

5. THE TRIGEMINAL SYSTEM

Somatic Sensation of the Face and Head

Objectives

1. Outline the two pathways for facial sensation from the head.
2. Contrast facial sensation from the head and somatic sensation from the body. In what ways are they similar? Different? Try drawing this on the Haines atlas diagram at the end of the lecture.
3. Diagram the corneal reflex: the afferent and efferent limbs as well as nuclei involved in the brainstem.
4. If a person does not blink, how would you determine if the problem were in the sensory (afferent) limb, motor (efferent) limb, or brainstem interconnections for the corneal reflex?
5. Explain how a single, small medullary vascular lesion could abolish pain and temperature from the face on the right side and pain and temperature from the body on the left side. What vessel is most likely occluded?

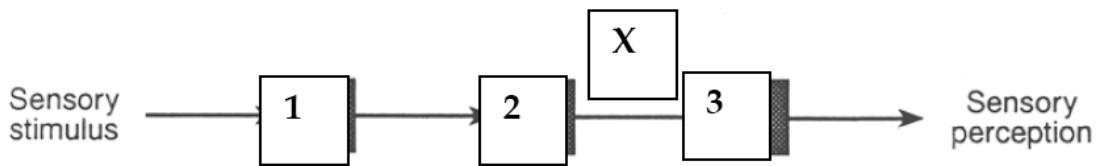
Introduction – The trigeminal system for the face and oral cavity is organized in a manner similar to the spinal cord. It has the equivalent of both the DCML pathway and the ALS pathway. The two trigeminal pathways will converge in the thalamus. The most confusing thing is that one of them descends before crossing and the other crosses immediately.

Peripheral Receptors and Sensation Structures served by trigeminal system.

1. Cornea
2. Mucocutaneous tissues around mouth and nostrils.
3. Oral and nasal mucosae
4. Paranasal sinuses
5. Tongue (anterior two thirds)
6. Teeth and gums
7. Dura of anterior and middle cranial fossae
8. Skin of face to the vertex except angle of jaw
9. Parts of external ear



How many neurons in sensory pathway?



B. THREE NEURON SENSORY RELAY CIRCUIT

ALS/DCML

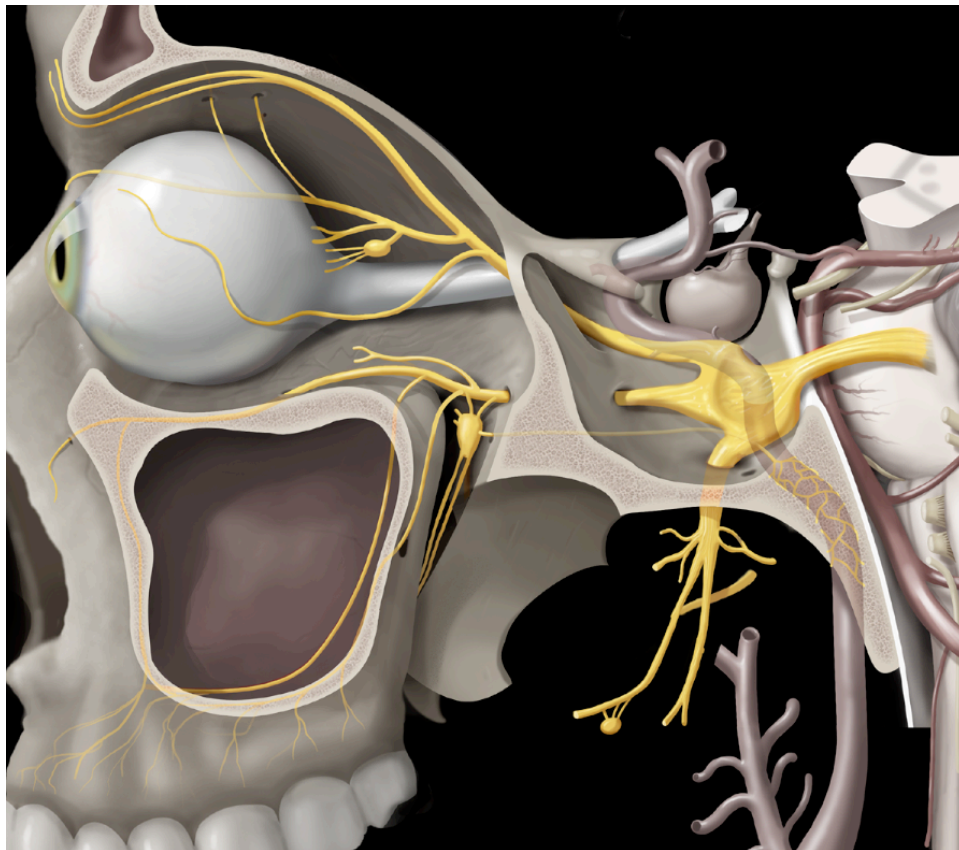
1. Peripheral ganglion (DRG)
2. Spinal cord, medulla
3. VPL nucleus (thalamus)

Trigeminal system

1. Peripheral ganglion (Trigeminal ganglion)
2. Brainstem (pons, medulla, spinal cord)
3. VPM nucleus (thalamus)

Primary Sensory Neurons: Trigeminal ganglion

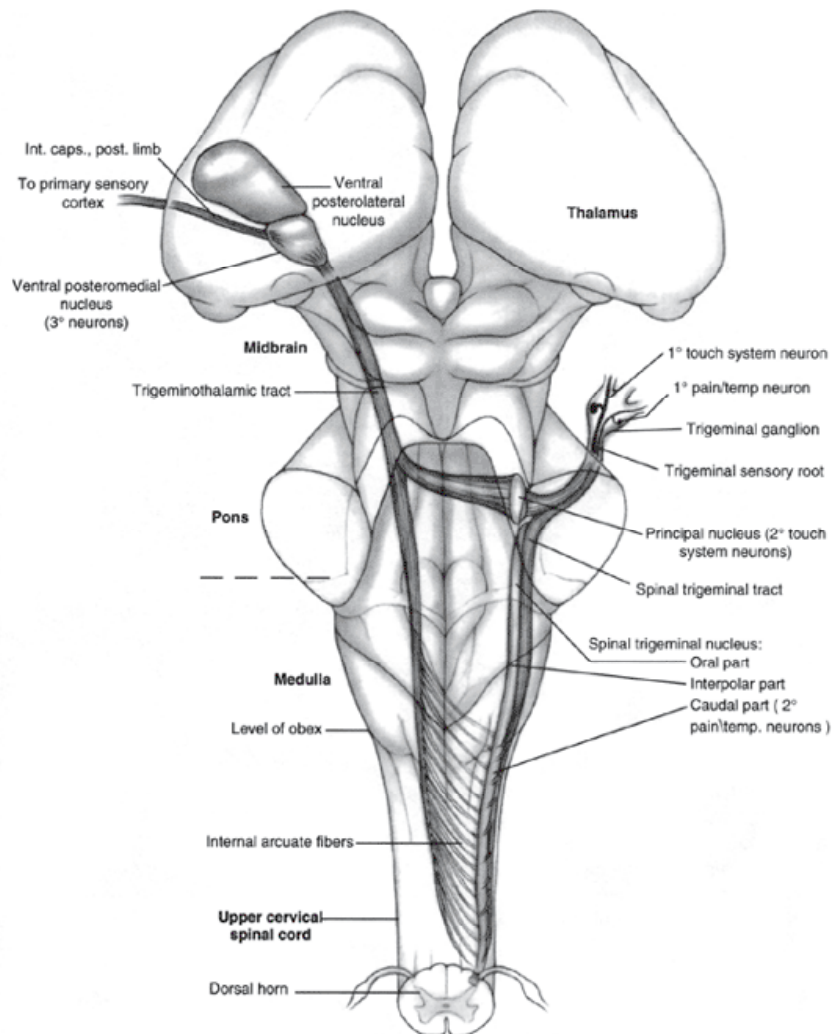
- A. Trigeminal (semilunar) ganglion.
 1. Unipolar neurons similar to dorsal root ganglion cells
 2. Three nerve roots give rise to:
 - a. Ophthalmic nerve, (CN V-1)
 - b. Maxillary nerve, (CN V-2)
 - c. Mandibular nerve, (CN V-3)
 3. Peripheral distribution of three branches. Back of head and the angle of the jaw are not supplied by the trigeminal (Areas around ear supplied by CNs VII, IX, and X also use this pathway but we will not discuss or test on this.)



Second-Order Trigeminal Neurons. Originate in two brain stem nuclei.

- A. **Principal (chief) trigeminal nucleus.** Mediates fine touch stimuli (two point discrimination), joint position, and vibration. Located in the middle of pons just lateral to the motor nucleus of CN V.

This would be equivalent to what nucleus in the brain stem? _____

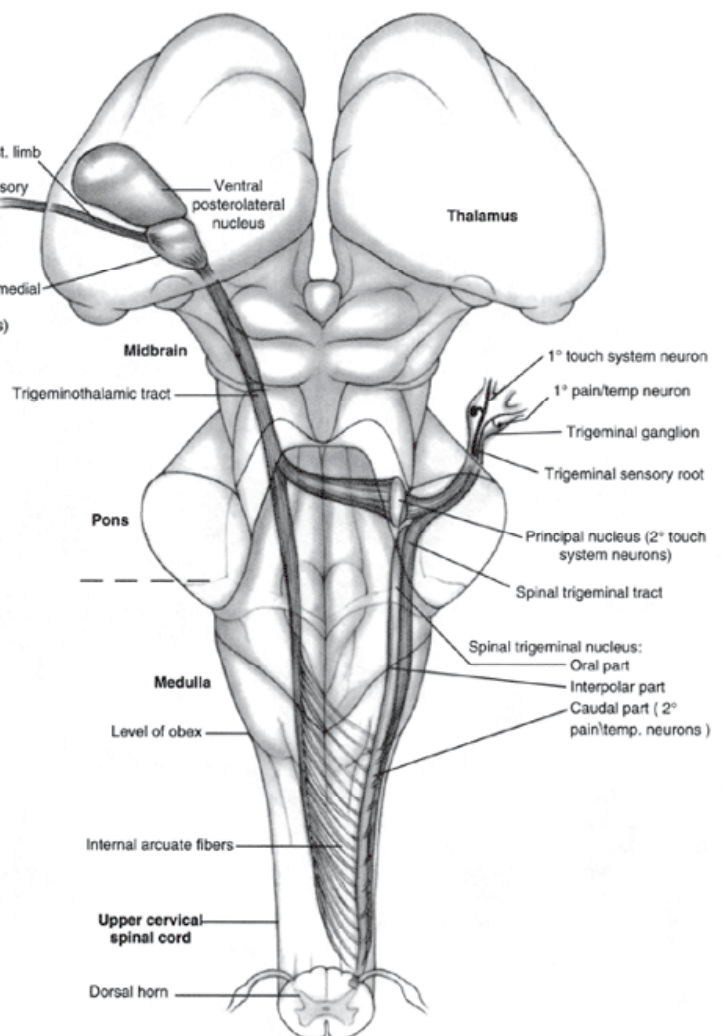
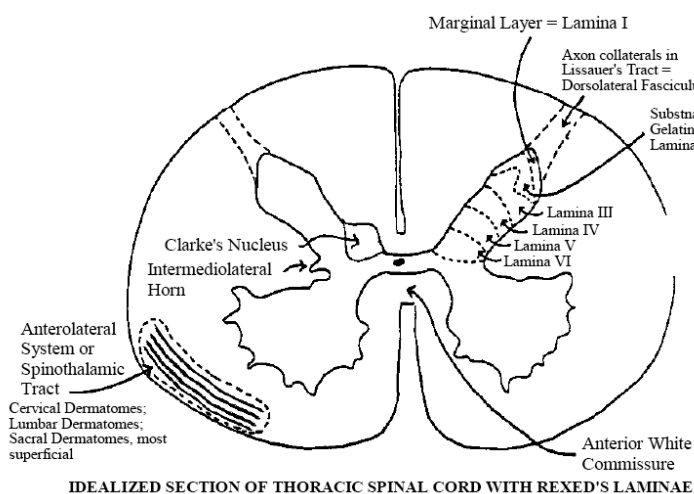


Young, Young and Tolbert, 2008 Fig 11-10 ©

B. **Spinal (descending) trigeminal nucleus.** Mediates pain and temperature.

This nucleus would be the equivalent to what region in the spinal cord? _____

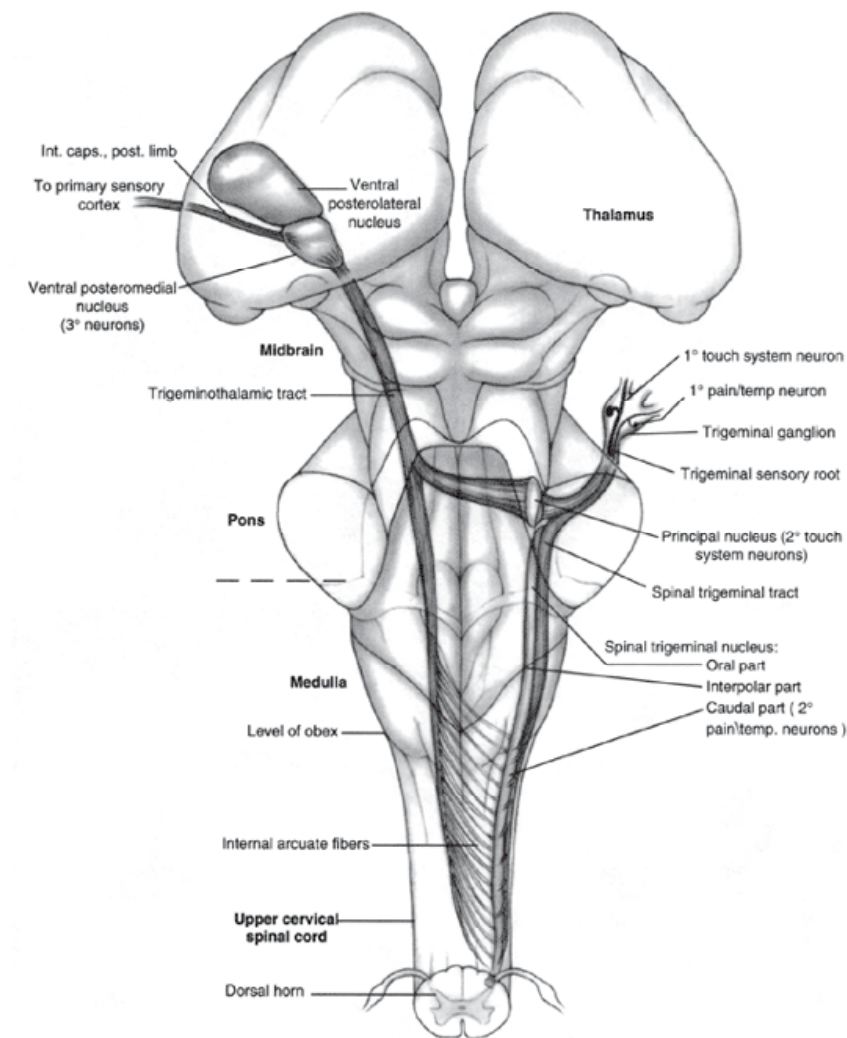
1. **Spinal (descending) trigeminal tract contains primary** afferents that will synapse in spinal nucleus of V. The tract is continuous with the dorsolateral fasciculus (Lissauer's tract) in the spinal cord, again emphasizing the similarities with the ALS system.
2. The Spinal (descending) nucleus extends caudally as far as C2-C3 and is continuous with the dorsal horn. This means it is several cm long.



- C. **Ascending Trigeminal Pathways.** Axons of second order neurons form the trigeminothalamic pathway to the VPM (ventroposteromedial) nucleus of the thalamus.

The trigeminothalamic pathway is located near the medial lemniscus. Axons from the spinal trigeminal nucleus are also referred to as the (ventral) trigeminothalamic tract and fibers coming from the principal trigeminal nucleus join it in mid pons. There is a dorsal trigeminothalamic tract we will ignore. We will use the term trigeminothalamic. These are not tracts you can identify, but vascular lesions can involve them.

- a. Axons from neurons in the chief sensory nucleus carry sensations such as:
- b. Axons from neurons in the spinal trigeminal nucleus carry sensations such as:



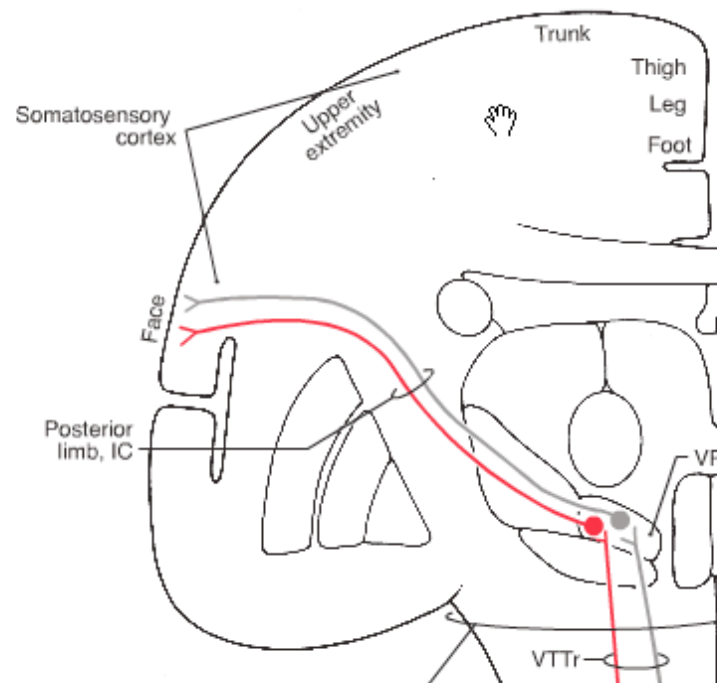
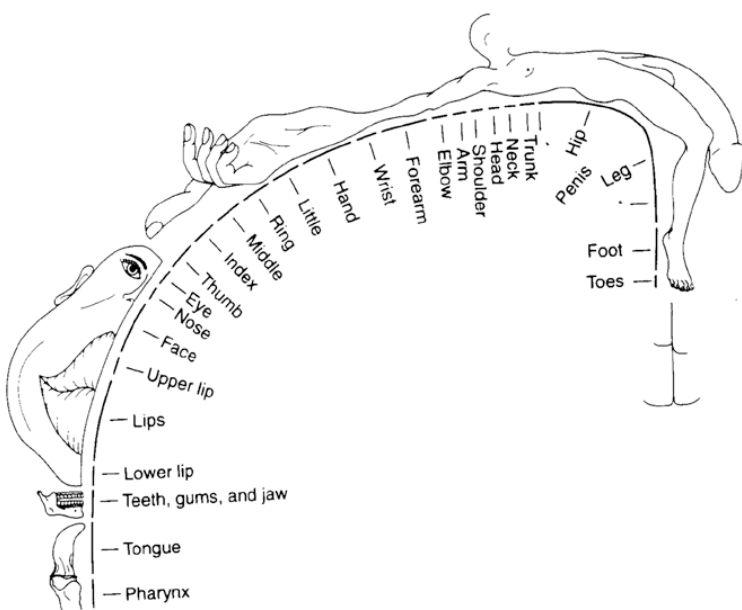
Third Order Neurons in Thalamus Project to Postcentral Gyrus (Primary sensory cortex).

VPM projects somatotopically to the face areas of the cortex via the internal capsule. The face is represented in primary, secondary, and association cortex (superior parietal cortex) just as the projections from VPL.

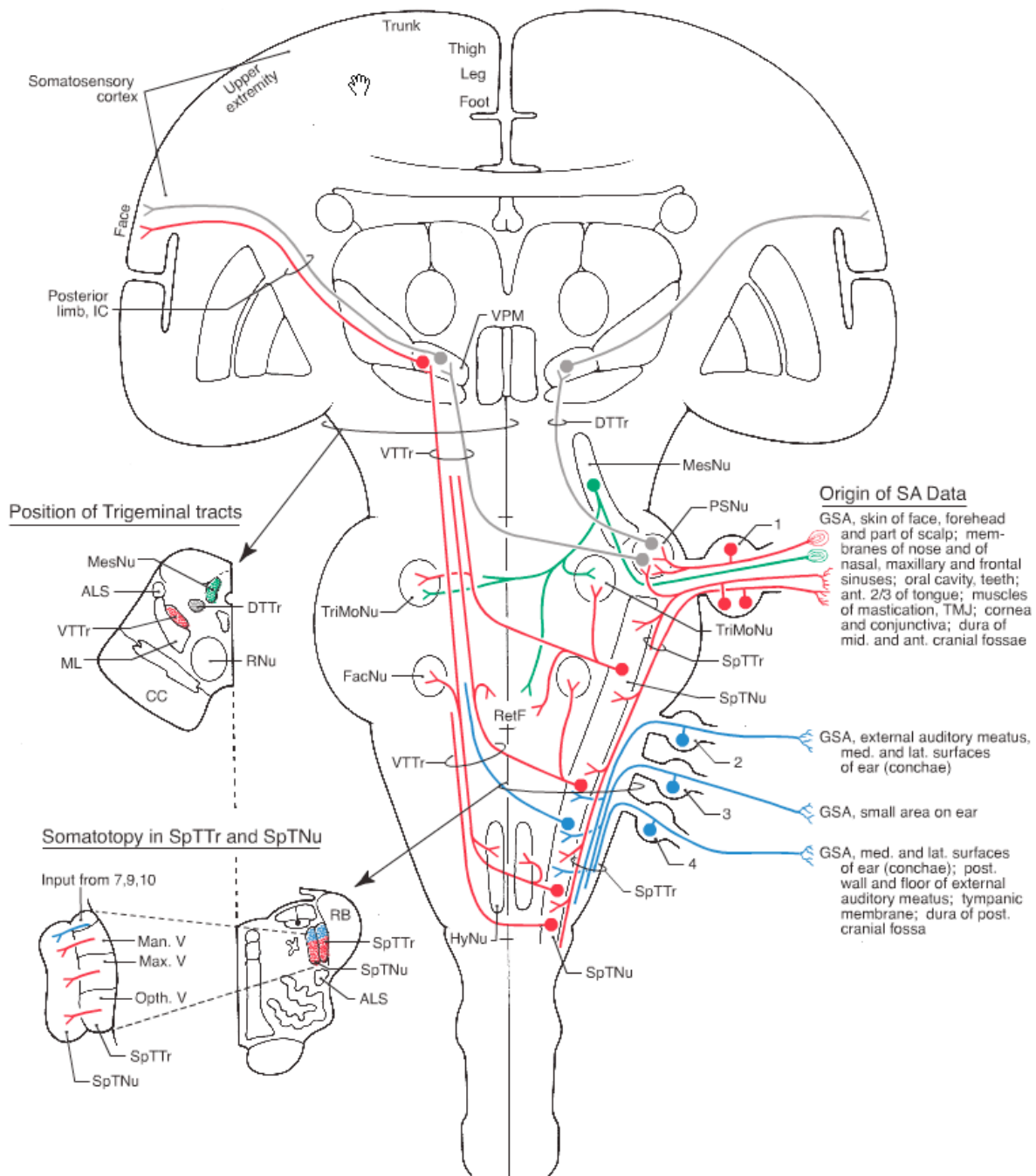
Primary Somatosensory Cortex, Postcentral Gyrus. There are four different body maps to help extract texture, form, and motion that come from the head and body.

INPUT. Internal capsule from VPM (CN V) and VPL (ALS and DCML).

INJURY. Postcentral gyrus. Deficits in position sense and ability to discriminate sizes, texture, shape. Pain and temperature are altered but not abolished.



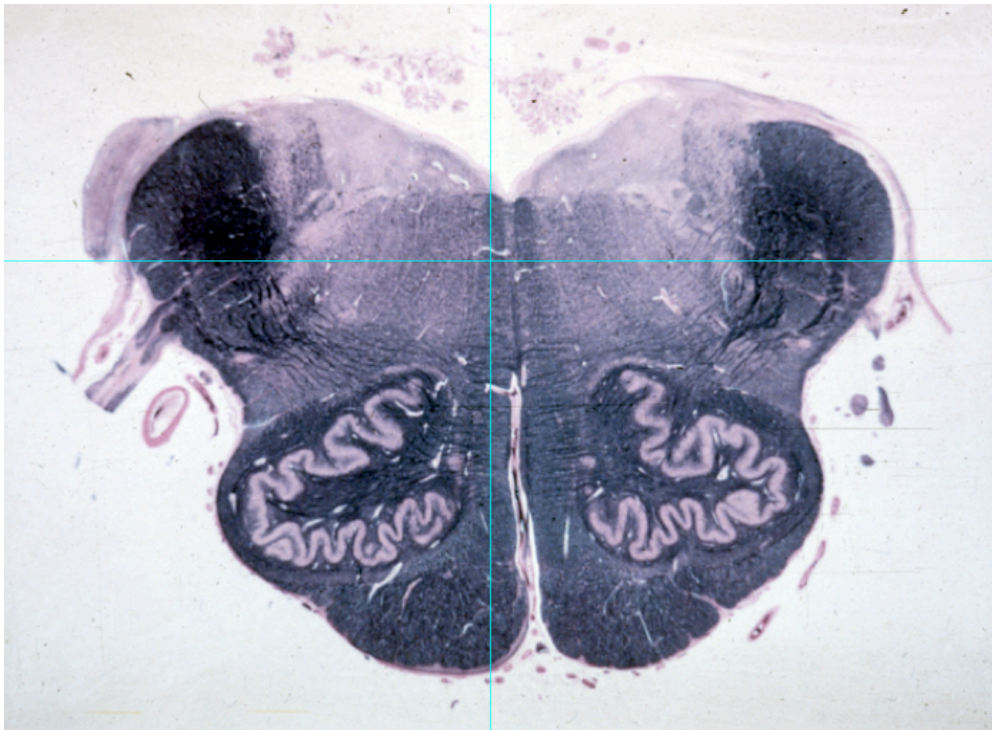
Trigeminal pathways (Haines)



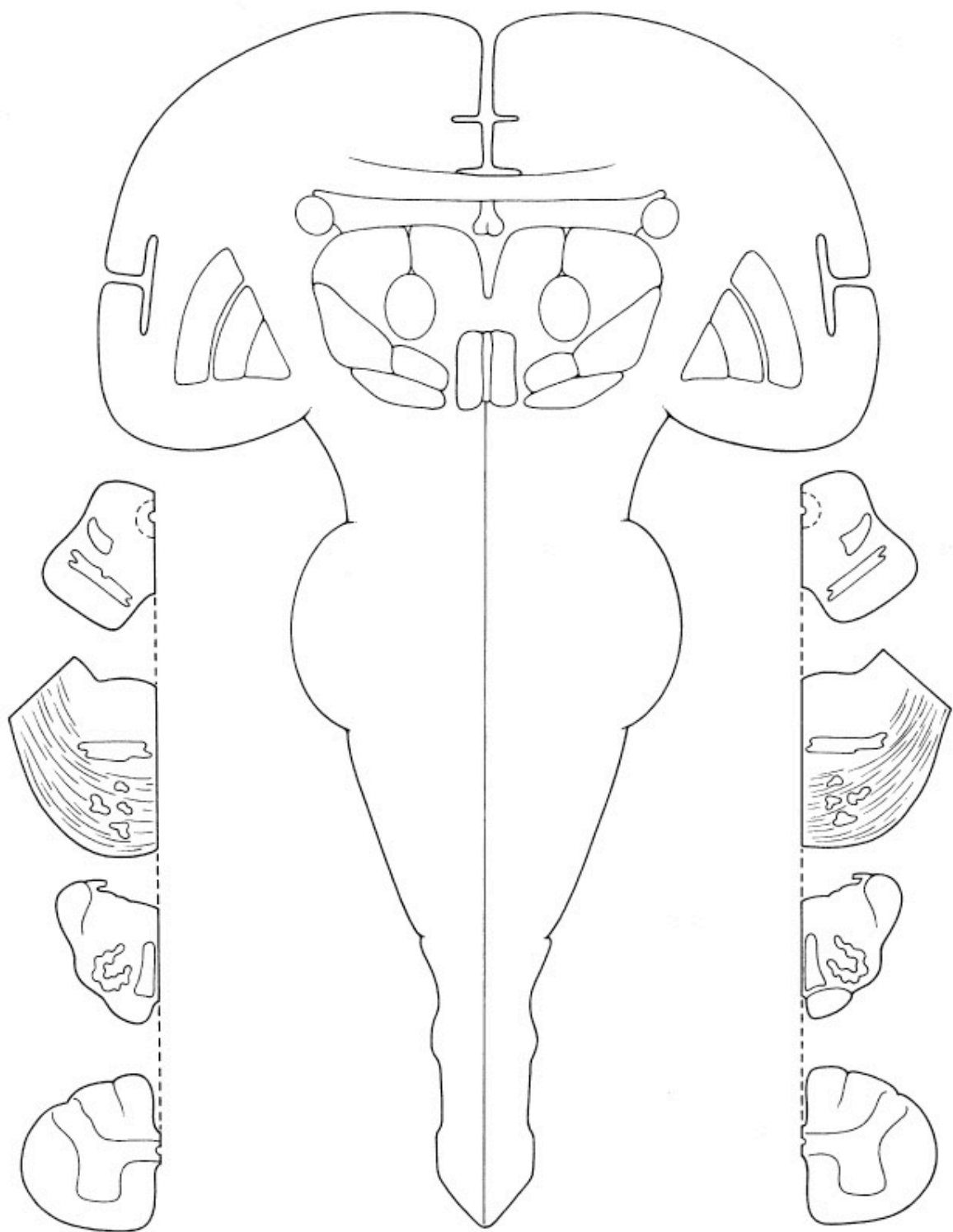
Locate the ALS, DCML, Chief trigeminal nucleus or Spinal trigeminal nucleus:



Pons



Medulla



Self-assessment: When you think you have mastered the pathways, select 2 colors in both a dark and light shade. Use the dark color for the body and the lighter color for the face pathways.

- e.g.
- Light blue-Trigeminothalamic (ventral)
 - Dark blue – ALS
 - Pink – trigeminothalamic (dorsal) from chief
 - Red – DCML