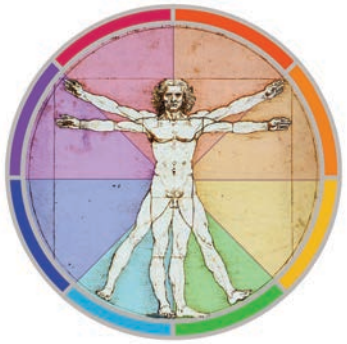
HUBS191 Lecture Material

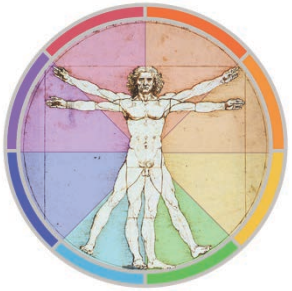
This pre-lecture material is to help you prepare for the lecture and to assist your note-taking within the lecture,

it is NOT a substitute for the lecture !



Please note that although every effort is made to ensure this pre-lecture material corresponds to the live-lecture there may be differences / additions.

Dr Christine Jasoni
Department of Anatomy



HUBS 191

Human Movement and Sensation

Theme 2: Integrating and coordinating roles of the nervous system

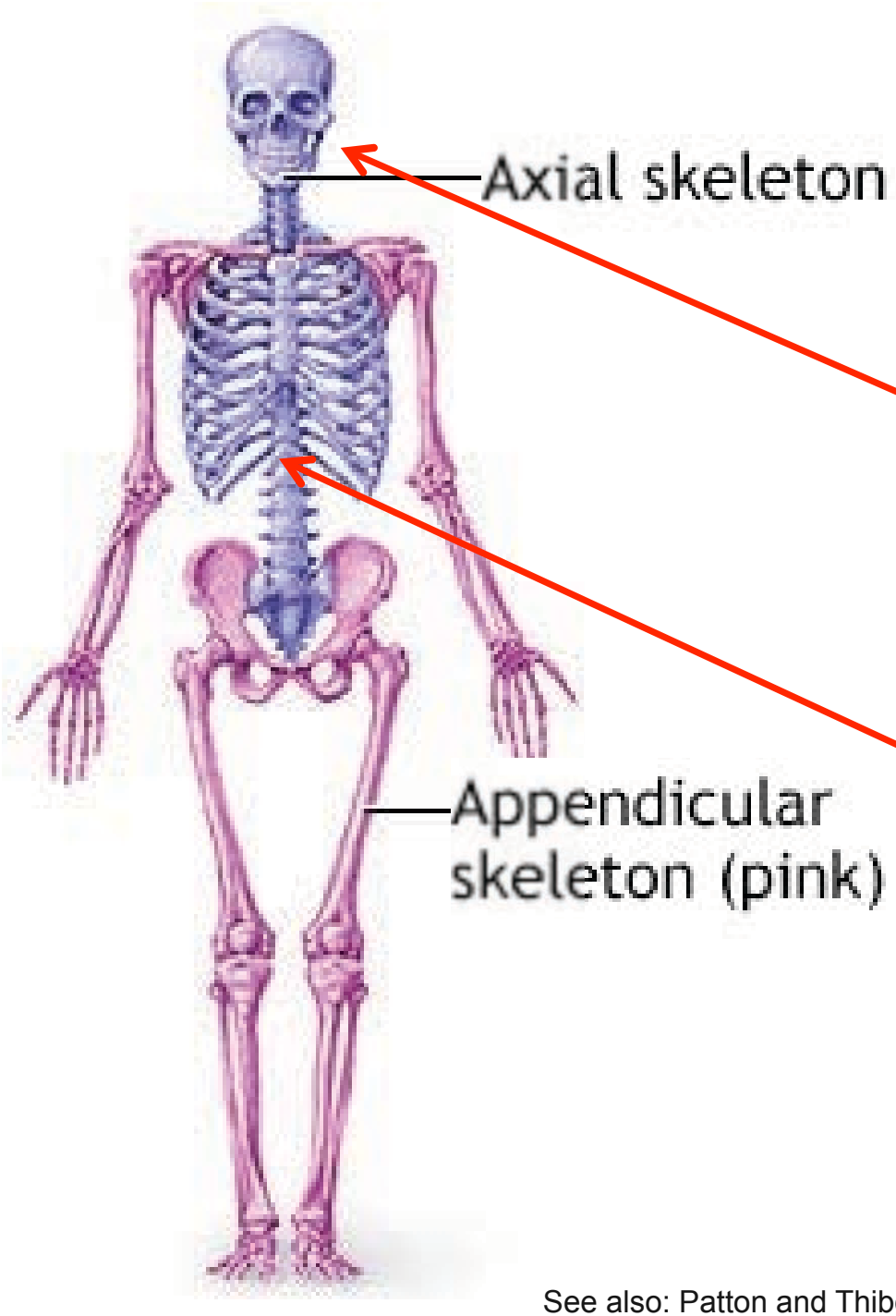
Lecture 19: Support and protection of the nervous system

30 March 2017

Lecture 19: Learning objectives

After this lecture and associated study you should know and understand:

- The bones of the cranium and facial skeleton and how they are joined
- The meninges and their structural and functional properties in both the brain and spinal cord
- The ventricular system and flow of cerebrospinal fluid (CSF)



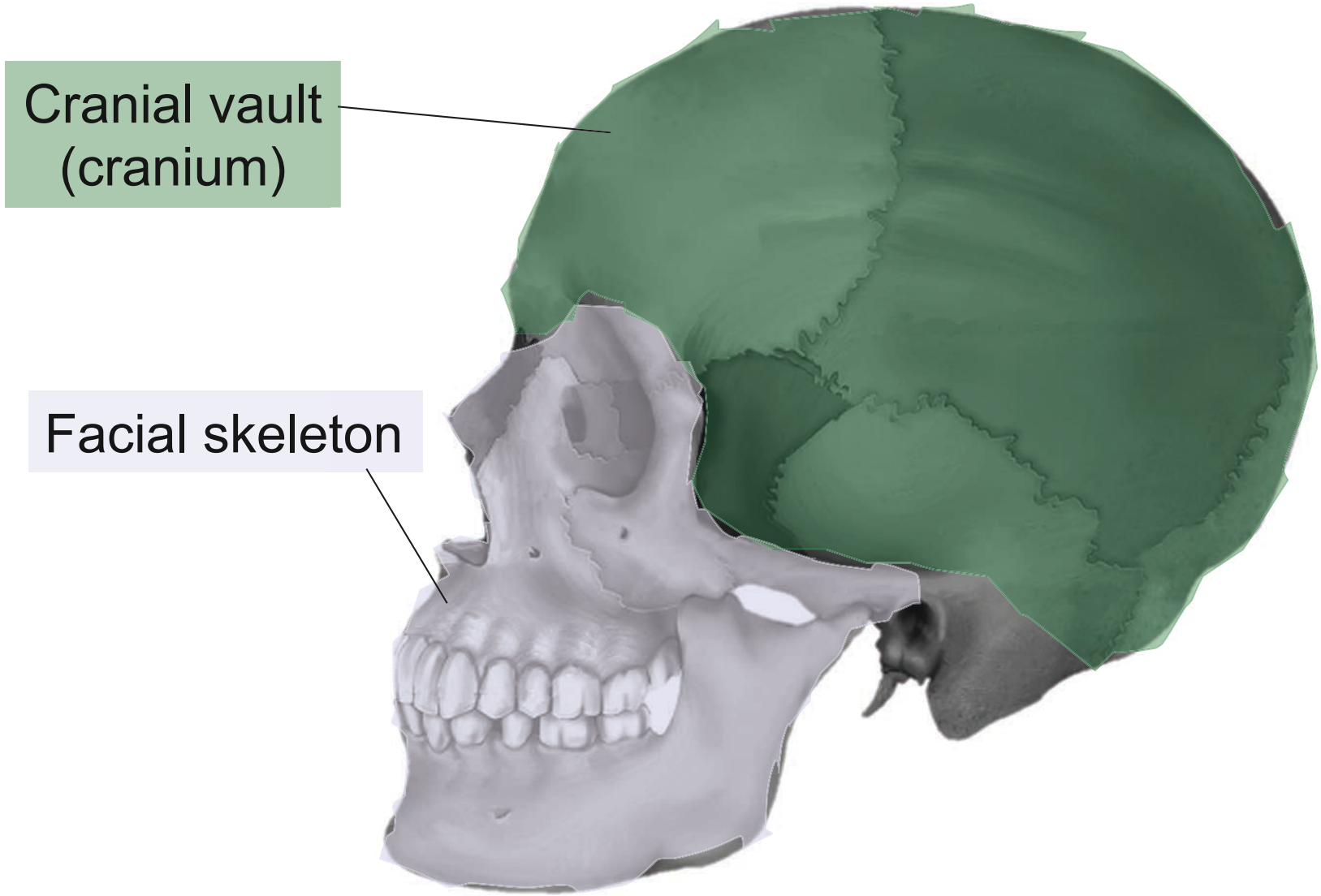
Support provided by the axial skeleton

- Skull - 28 bones
  - Cranium (=8)
  - Face (=14)
  - Ear bones (=6)
- Vertebral column - 26 bones
  - Cervical vertebrae (7)
  - Thoracic vertebrae (12)
  - Lumbar vertebrae (5)
  - Sacrum (5 fused vertebrae)
  - Coccygeal (4/5 fused vert)

See also: Patton and Thibodeau 8th ed Fig 9-1 (7th ed Fig 8-1)

Bones of the skull

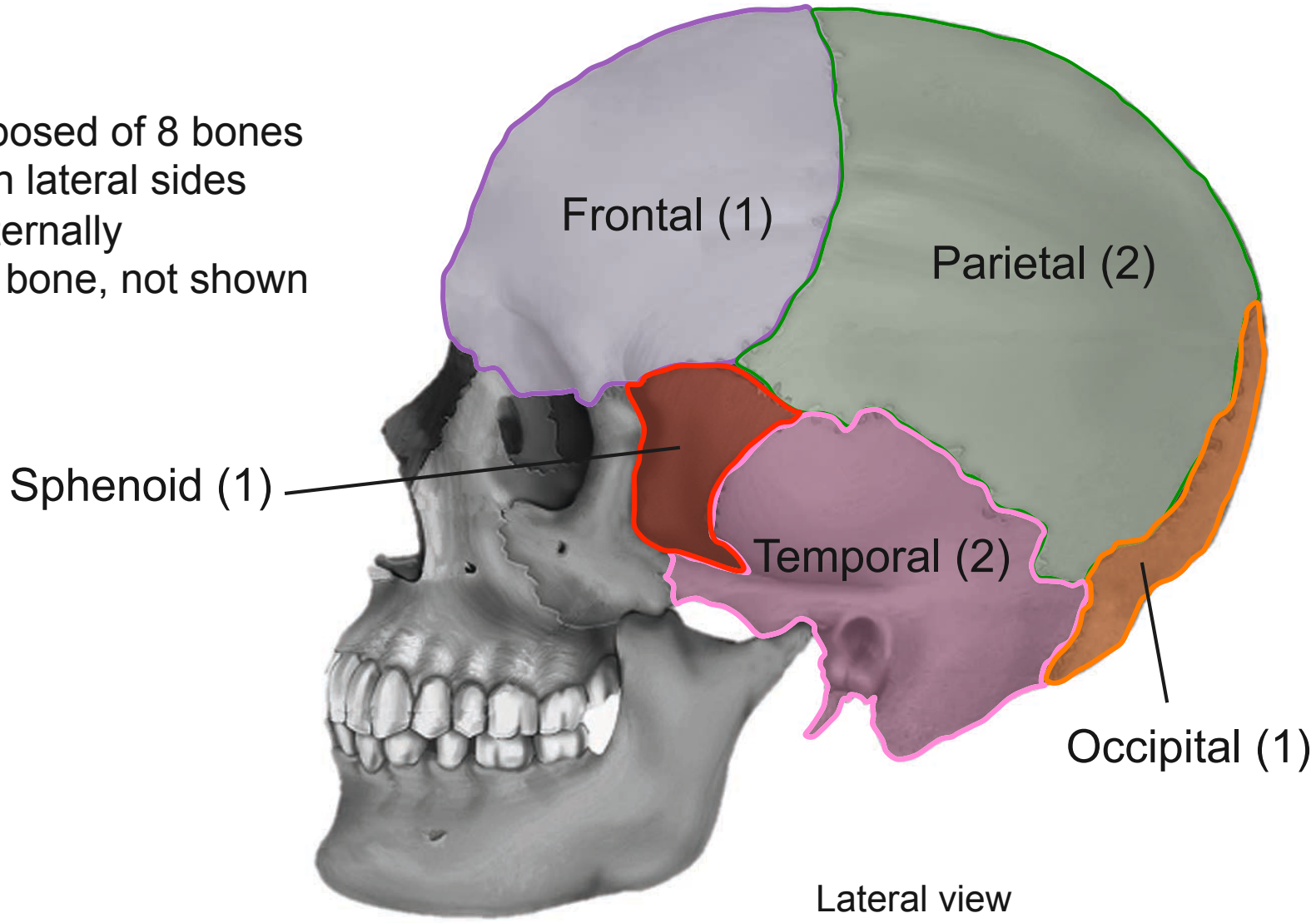
Skull = cranial vault (or cranium) + facial skeleton



Modified from Patton and Thibodeau 8th ed, Fig 9-3 (7th ed, Fig 8-3)

Bones of the skull: I. The cranium

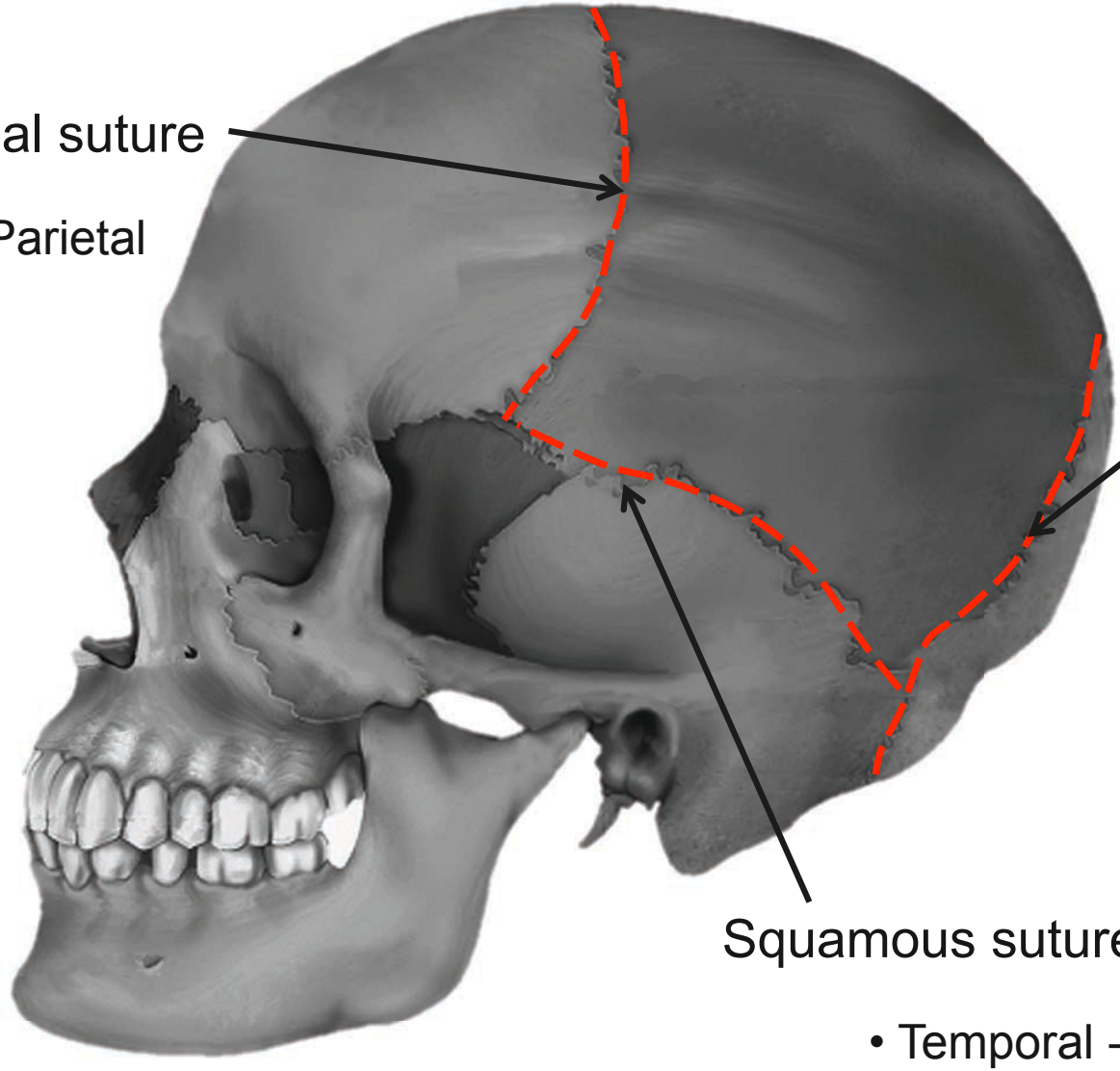
- Cranium composed of 8 bones
  - ~ 7 visible on lateral sides
  - ~1 visible internally
    - = Ethmoid bone, not shown



Lateral view
(from the side)

Modified from Patton and Thibodeau 8th ed, Fig 9-3 (7th ed, Fig 8-3)

Bones of the cranium have joints between them called ***sutures***



Coronal suture

- Frontal - Parietal

Lambdoidal suture

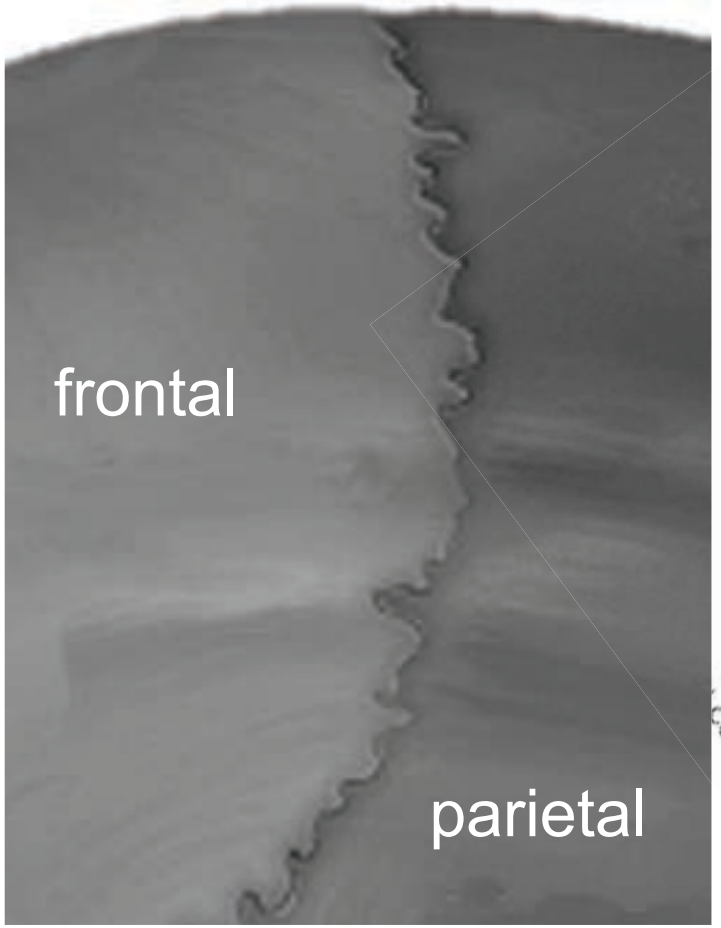
- Occipital - Parietal

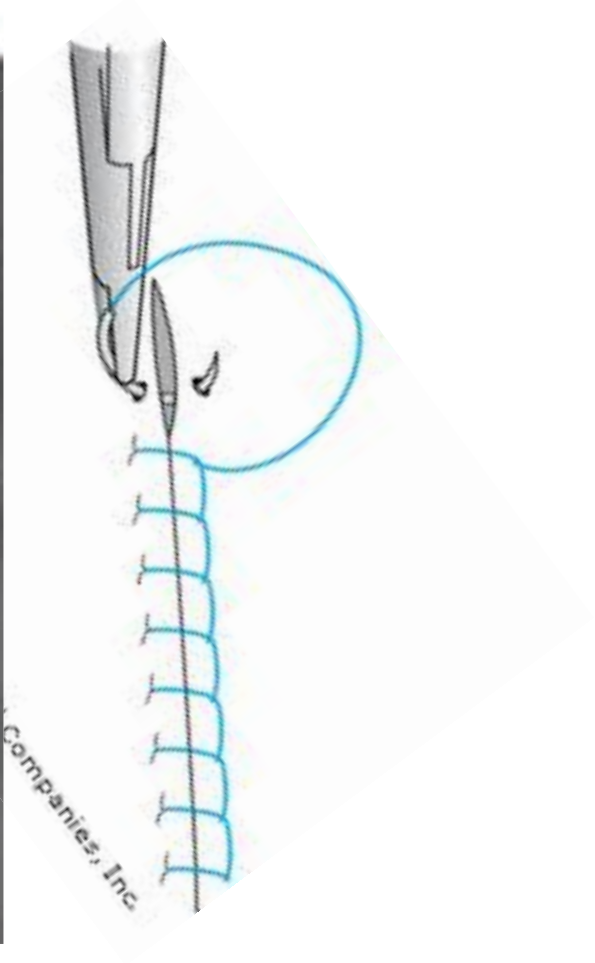
Squamous suture

- Temporal - Parietal

Modified from Patton and Thibodeau 8th ed, Fig 9-3 (7th ed, Fig 8-3)

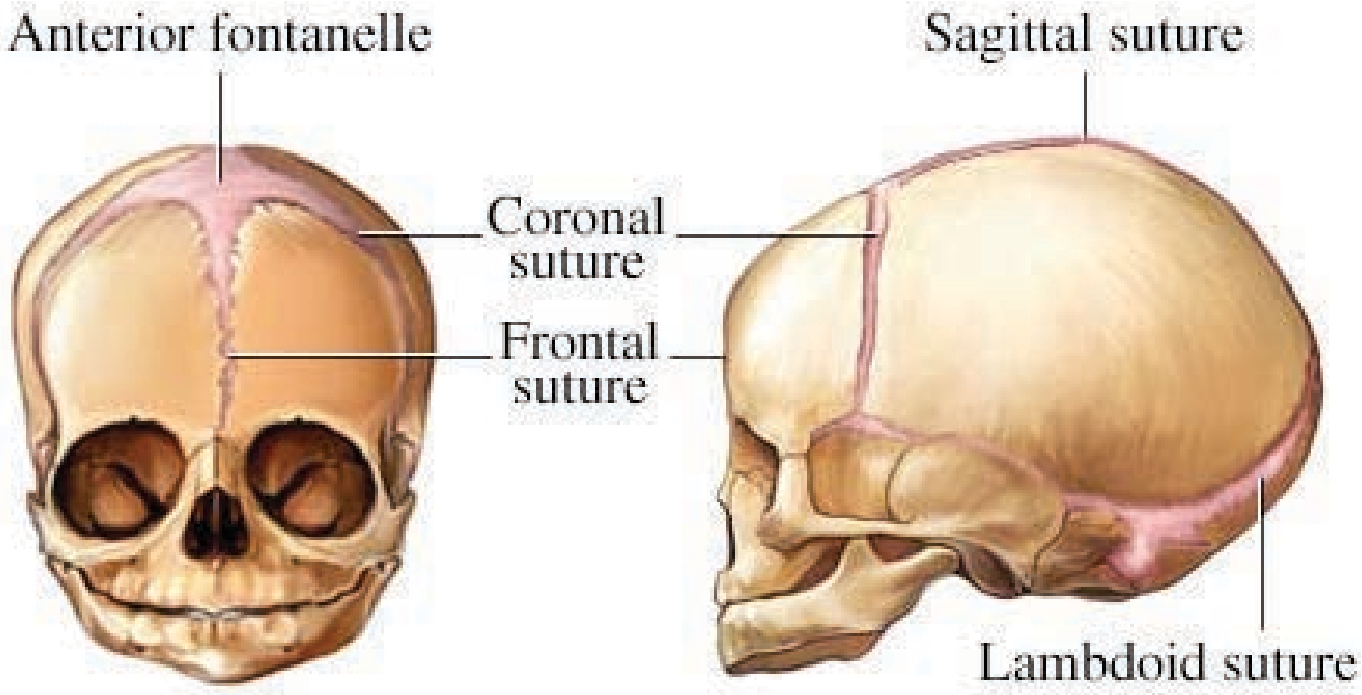
Suture means a row of stitches





Modified from Patton and Thibodeau 8th ed, Fig 9-3 (7th ed, Fig 8-3)

The skull at birth – Sutures are not yet joined



- Gaps between sutures are called ***fontanelles***
- Allow the brain to grow after birth
  - Premature closure can block brain growth → cognitive impairment

See also: Patton and Thibodeau, 8th ed, Fig 9-11 (7th ed, Fig 8-11)

Relationship between the brain and the cranium – Anterior view

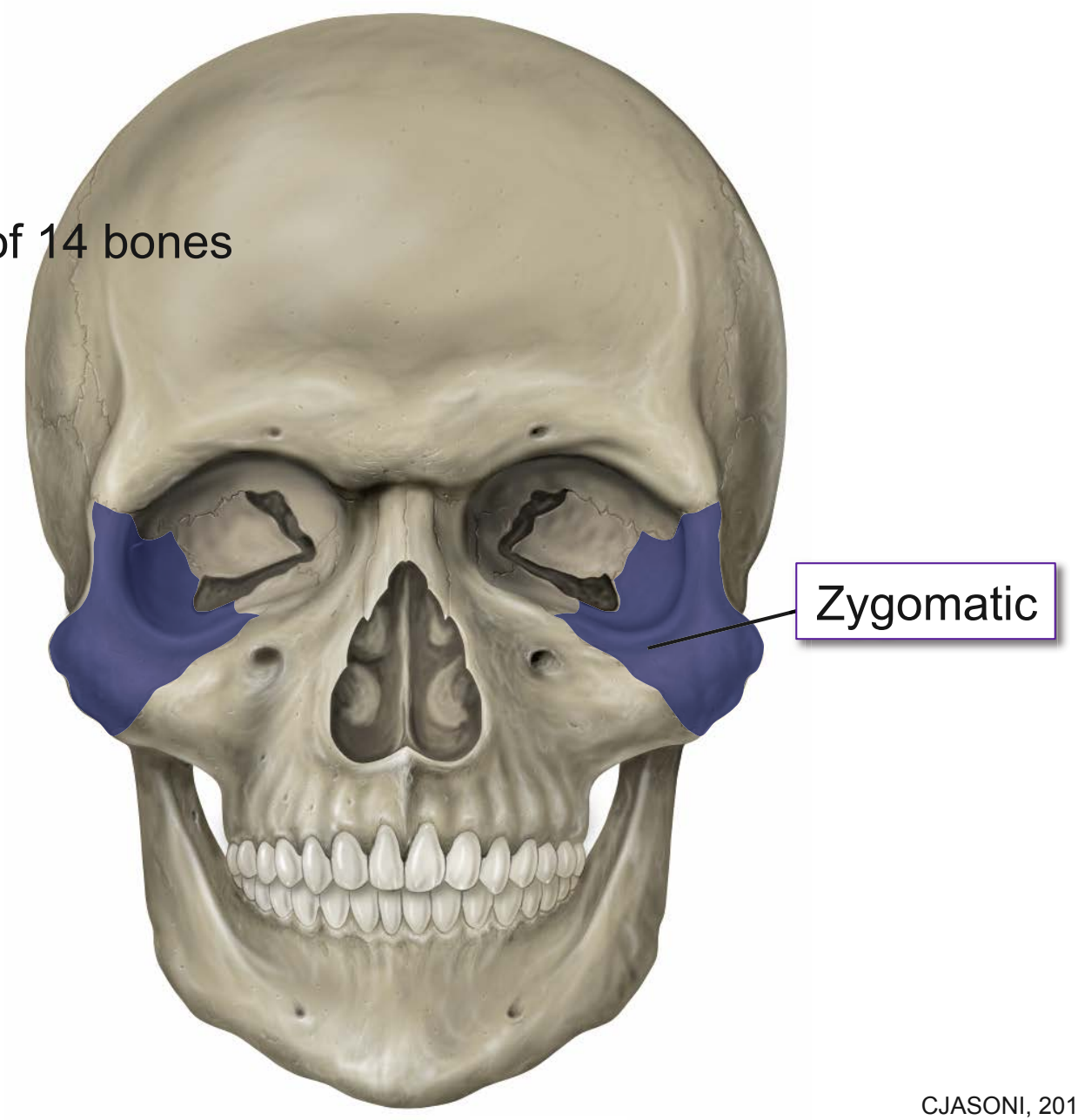
http://filetraffic.eu/s/the%20human%20head%20skull

SMART image base, with approval (for anterior brain)

Bones of the cranium: II. Facial skeleton

Facial skeleton composed of 14 bones

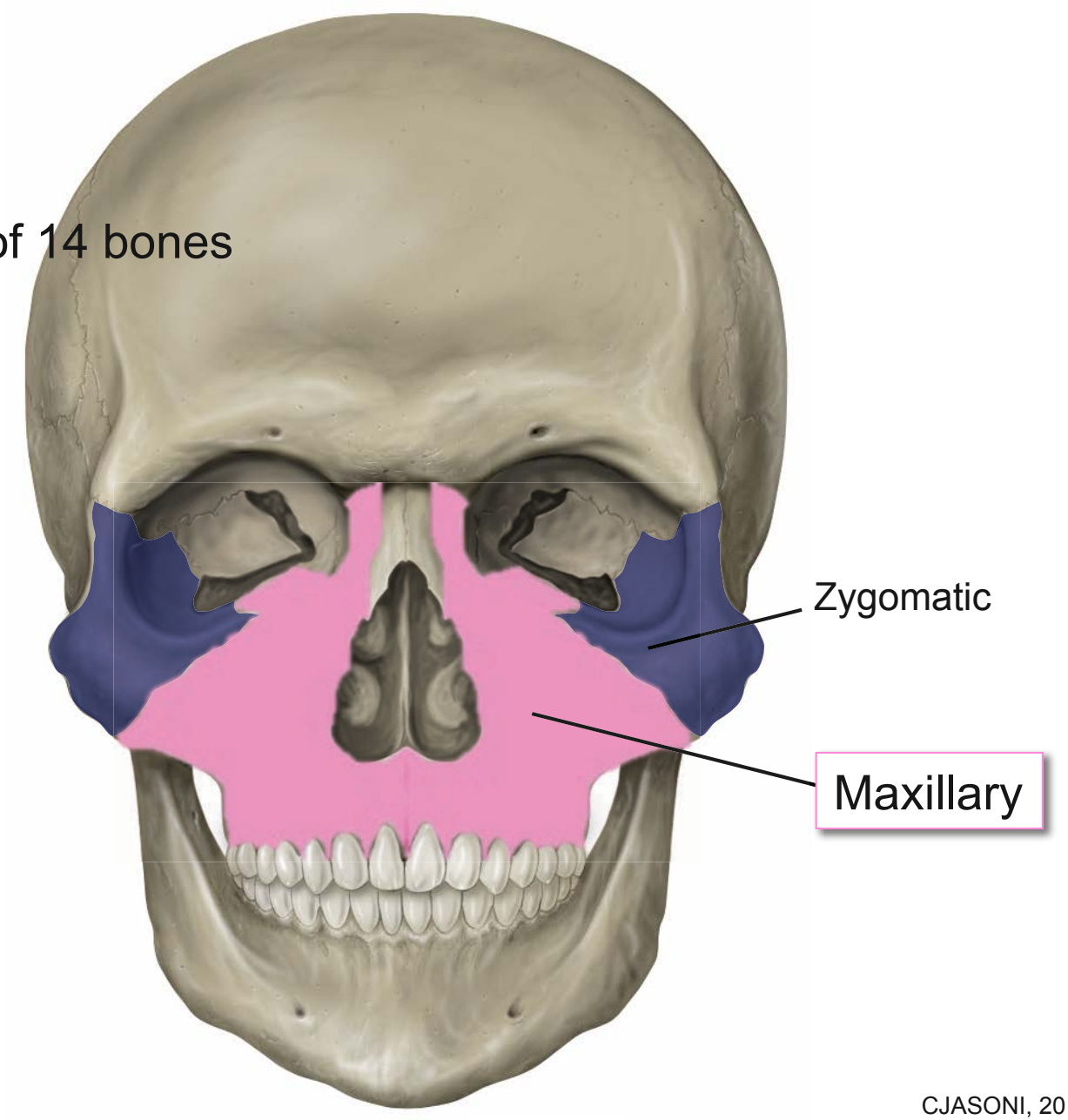
SEVEN (7) external:
- Zygomatic (2)



Bones of the cranium: II. Facial skeleton

Facial skeleton composed of 14 bones

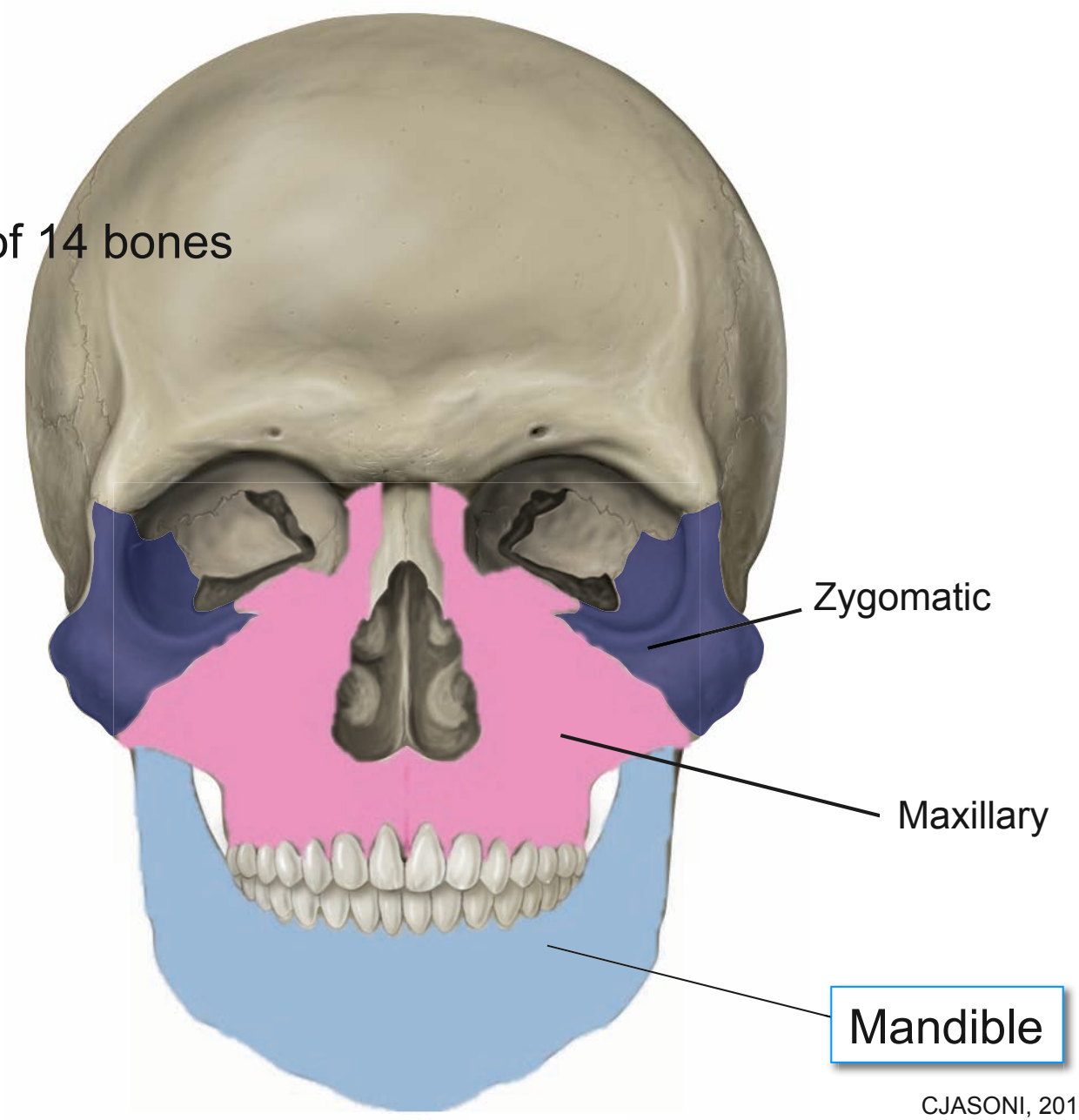
SEVEN (7) external:
- Zygomatic (2)
- Maxillary (2)



Bones of the cranium: II. Facial skeleton

Facial skeleton composed of 14 bones

SEVEN (7) external:
- Zygomatic (2)
- Maxillary (2)
- Mandible (1)

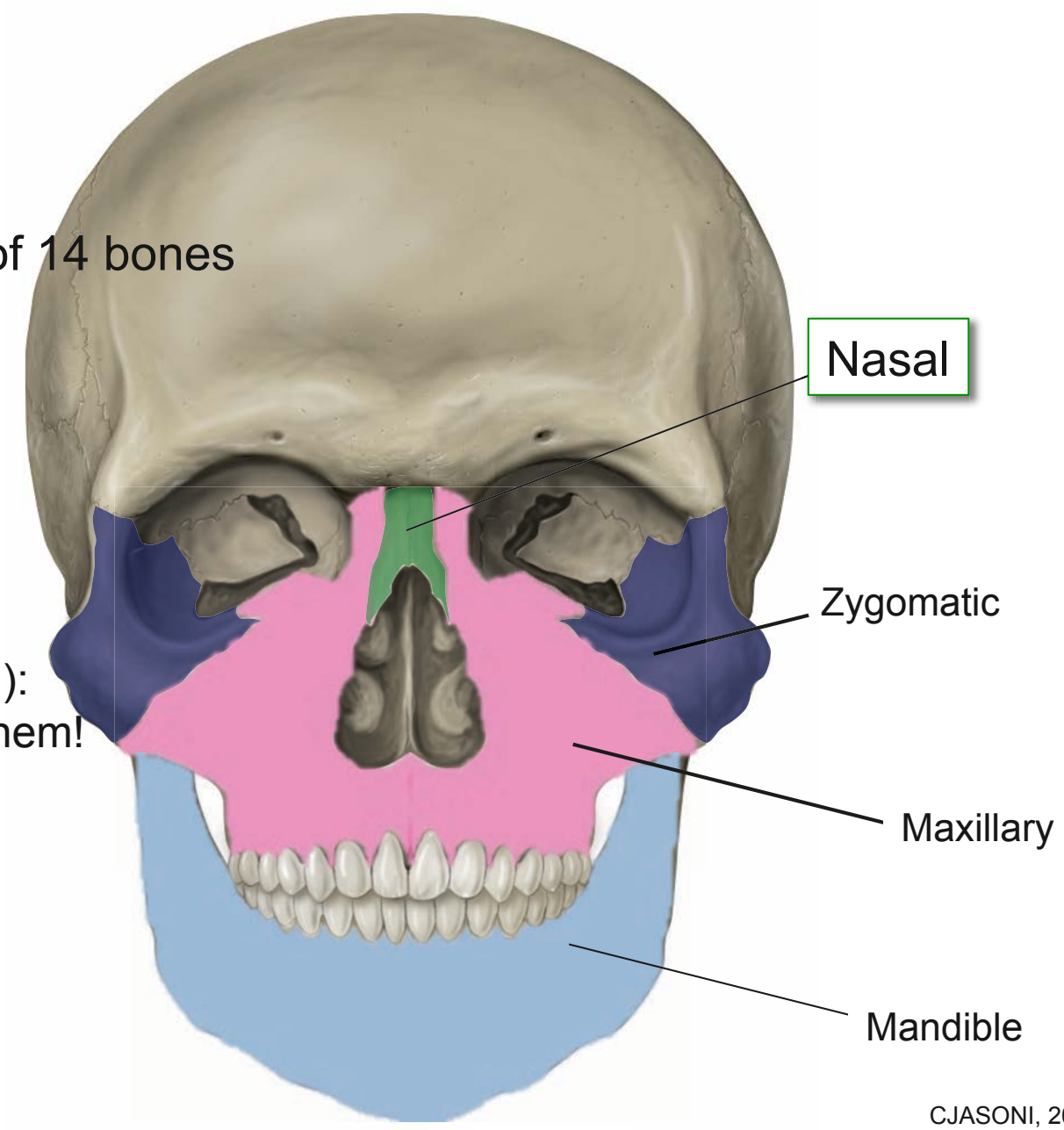


Bones of the cranium: II. Facial skeleton

Facial skeleton composed of 14 bones

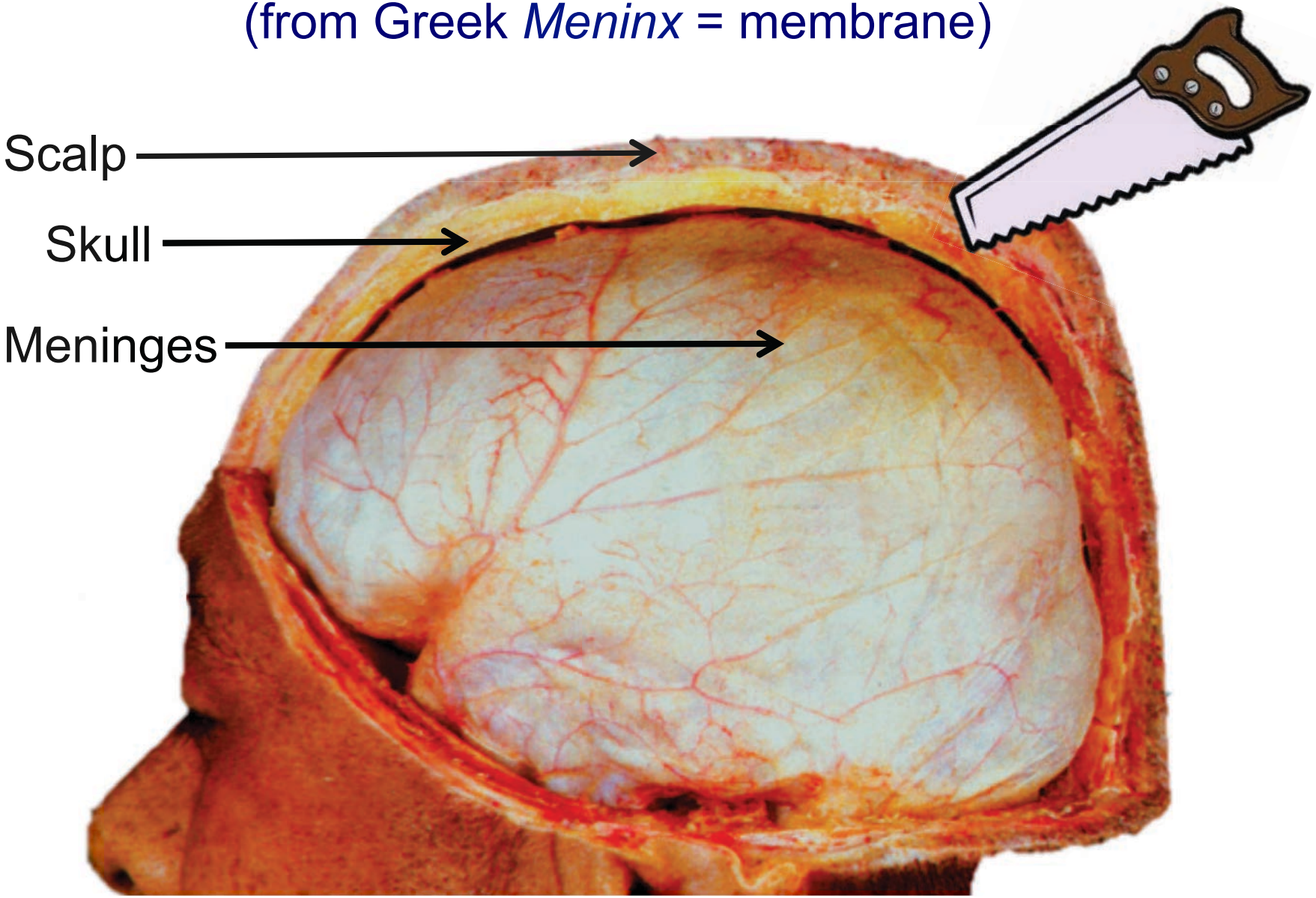
SEVEN (7) external:
- Zygomatic (2)
- Maxillary (2)
- Mandible (1)
- Nasal (2)

SEVEN (7) internal (not shown):
*And you don't need to know them!



Meninges - Protective covering for the brain

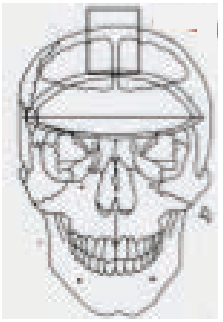
(from Greek *Meninx* = membrane)

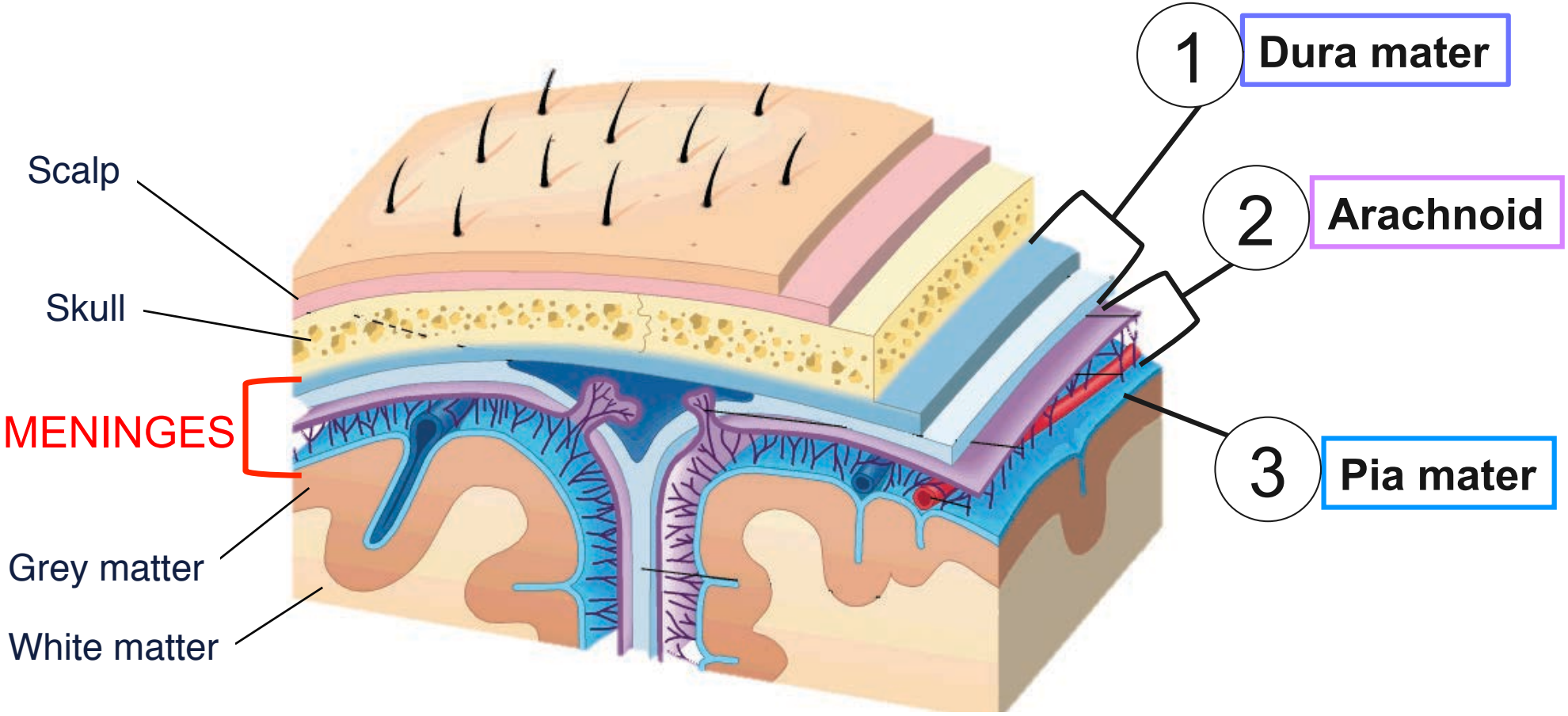


Equivalent to Patton and Thibodeau, 8th ed, Fig 14-2 (7th ed, Fig 13-2)

Meninges: Three layers of protective tissue

- Meninges means membrane
- Between the skull and the brain





From Marieb: Human Anatomy and Physiology, 8th ed, 2010. See also: Patton and Thibodeau, 8th ed, Fig 14-2 (7th ed, Fig13-2).

Dura mater = ‘Tough mother’

Dura like **Dura**ble, *Mater* like **Mater**nal

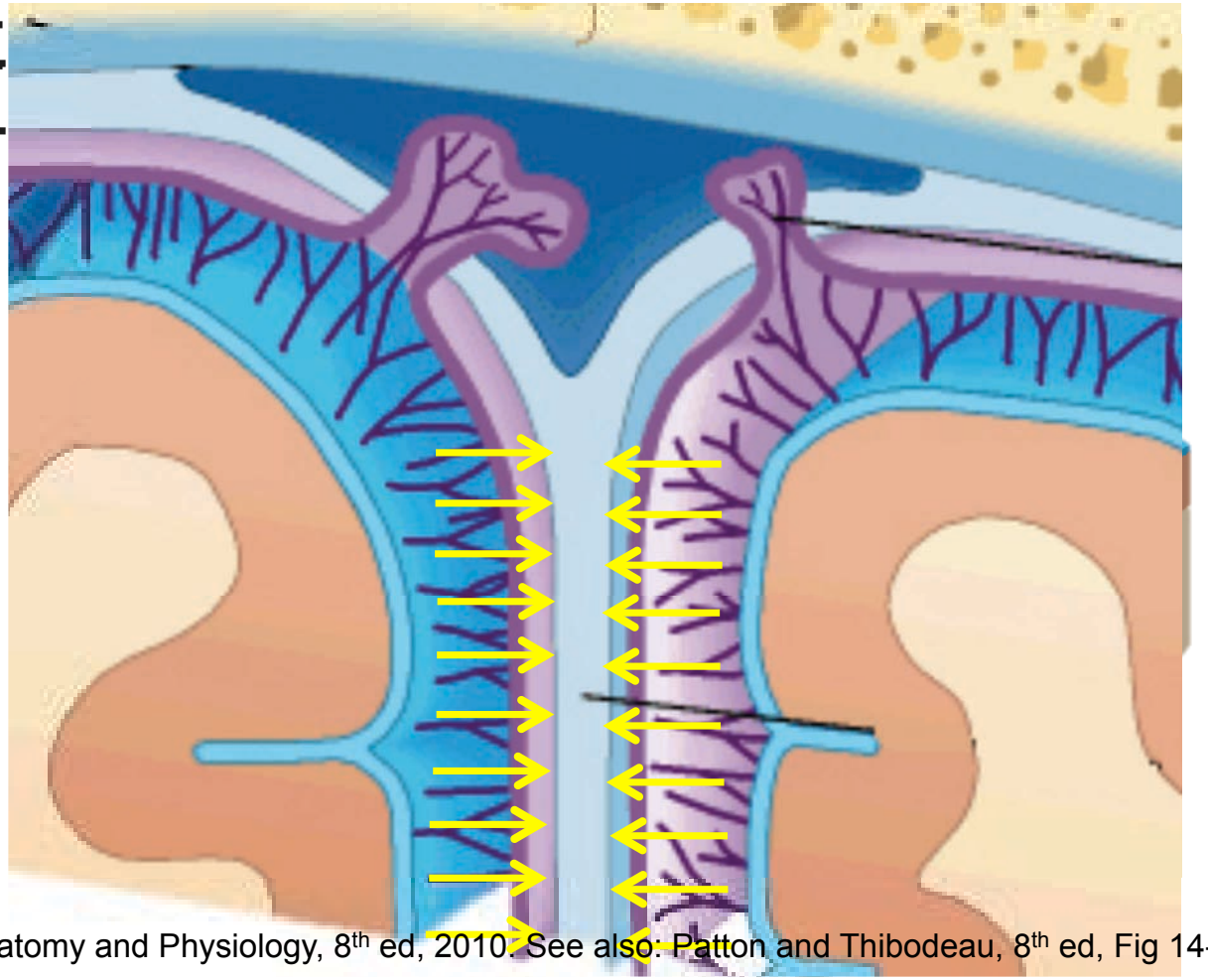
- Outer-most layer of meninges
- Dense and fibrous – tough
- Two layers
- Inner layer forms the ***dural reflections***
- Space between the layers forms ***venous sinuses***

Features of Dura mater: I. Dural reflections

- Formed from inner layer of dura mater
- Separate major divisions of brain
- Three of them

Outer layer

Inner layer



From Marieb: Human Anatomy and Physiology, 8th ed, 2010. See also: Patton and Thibodeau, 8th ed, Fig 14-2 (7th ed, Fig13-2)

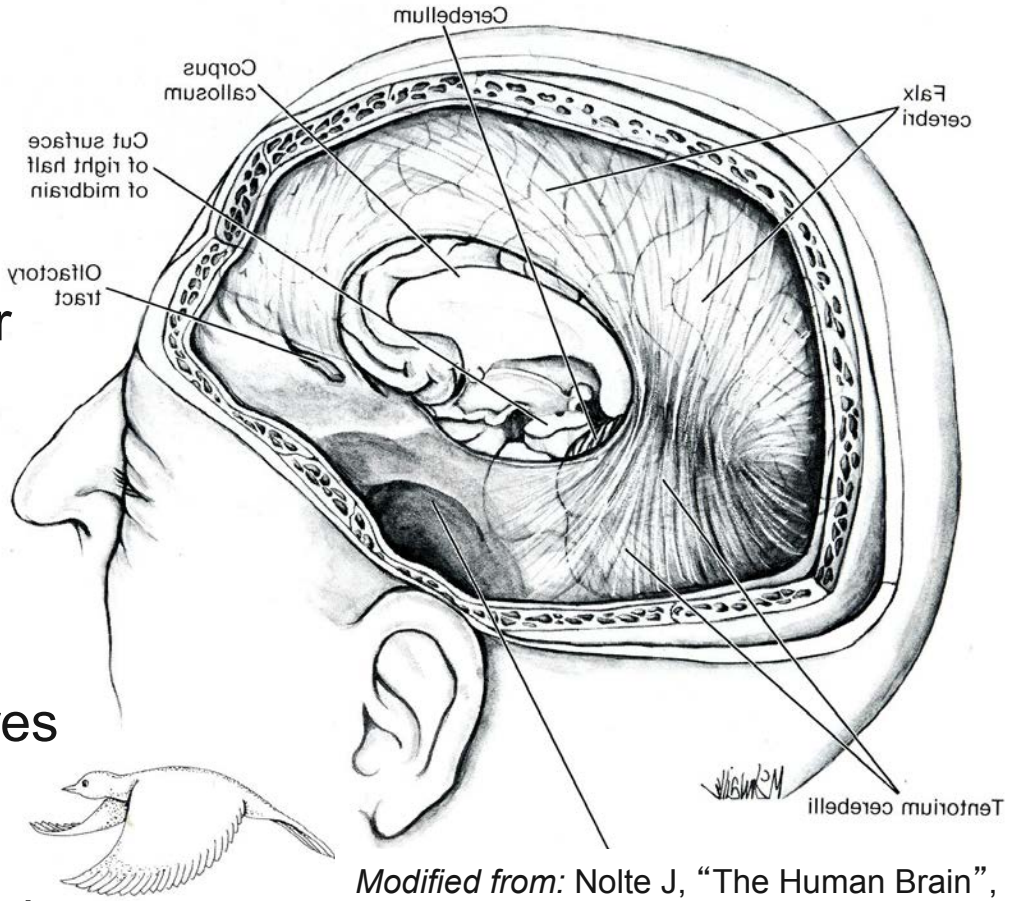
Dural reflections

- Inward extensions of the dura mater

Three of them:

1. **Falx cerebri**
   - separates cerebral hemispheres
   - median plane
2. **Falx cerebelli**
   - separates cerebellar hemispheres
   - median plane

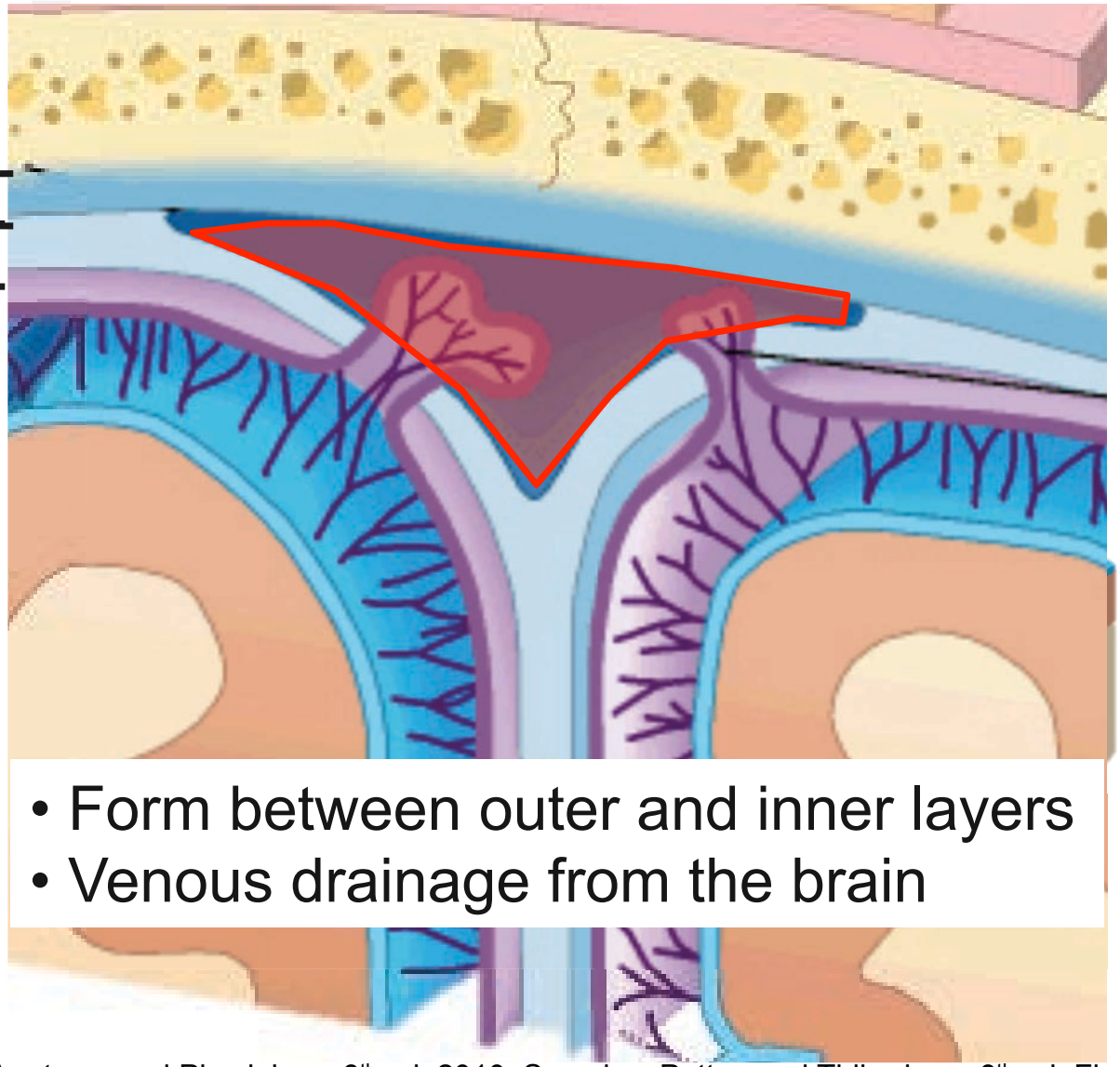
3. **Tentorium cerebelli**
   - separates the cerebrum from the cerebellum
   - horizontal plane



Modified from: Nolte J, "The Human Brain", ed. 2, 1988, fig. 3.3, CV Mosby pub.

Falx means sickle-shaped

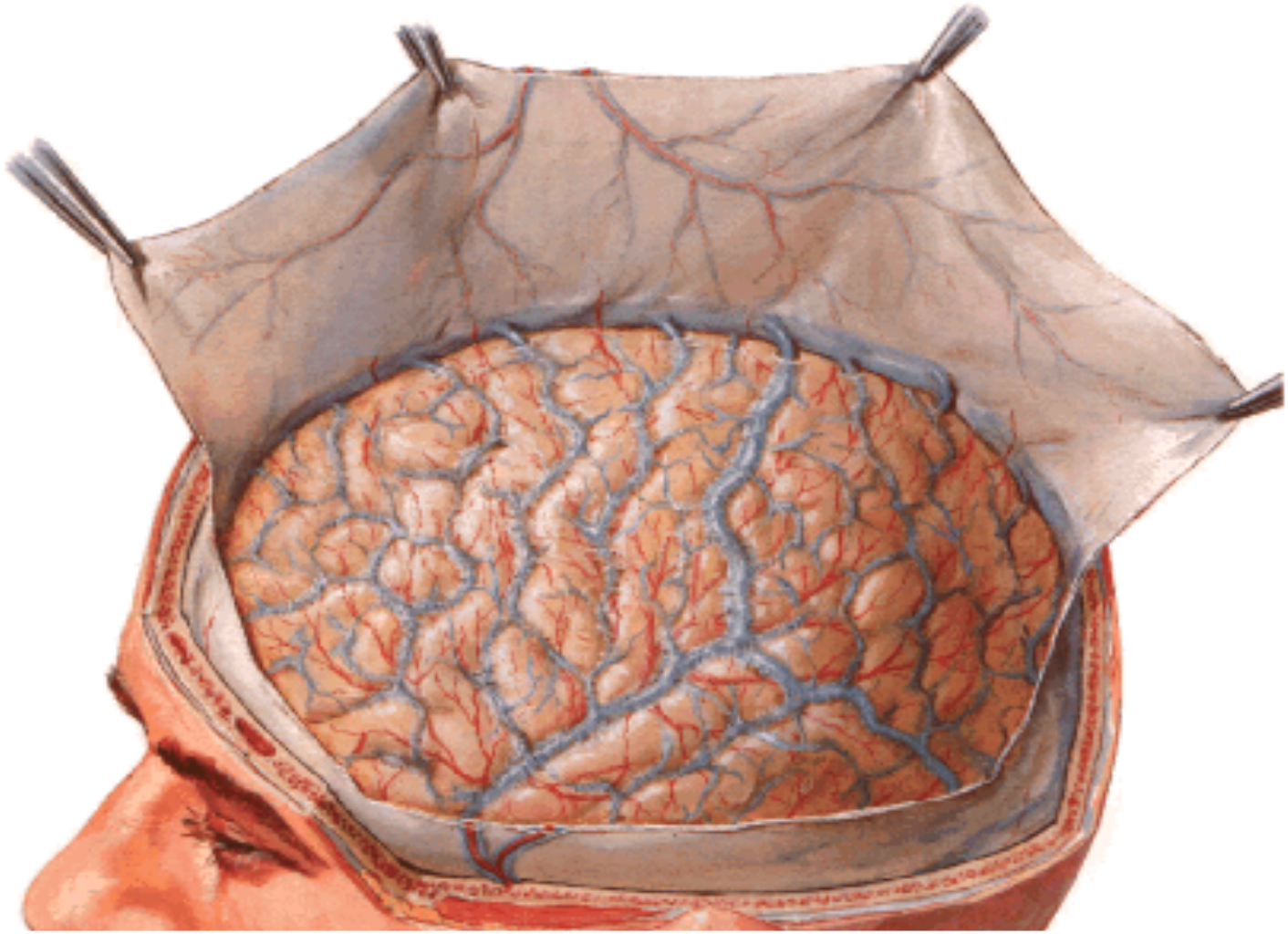
Features of Dura mater: II. Venous sinus



- Form between outer and inner layers
- Venous drainage from the brain

From Marieb: Human Anatomy and Physiology, 8th ed, 2010. See also: Patton and Thibodeau, 8th ed, Fig 14-2 (7th ed, Fig13-2)

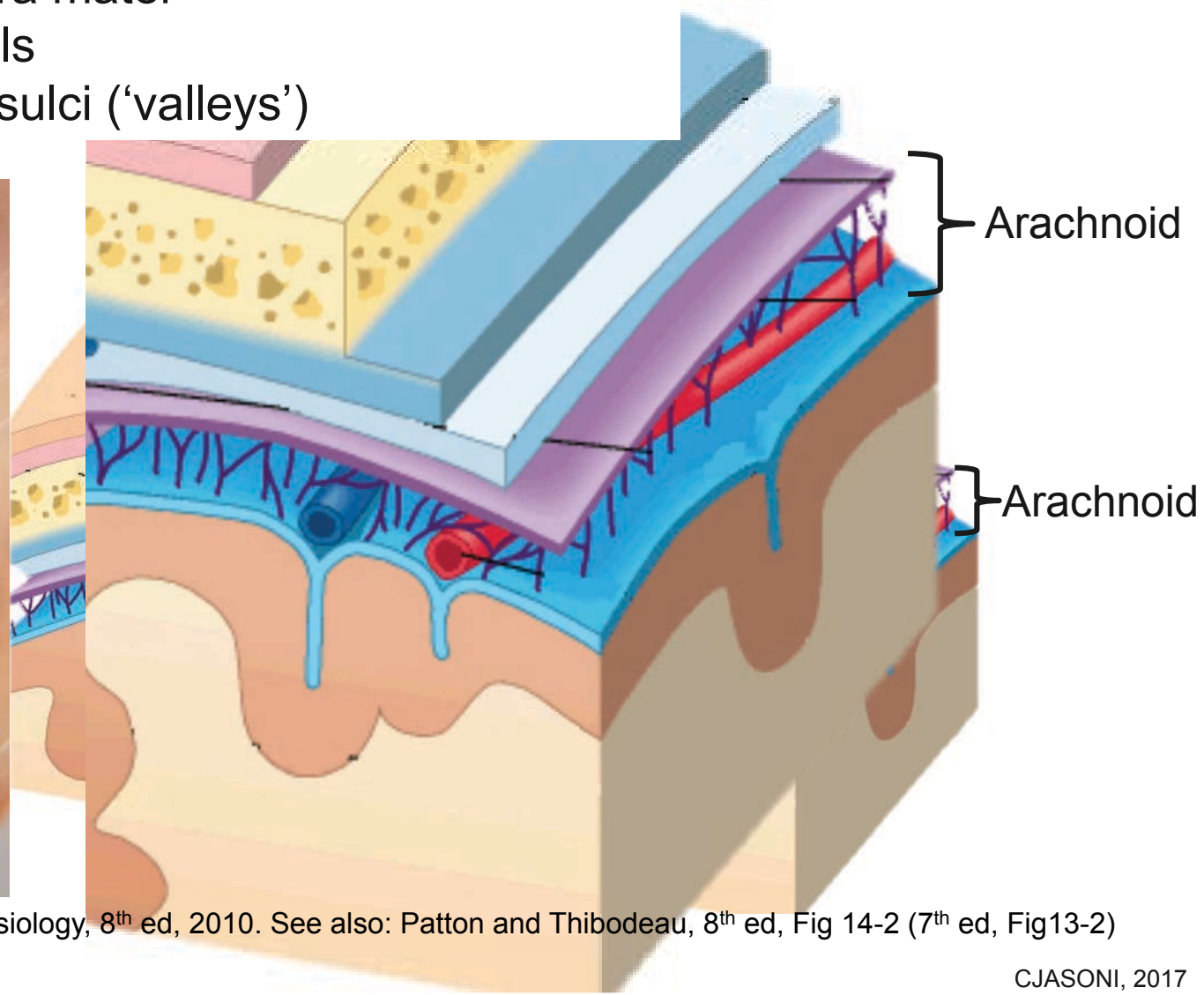
Arachnoid – A layer beneath the Dura mater



See also: Patton and Thibodeau, 8th ed, Fig 14-2 (7th ed, Fig 13-2)

Arachnoid mater = spider like

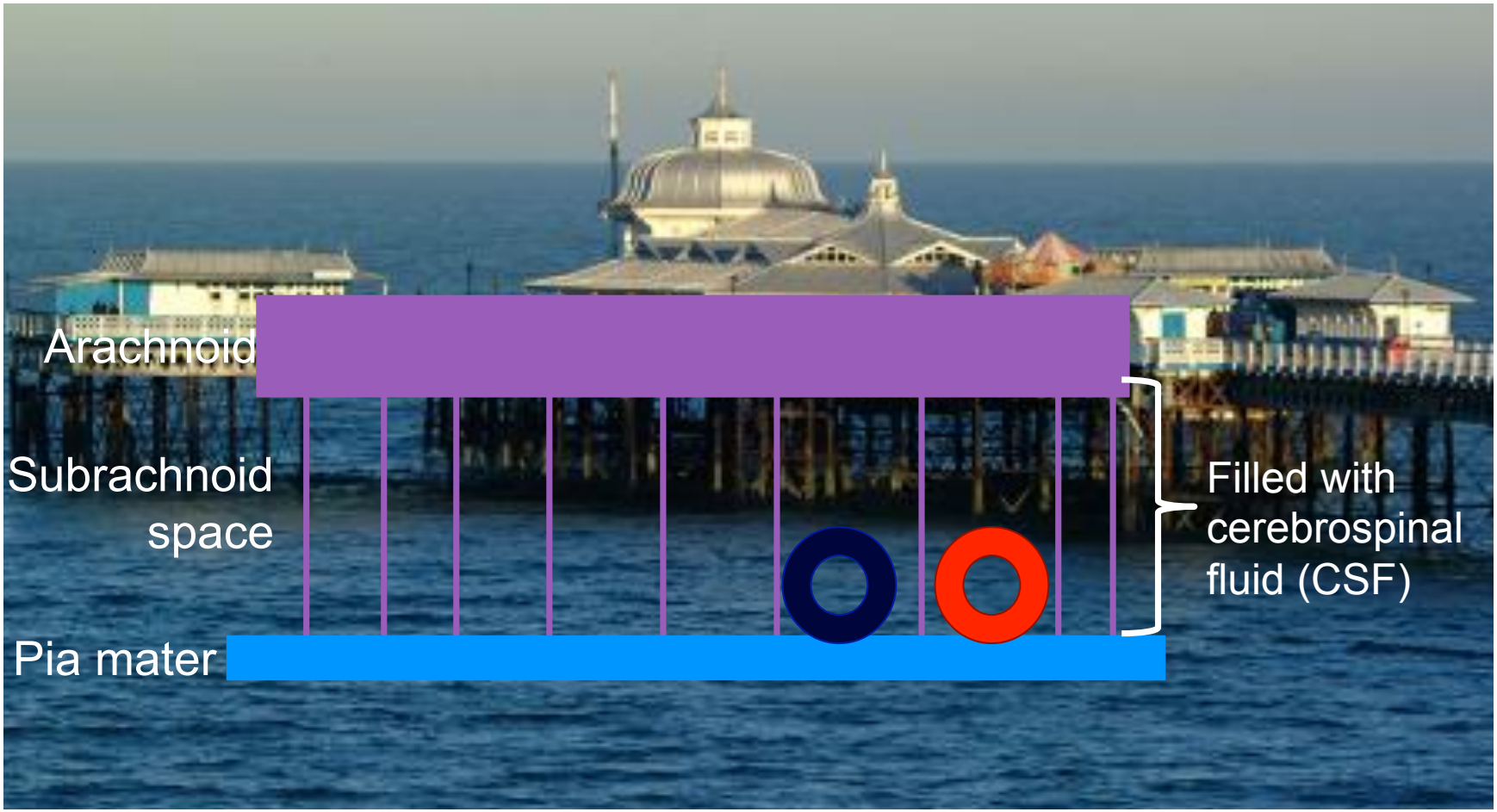
- Layer beneath the dura mater
- Contains blood vessels
- Does not extend into sulci (‘valleys’)



From Marieb: Human Anatomy and Physiology, 8th ed, 2010. See also: Patton and Thibodeau, 8th ed, Fig 14-2 (7th ed, Fig13-2)

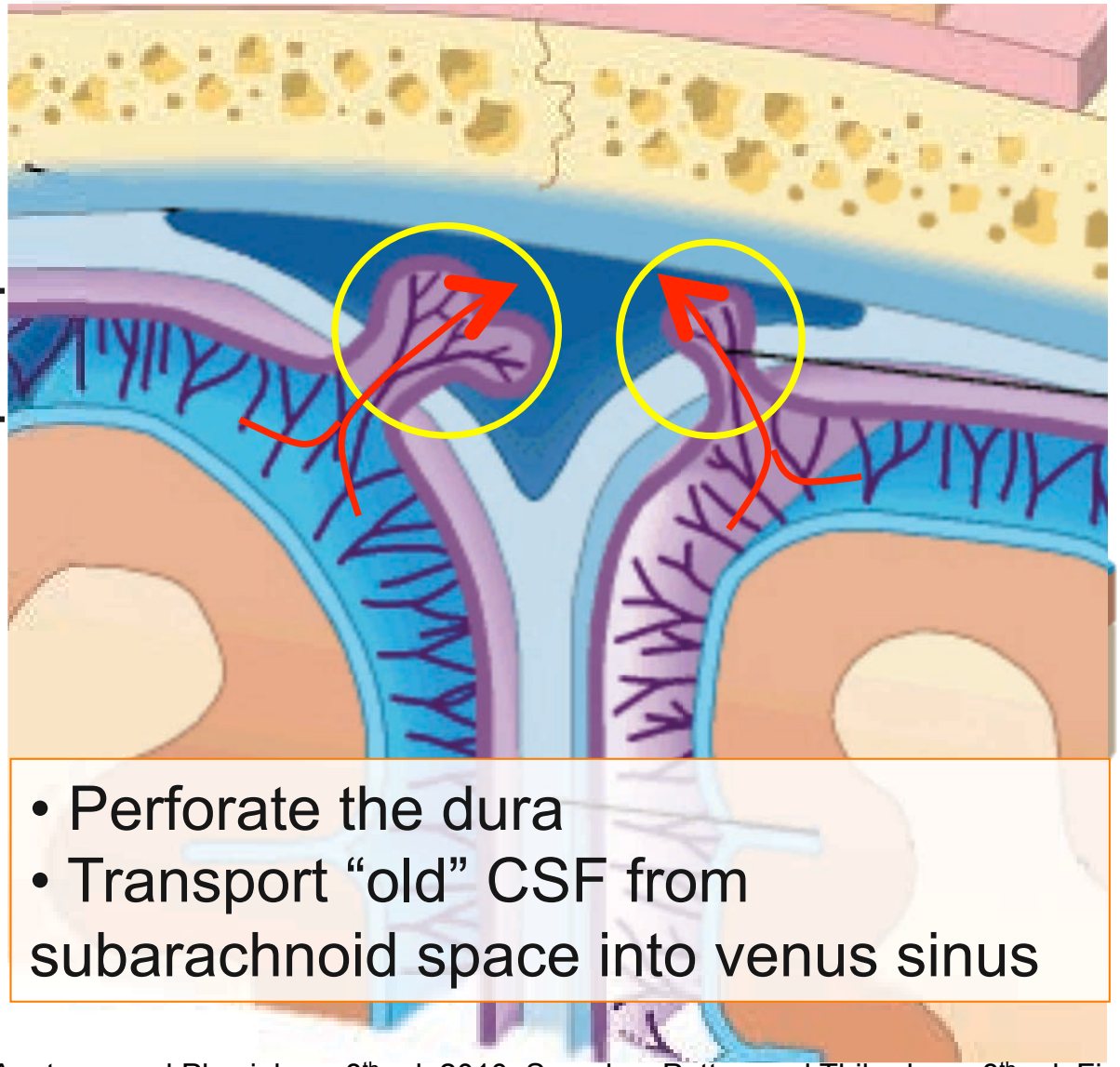
Subarachnoid space

- Between the arachnoid and the pia mater
- Filled with cerebrospinal fluid (CSF)



http://www.freefoto.com

Arachnoid granulations (or villi)

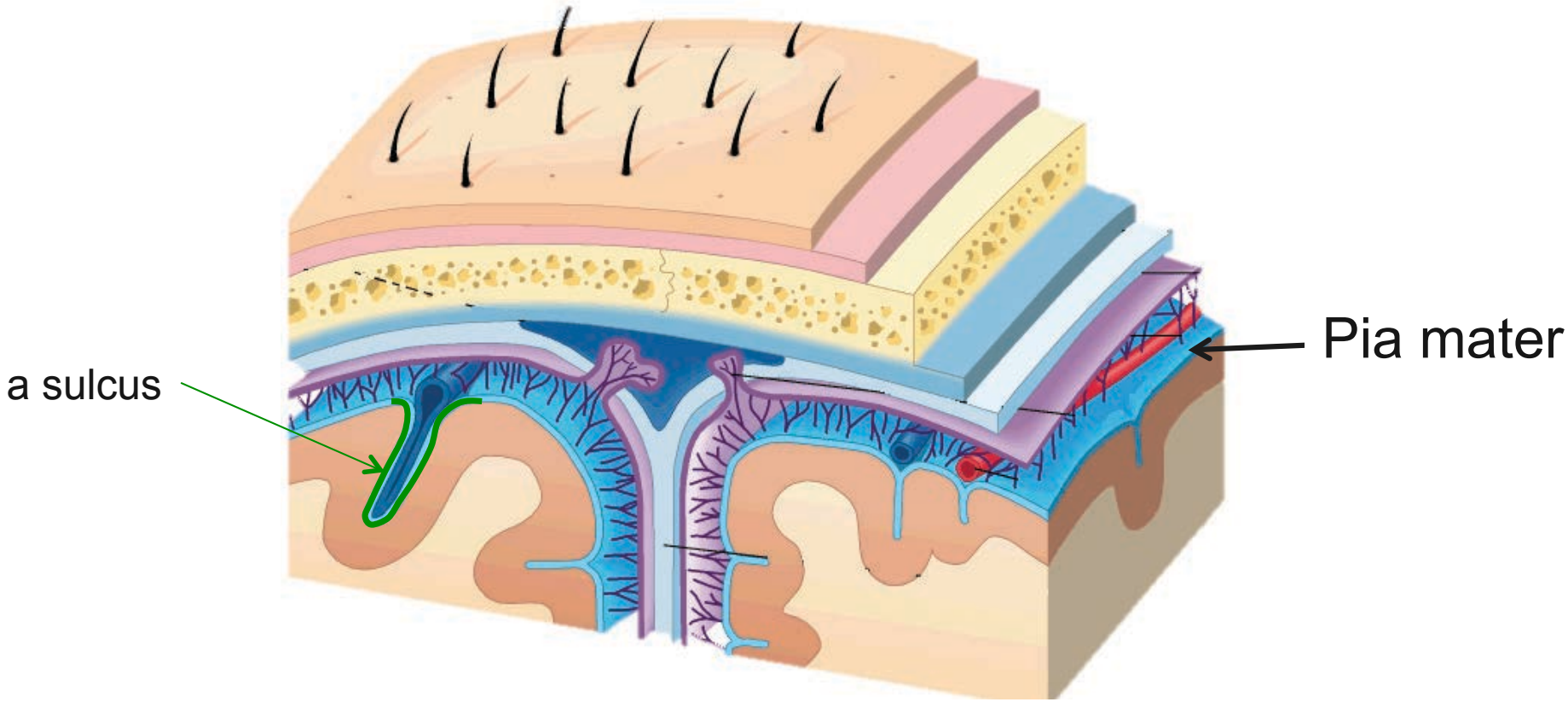


- Perforate the dura
- Transport “old” CSF from subarachnoid space into venus sinus

From Marieb: Human Anatomy and Physiology, 8th ed, 2010. See also: Patton and Thibodeau, 8th ed, Fig 14-2 (7th ed, Fig13-2)

Pia mater = delicate mother

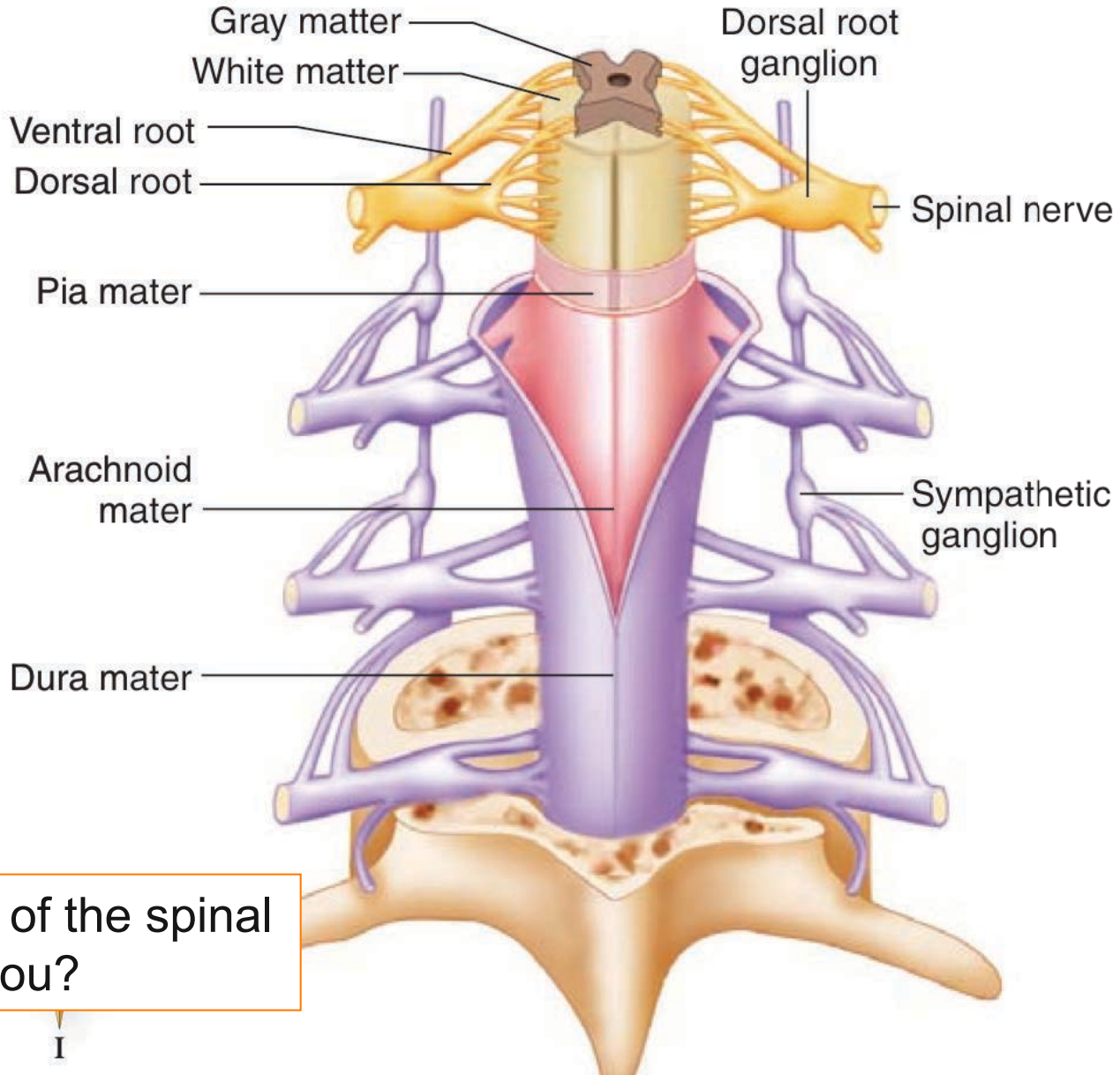
- Transparent and delicate
- Blood vessels in arachnoid sit on top of pia mater
- Adheres to brain and follows gyri and sulci



Adapted from: Marieb: Human Anatomy and Physiology

See also: Patton and Thibodeau, 8th ed, Fig 14-2 (7th ed, Fig13-2)

The meninges of the spinal cord

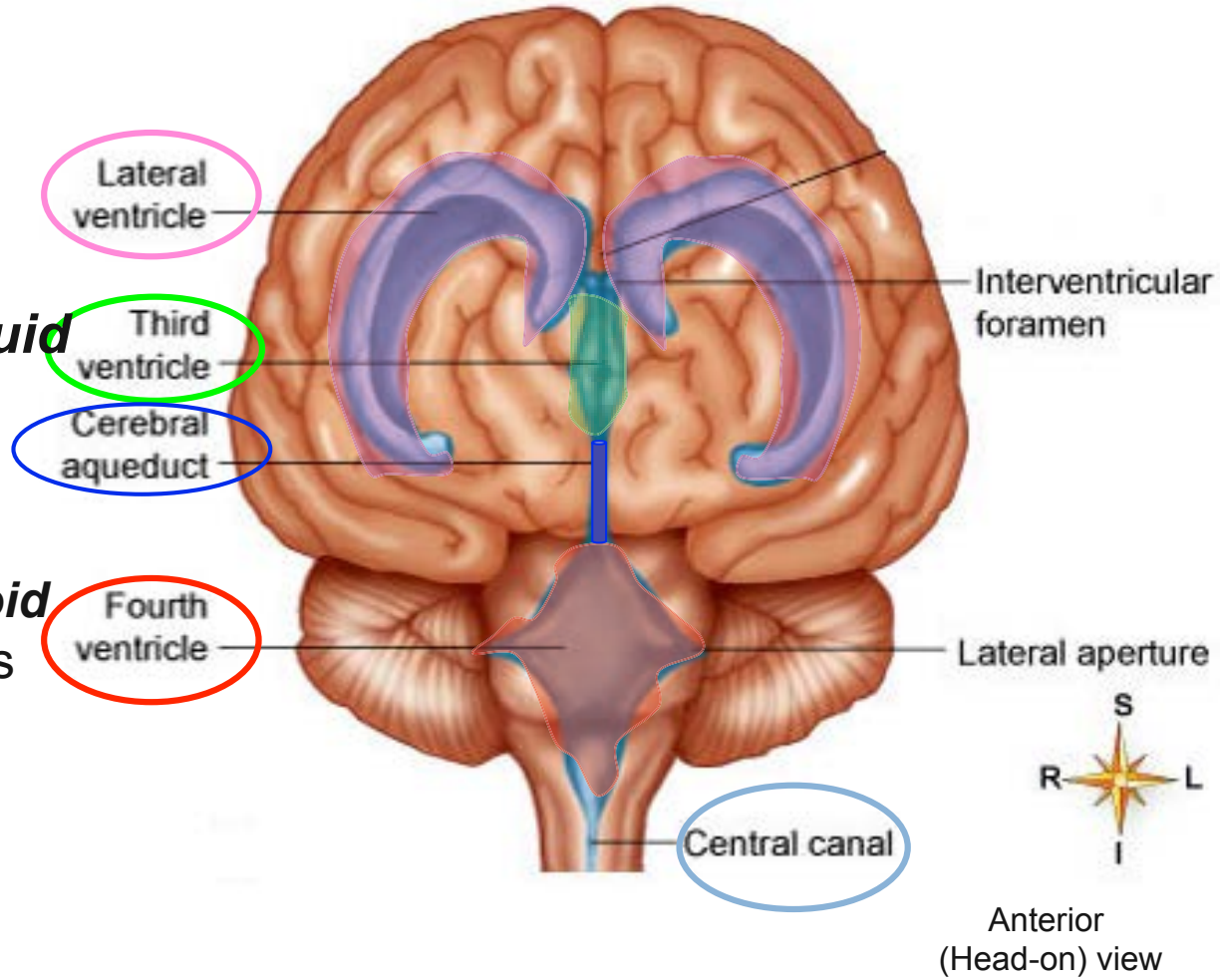


*Q: Which side of the spinal cord is facing you?

Patton and Thibodeau, 8th ed, Fig 14-3 (7th ed, Fig 13-3)

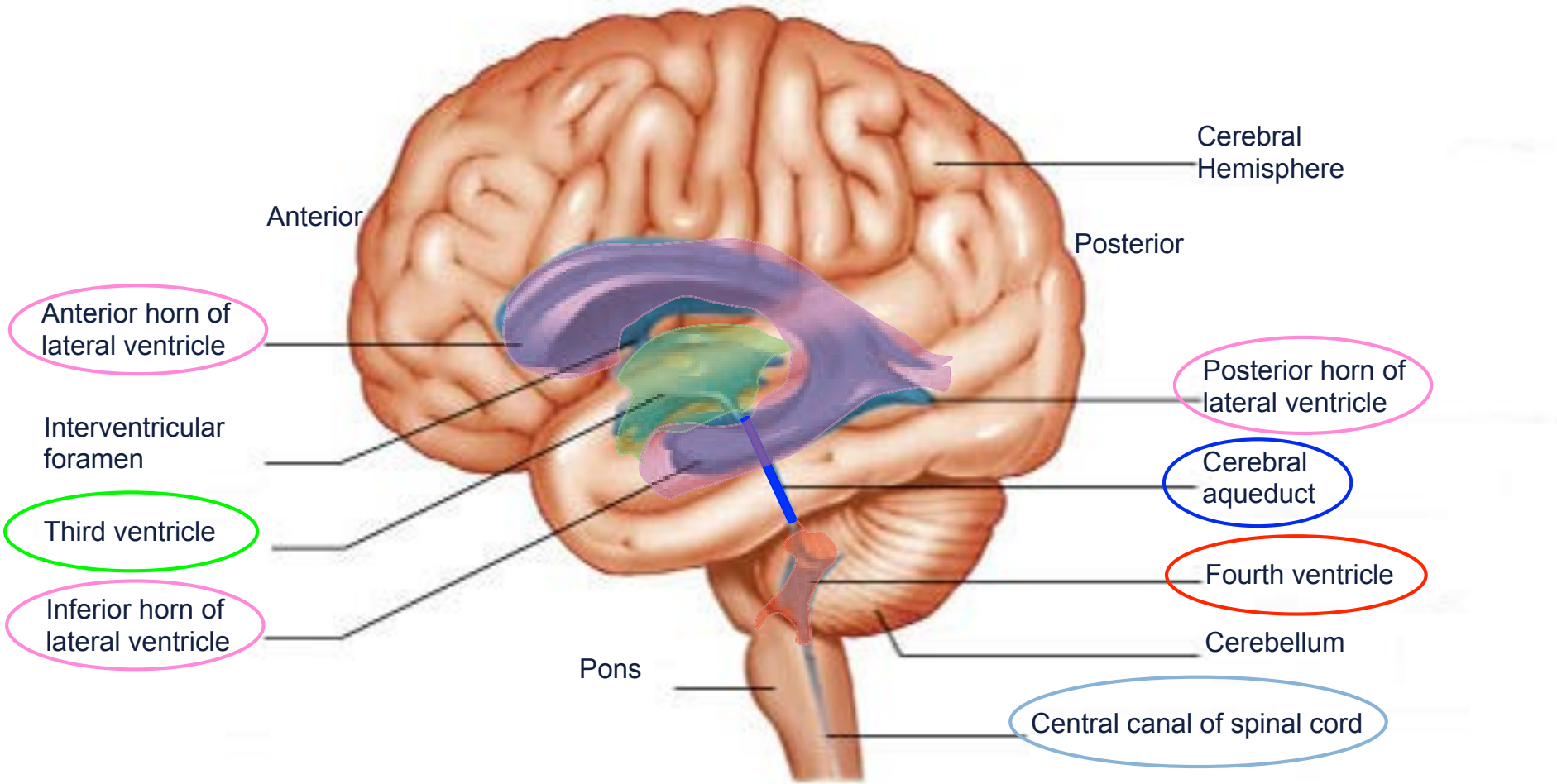
The ventricular system

- Network of interconnected "spaces" within the brain
- Filled with ***cerebrospinal fluid*** (CSF), which nourishes and protects the brain
- CSF is produced by the ***choroid plexus***, which lines the ventricles

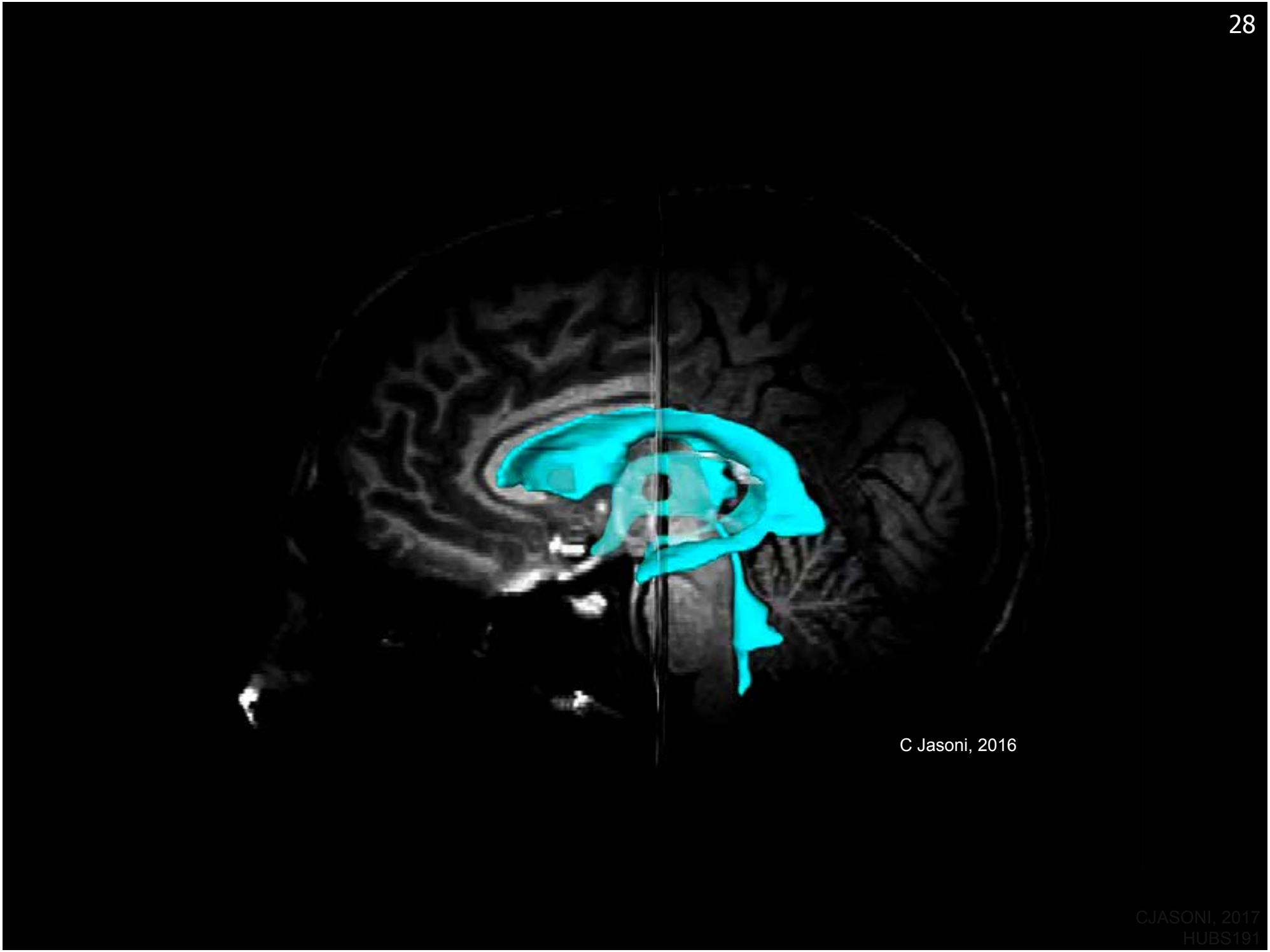


Patton and Thibodeau, 8th ed, Fig 14-4 (7th ed, Fig. 13-4)

The ventricular system

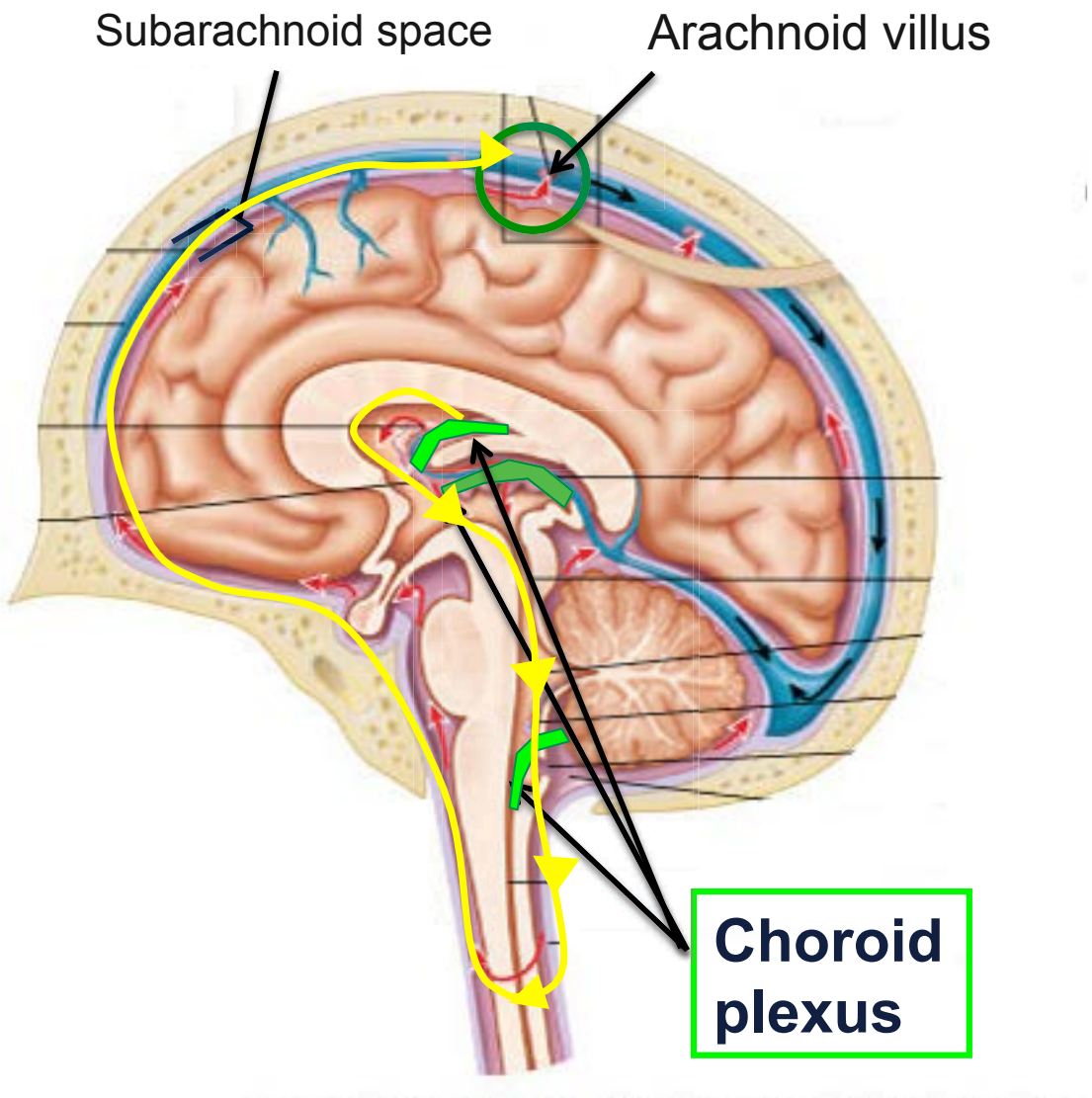


Patton and Thibodeau, 8th ed, Fig 14-4 (7th ed, Fig 13-4)


C Jasoni, 2016

Circulation of the CerebroSpinal Fluid (CSF)

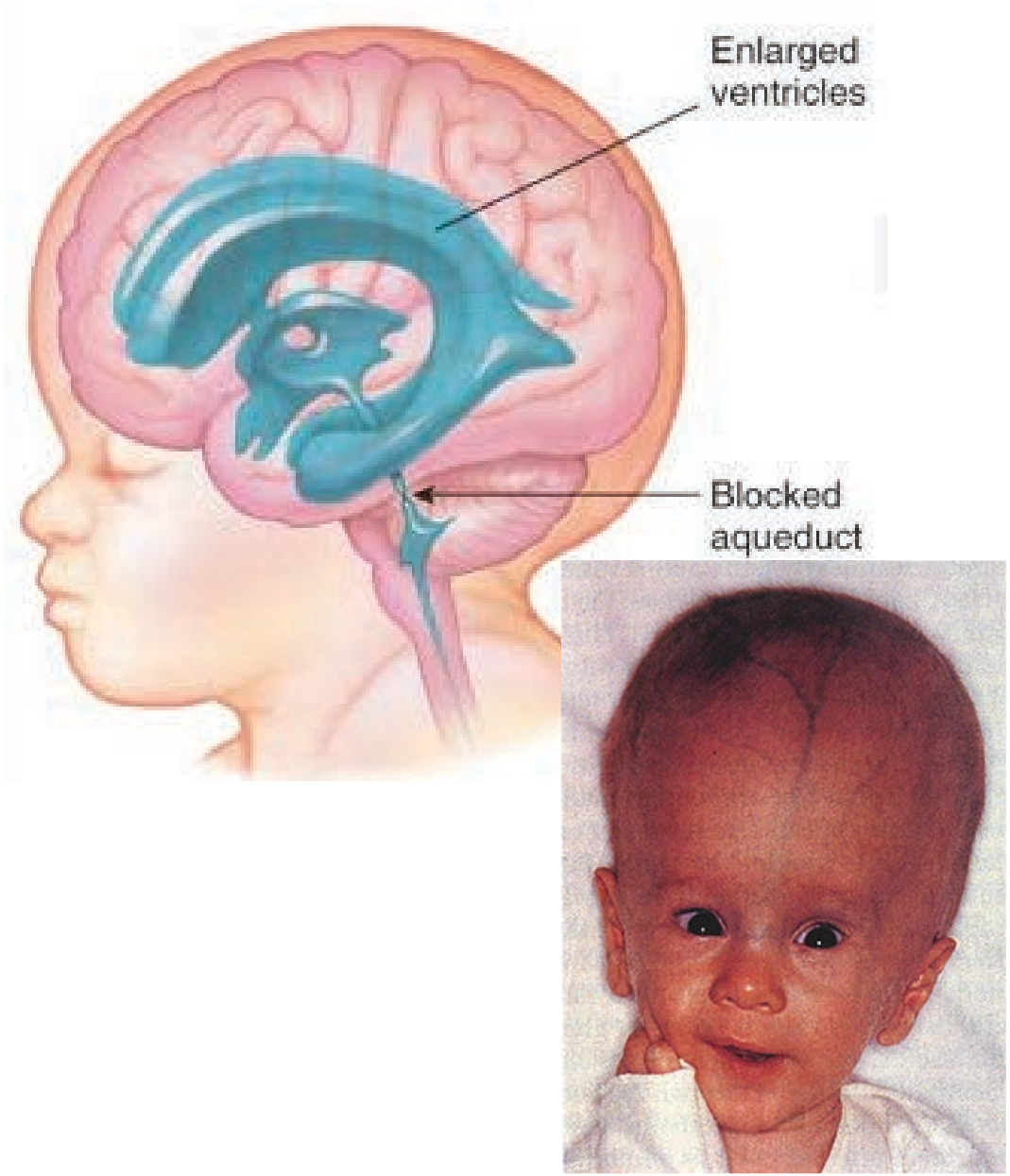
- Bathes and cushions the brain
- Is generated in the ventricles by ***choroid plexus***
- Circulates through ventricles and subarachnoid space of the brain and spinal cord
  Route: Lateral ventricle → 3rd ventricle → cerebral aqueduct → 4th ventricle → subarachnoid space
- Enters venous blood circulation within the venous sinuses via *arachnoid villi/granulations*
- Is sampled to determine if meningitis is present



Patton and Thibodeau, 8th ed, Fig 14-5 (7th ed, Fig 13-5)

When it goes wrong: *Hydrocephalus*

- Caused by abnormal accumulation of CSF in the ventricles of the brain
- Leads to increased intracranial pressure inside the skull,
- Progressive enlargement of the head,
- Other symptoms include
  - convulsion,
  - tunnel vision,
  - mental disability.



From: Marieb: Human Anatomy and Physiology

Lecture 19: Post-lecture quiz

- Which of these is not a layer of meninges

(a) dura mater; (b) epineurium; (c) pia mater; (d) arachnoid

- Which of the following bones is part of the facial skeleton

(a) parietal bone; (b) occipital bone; (c) mandible; (d) spinous process

- Which layer of the meninges contains circulating cerebrospinal fluid?

(a) arachnoid; (b) dura mater; (c) perineurium; (d) choroid plexus

- Which structure is important for removal of old/used CSF

(a) choroid plexus; (b) arachnoid granulations; (c) dural reflections; (d) pia mater

HUBS191