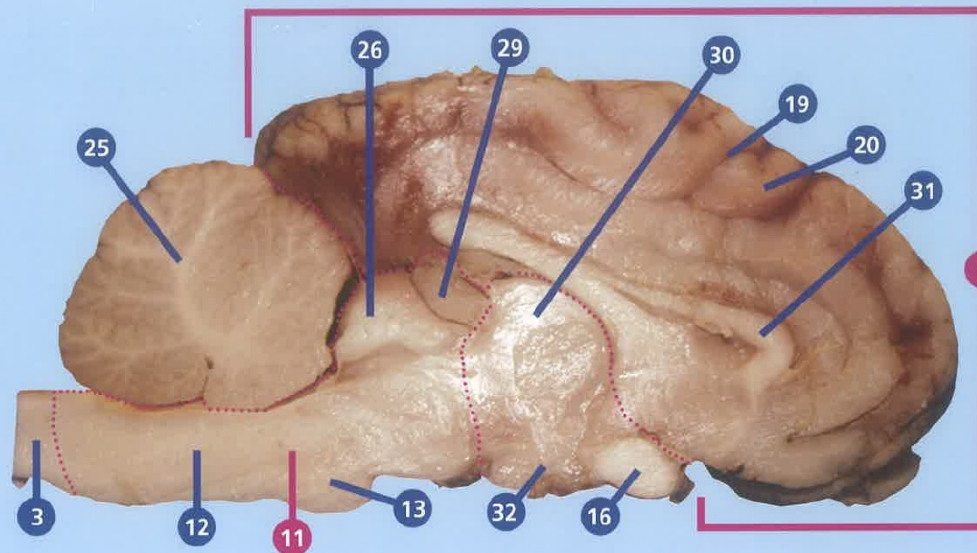
SHEEP BRAIN



- | | |
|-------------------------------|-------------------|
| 1 Cerebrum | 11 Brain Stem |
| 2 Cerebellum | 12 Medulla |
| 3 Spinal Cord | 13 Pons |
| 4 Frontal Lobe | 14 Optic Tract |
| 5 Parietal Lobe | 15 Optic Chiasm |
| 6 Temporal Lobe | 16 Optic Nerve |
| 7 Occipital Lobe | 17 Olfactory Bulb |
| 8 Left Hemisphere | 18 Midbrain |
| 9 Medial Longitudinal Fissure | 19 Sulci |
| 10 Right Hemisphere | 20 Gyri |



Cross Section of Frontal Lobe



Arbor vitae. The branching white matter in the cerebellum.

Brain stem. Route of information transfer between the forebrain and spinal cord; consists of the medulla, pons, and midbrain.

Cerebellum. Controls movement, balance, and muscle coordination.

Cerebrum. Large, deeply wrinkled region of the brain responsible for conscious experience, including perception, emotion, thought, and planning.

Corpus callosum. Bundle of nerve fibers connecting the right and left cerebral hemispheres.

Forebrain. Region consisting of the cerebrum, thalamus, and hypothalamus.

Lobes. Regions of the cerebrum, each with certain functions:

Frontal. Controls cognitive processes such as planning and the inhibition of drives.

Occipital. Receives sensory information from the eyes.

Parietal. Integrates sensory information and functions in spatial perception.

Temporal. Functions in auditory perception and long-term memory.

Gray matter. Portions of the central nervous system made up mainly of nerve cell bodies.

Gyri. (singular, gyrus). Bulges in the folds of the cerebrum.

Hemispheres. (Right and Left). The two sides of the cerebrum, separated by the medial longitudinal fissure and connected by the corpus callosum.

Hindbrain. Region consisting of the cerebellum, pons, and medulla.

Hypothalamus. Brain structure with many functions concerning hormone secretion, temperature regulation, hunger, mood, thirst, and fatigue.

Medulla. Brain region that connects to the spinal cord; important in autonomic functions.

Midbrain. Region connecting the forebrain and hindbrain.

Olfactory bulb. Involved in detection and discrimination of odors.

Optic chiasm. Junction at which some fibers from each optic nerve crisscross, enabling effective binocular vision.

Optic nerve. Connects the retina to the optic chiasm.

Optic tract. Nerves that continue from the optic chiasm to the thalamus, from which visual stimuli are routed to the visual cortex.

Pineal body. Endocrine gland that secretes melatonin, which influences circadian rhythms and timing of sexual development.

Pons. Connection between forebrain, cerebellum, and medulla; important in regulation of sleep and breathing.

Septum pellucidum. Membrane in longitudinal midline of cerebrum that separates left and right lateral ventricles.

Spinal cord. Bundle of nerve fibers inside the spine that connects the brain to different sensory and motor parts of the body.

Sulci. (singular, sulcus). Furrows in the folds of the cerebrum.

Superior colliculus. Midbrain portion that coordinates movement of the eyes, head, and neck in response to stimuli.

Thalamus. Region between the midbrain and cerebral cortex; receives many types of sensory signals and relays them to the cerebral cortex.

Ventricles. Cavities in the brain. The ventricular system of cavities and connecting tubes is filled with cerebrospinal fluid, which cushions and supports the brain. The system includes the central canal of the spinal cord.

White matter. Portions of the central nervous system made up mainly of myelinated nerve fibers; usually surrounded by gray matter.

- 1 Cerebrum
- 2 Cerebellum
- 3 Spinal Cord
- 4 Frontal Lobe
- 5 Parietal Lobe
- 6 Temporal Lobe
- 7 Occipital Lobe
- 8 Left Hemisphere
- 9 Medial Longitudinal Fissure
- 10 Right Hemisphere
- 11 Brain Stem
- 12 Medulla
- 13 Pons
- 14 Optic Tract
- 15 Optic Chiasm
- 16 Optic Nerve
- 17 Olfactory Bulb
- 18 Midbrain
- 19 Sulcus
- 20 Gyrus
- 21 Septum Pellucidum
- 22 Third Ventricle
- 23 Left Lateral Ventricle
- 24 Fourth Ventricle
- 25 Arbor Vitae
- 26 Superior Colliculus
- 27 Hindbrain
- 28 Forebrain
- 29 Pineal Body
- 30 Thalamus
- 31 Corpus Callosum
- 32 Hypothalamus
- 33 White Matter
- 34 Gray Matter

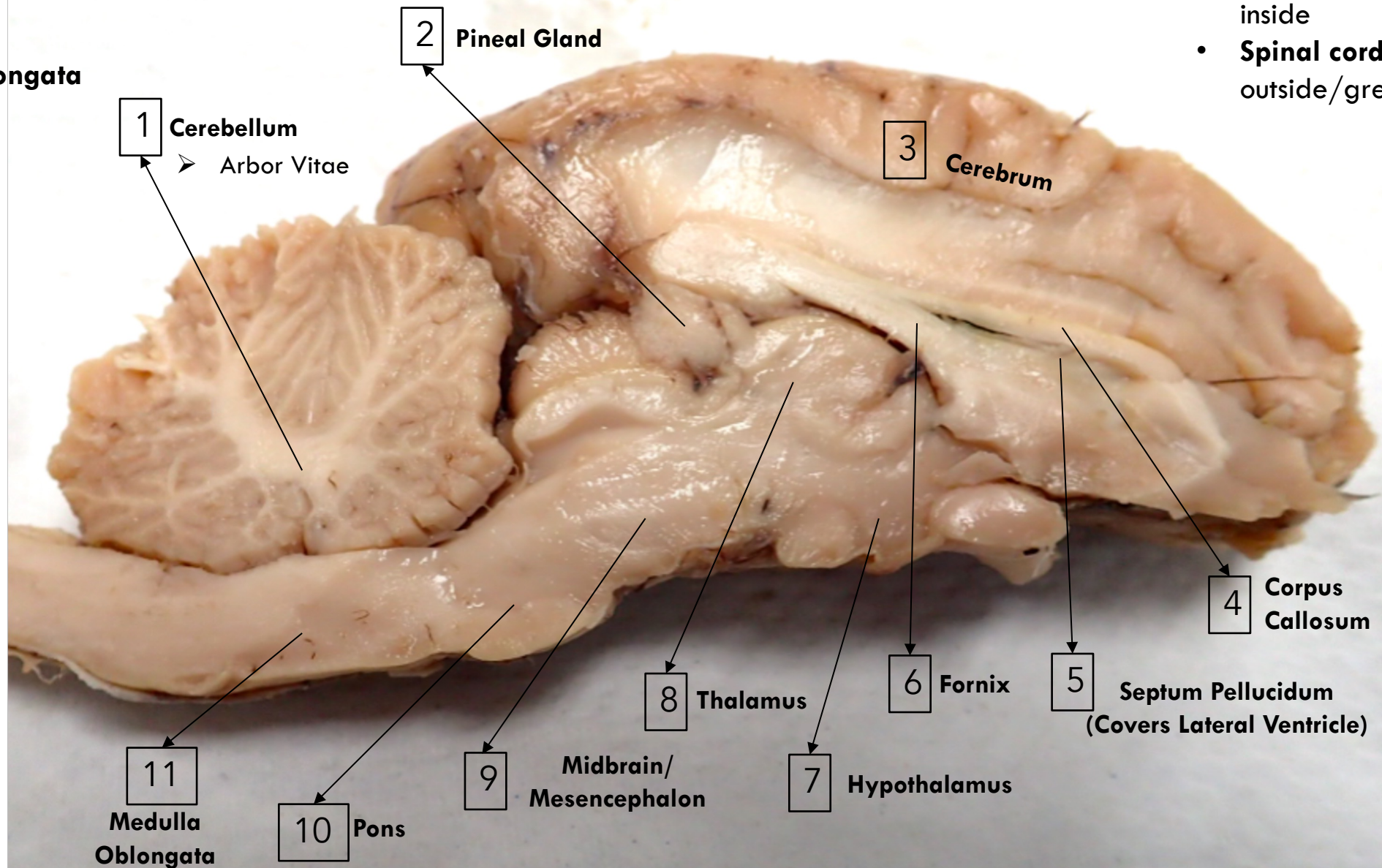
IDENTIFYING STRUCTURES

How does the location of grey and white matter differ between the brain and spinal cord?

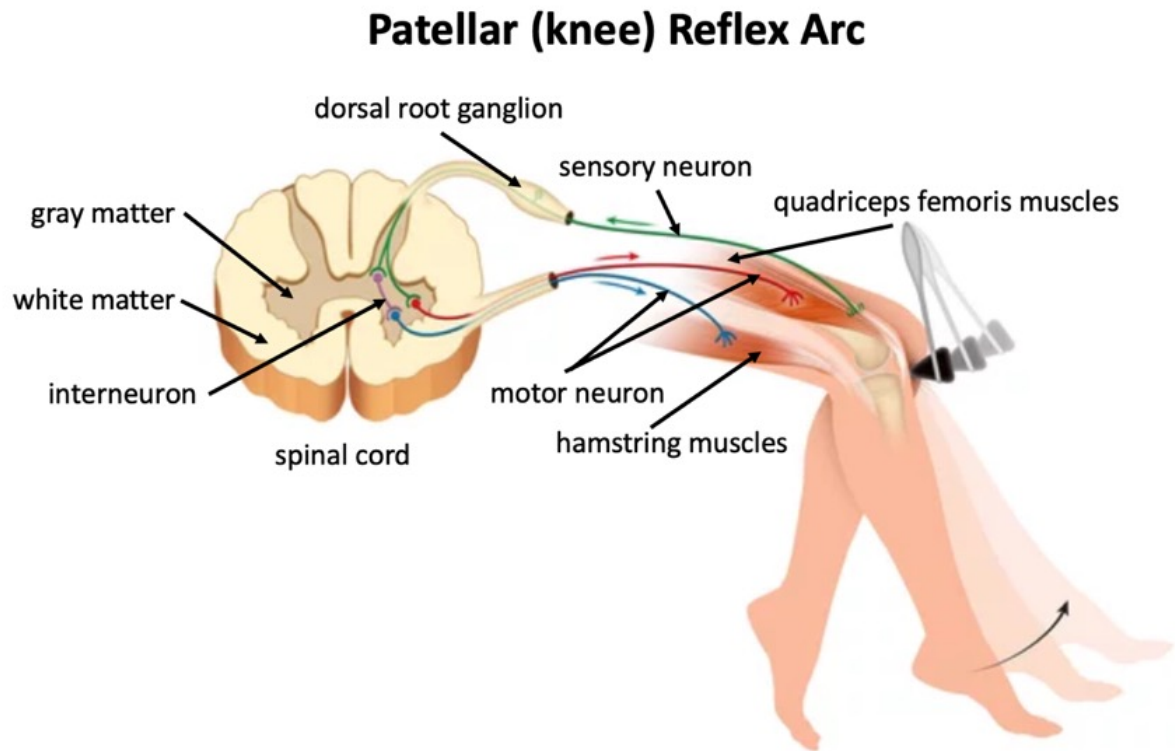
- **Brain:** grey outside/white inside
- **Spinal cord:** white outside/grey inside

What structures compose the brain stem?

- **Midbrain**
- **Pons**
- **Medulla Oblongata**



PATELLAR/KNEE-JERK REFLEX



- A monosynaptic reflex commonly used by healthcare professionals to assess the function of the nervous system.
- Elicited by a rubber hammer struck against the patellar ligament.
- This will stretch the quadriceps femoris muscle, activating muscle spindle receptors. The axon from this receptor structure will cause direct contraction of the muscle. A collateral of the muscle spindle fiber will also inhibit the motor neuron of the antagonist muscle, namely the hamstring muscles. The reflex helps to maintain muscles at a constant length.
- Ipsilateral reflex.

JENDRASSIK MANEUVER

- Medical maneuver in which the patient clenches their teeth, flexes both sets of fingers into a hook-like form, and interlocks those sets of fingers together. The tendon below the patient's knee is then struck with a reflex hammer to elicit the patellar reflex
- **Do you think this would enhance or diminish the knee-jerk reflex?**

REFLEXES OVERVIEW

1. Pupillary Reflex

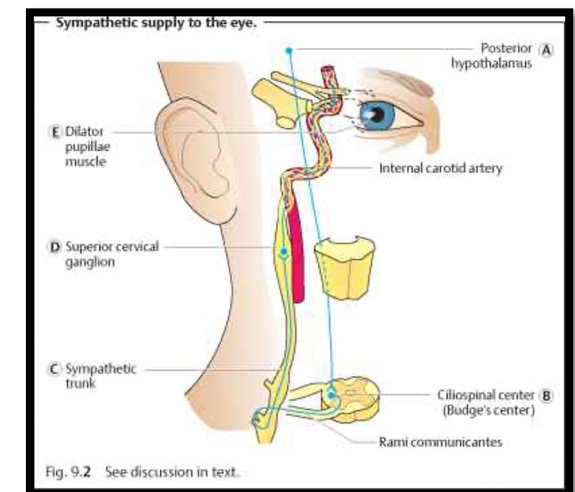
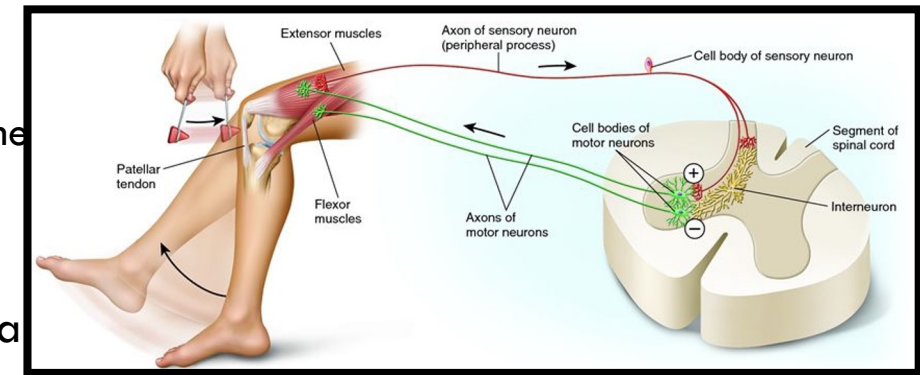
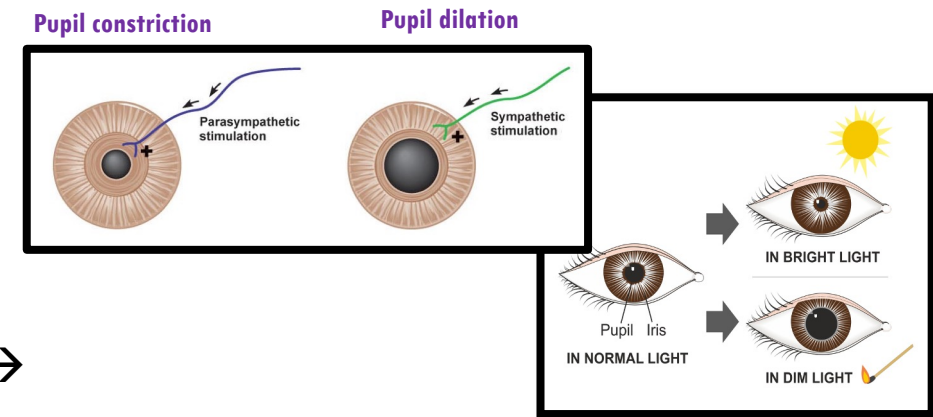
- Shining a bright light to one eye, makes the pupils in both eyes **constrict** → Activation of the parasympathetic system
 - Direct Response: Shining a light in one eye causes a pupil response in that same eye.
 - Consensual Response: Shining a light in the left eye causes pupil constriction in the right eye and vice versa.

2. Patellar Reflex

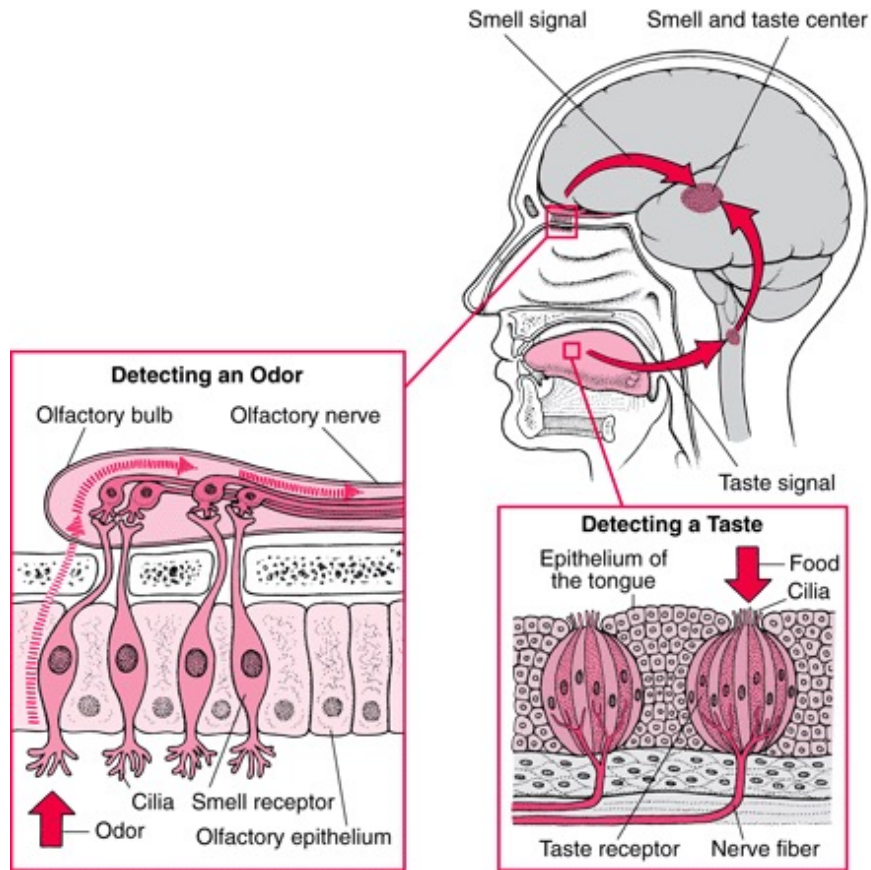
- Striking the patellar tendon under the knee, causes the leg on the ipsilateral side to jerk and straighten. Reaction tends to be small
- Jendrassik maneuver:** clasp hands in front of you and try pull them away from each other
 - Reaction tends to be more pronounced/enhanced
- What muscle(s) do you think contract as a result? Which muscle(s) relax?**
 - Quadricep muscles contract while the hamstring muscles relax

3. Ciliospinal Reflex

- Pinching the neck of an individual will cause the pupil on that same side to **dilate** → Activation of the sympathetic system
 - Ipsilateral Response: Results in pupil dilation in the same side that is pinched.



SPECIAL SENSES ACTIVITY — SMELL AND TASTE



- Smell is concerned more with detecting the presence or absence of odors than with quantifying their intensity.
- Both smell and taste sensory information is integrated into determining flavor.

Tasting jellybeans when:

1. **Eyes and nostrils are closed**
2. **Eyes are closed but nostrils are open**

Could the subject(s) taste the jellybean while holding their nose(s)?

- *Most likely no.*

Was the subject(s) able to taste the jellybean once they regained their sense of smell?

- *Yes (typically).*

Why does food often seem tasteless when you have a cold?

- *When you have a cold or are suffering from allergies and cannot taste your food, it is olfaction that is blocked, not gustation.*
- *About 80% of our perception of taste comes from chemical stimuli of olfactory cells in the nose; 20% of perceived taste comes from the tongue*

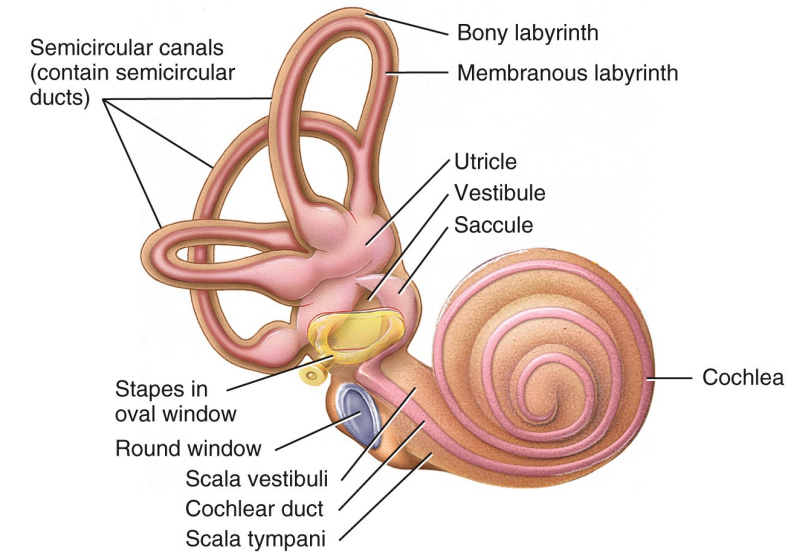
SPECIAL SENSES — BALANCE & EQUILIBRIUM

The vestibular apparatus/system of the inner ear contains the:

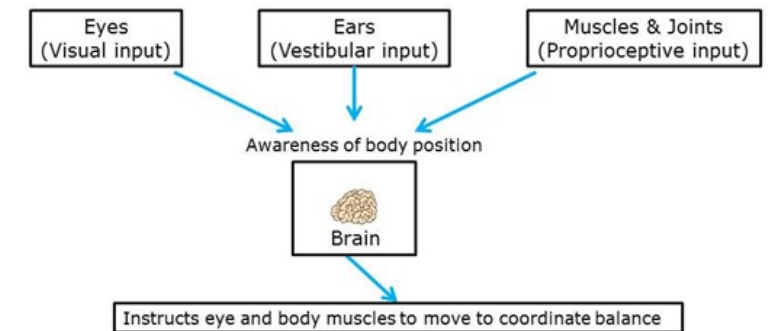
- The Utricle and saccule which detect gravity and linear acceleration.
- The semicircular canals which detect rotational movements.
 - Each of the three canals is oriented along one of the 3 dimensions of the body (the x, y and z axes), so motion in any angular direction is felt when the fluid inside the canals triggers tiny hairs on the inside.

How does vision work in concert with the sense of balance?

- Good balance requires sensory input from: (1) the vestibular system/apparatus, (2) the visual system, and (3) proprioceptive input from the muscles, tendons, joints.



(c) The bony and membranous labyrinths of the inner ear

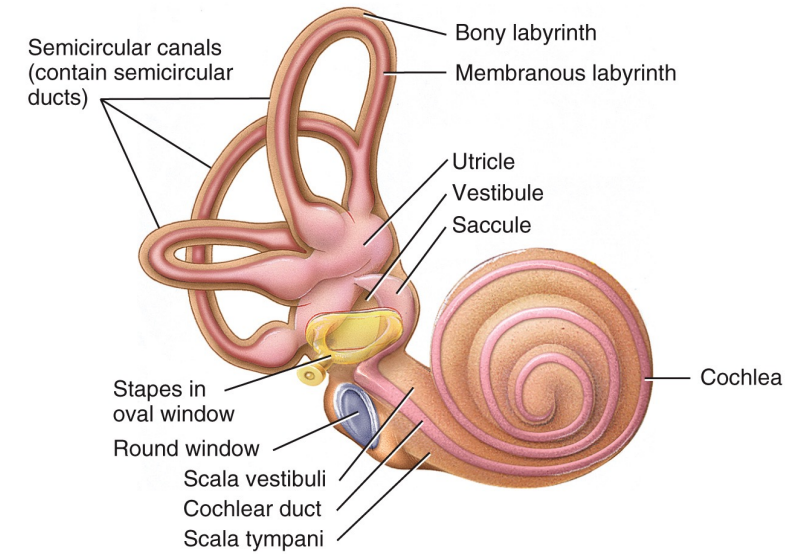


Spotting is a technique used by ballerinas to prevent dizziness.

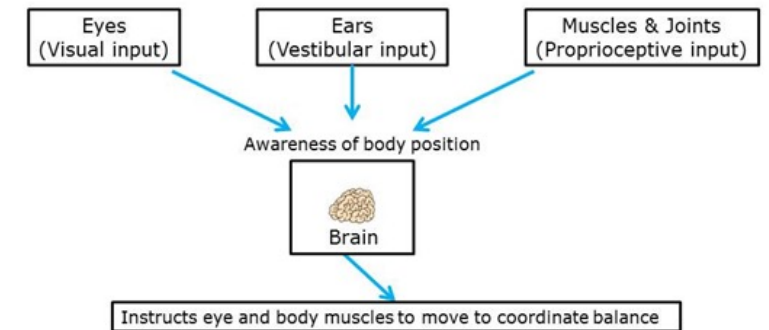
BALANCE AND ALCOHOL

Can you see why people are asked to walk a straight line to test sobriety?

- Alcohol consumption can lead to changes in the density of the endolymph, a fluid within the semicircular canals of the inner ear. These density changes result from alcohol's ability to dilute bodily fluids, including endolymph
- Altered endolymph density can disrupt the normal functioning of the semicircular canals, which are responsible for detecting rotational movements and changes in head position
- As a consequence of these density changes, the hair cells within the semicircular canals can bend, sending signals to the brain when the head is not rotating
- This disruption in the functioning of the inner ear contributes to symptoms such as dizziness and impaired balance often experienced after alcohol consumption



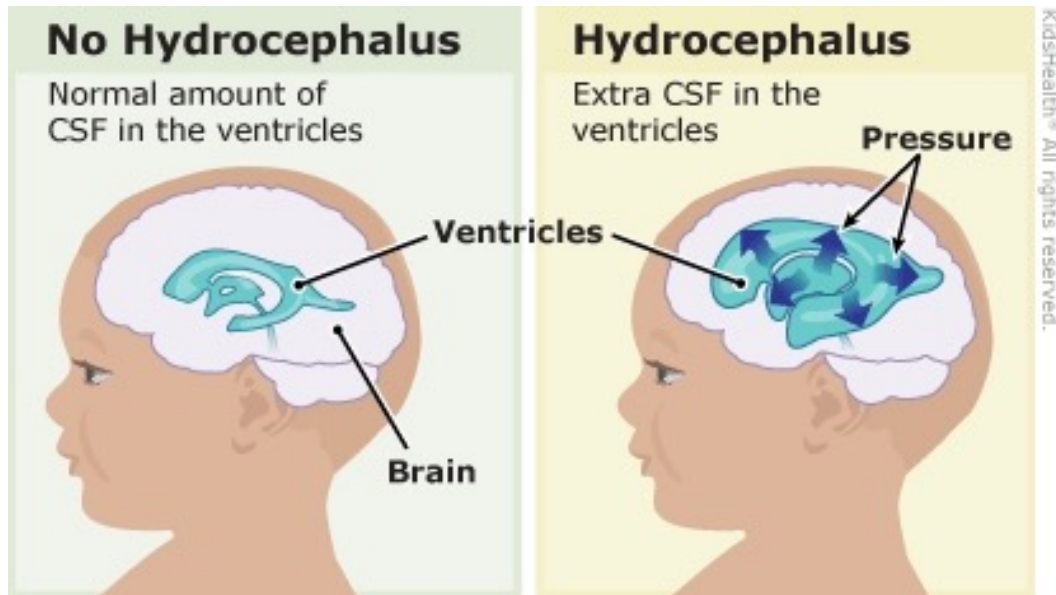
(c) The bony and membranous labyrinths of the inner ear



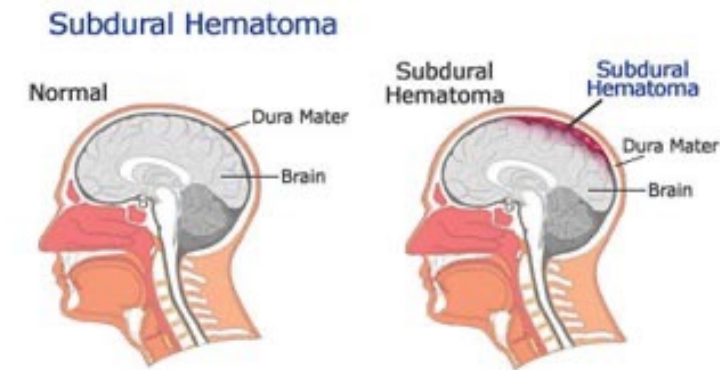
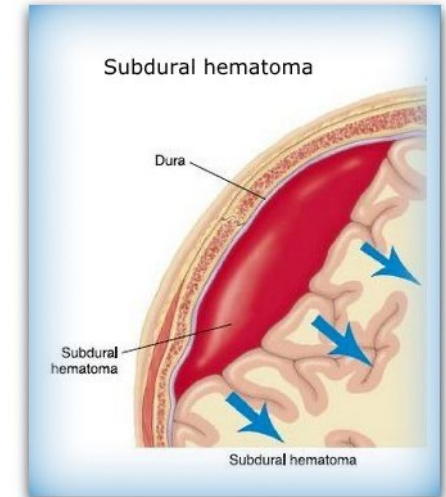
Spotting is a technique used by ballerinas to prevent dizziness.

CLINICAL APPLICATIONS

HYDROCEPHALUS



Hydrocephalus – Ventricles become enlarged due to CSF buildup, placing extra pressure on the brain and may disrupt the flow of CSF.



Subdural Hematoma

Subdural Hematoma – Collection of blood within the subdural space of the brain.

CLINICAL APPLICATION: WERNICKE'S APHASIA



- Also referred to as “word salad”
- Fluent speech but formed sentences do not make sense

CLINICAL APPLICATION: BROCA'S APHASIA

- Expressive Aphasia
- Comprehension of language remains intact, but these individuals have difficulty with communicating efficiently
- Patients get frustrated since they know what they want to say but have difficulty doing so

