Note: Waxman is very sketchy on today’s pathways and nonexistent on the Trigeminal.

Resources: Pathway Quiz for HyperBrain Ch. 5 and 6 on ALS, DCML and Trigeminal: [http://library.med.utah.edu/kw/animations/hyperbrain/pathways/](http://library.med.utah.edu/kw/animations/hyperbrain/pathways/)

*Functional Neuroanatomy*, 2003, Univ. of Toronto, Dr. Patricia Stewart and Contributors. Does not work on Macs. This program has angiograms. Excellent for radiology and vascular territories. If you wish a copy, 130 MB can be downloaded from [http://video.med.utoronto.ca/neuronotes/](http://video.med.utoronto.ca/neuronotes/) for free. There is also an online practice practical which might be useful later in our course.

**SOMATIC SENSATION PART II:**

THE DORSAL COLUMN-MEDIAL LEMNISCUS SYSTEM (DCML)

I. Objectives:
   1. Compare and contrast the differences and similarities between the ALS and DCML pathways. Do this from memory using the drawing from the Haines atlas diagram at the end of today’s notes.
   2. Explain the term sensory dissociation and explain why the concept is useful.
   3. When performing a sensory examination explain which of the two sensory pathways the sensory modalities is traveling in. *(see NLE note)*

II. DCML PATHWAY TO CORTEX (Follow on the Haines Diagram in class)

A. 1° sensory neurons in dorsal root ganglia (DRG) innervate cutaneous, muscle and joint receptors for fine discriminating touch *(2-point discrimination)*, vibration, joint position *(proprioception)*.

   1. Multiple types of touch receptors (= labeled lines)

   2. Joint movement: more than one receptor type is activated, i.e. receptors in
      a. Joint capsule
      b. Muscle spindle
      c. Tendon organ

   3. Central axon of the DRG cell (Primary sensory neuron)
      a. Ascending *ipsilateral* axons are added sequentially along medial border of the dorsal column *(DC)* with the sacral region most medial.
      b. Collateral branches of these axons mediate local reflexes just as in the ALS system.
      c. Somatotopic organization of "serial" bands of axons = leg (medial), arm (lateral) in the dorsal columns.

         1. Cuneate fasciculus – C1-T6 (upper trunk and arm)
         2. Gracile fasciculus - T7-S5 (lower trunk and leg)
4. The integrity of this ascending tract is VERY important in being able to recognize objects (stereognosis) or interpret a number drawn on your hand (graphesthesia) or indicate the direction of movement across your skin with your eyes closed. Also, knowing where your limbs and joints are in space with your eyes closed, proprioception is essential for locomotion in the dark. Damage or degeneration of these large, long axons produces a clinical condition called sensory ataxia.

Fig 11-9 Young, Young and Tolbert, 2008 ©

B. 2° sensory neurons - Dorsal Column Nuclei are located in caudal medulla. They are called the gracile and cuneate nuclei.
1. INPUT - Gracile and cuneate fasciculi = axons of cell bodies in DRG that form the cuneate and gracile fasciculi (dorsal columns)
2. OUTPUT
   a. The axons of cells in the nuclei are called arcuate fibers as they decussate (cross midline) below (anterior to) dorsal column nuclei in the medulla.
   b. They form a band called the medial lemniscus (ML), axons of 2° neurons. Their somatotopic organization rotates as the tract ascends:

C. 3° sensory neurons - Ventral Posterior Lateral Nucleus (VPL) (thalamus)
1. INPUT - medial lemniscus
   a. All receptor types (labeled lines) are still identifiable.
   b. Somatotopic representation.
2. OUTPUT - Thalamocortical projections, also called somatosensory radiations.
   a. Travel in (posterior limb) internal capsule.
   b. Project somatotopically to postcentral gyrus and posterior...
paracentral lobule.
IV. 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.
V. **Primary Somatosensory Cortex, Postcentral Gyrus, Also Called SI** There are four different body maps to help extract texture, form, and motion that come from the head and body.

A. INPUT - via internal capsule from VPM and VPL for both ALS, DCML and trigeminothalamic systems.

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

VI. **Association Somatosensory Cortex:** Posterior Superior Parietal Areas 5 and 7 of Brodmann.

A. Relays information to sensory association cortex, posterior superior parietal cortex areas 5, 7 for stereognosis, the ability to recognize objects by "handling", perception of your body image.

B. Relays information to Motor and Premotor parts of cortex to guide intentional movement.

C. Connects homotopic areas via corpus callosum.

D. Lesions Of Association Area 5 and 7

Inability to perform simple acts requiring information on bodily orientation.

"Cortical Neglect" - inability to perceive objects or parts of body in "body space". With lesions of the **non-dominant**, usually right, hemisphere.
Self-assessment: When you think you have mastered the pathways, select a blue marker in both a dark and light shade. Use the dark color for DCML and lighter one for the ALS. Now draw the pathways on the diagram including the cross sections. (Answers in Neuroanatomy: An Atlas of Structures, Sections, and Systems, Duane Haines, 5th ed. 2002. Lippincott Williams and Wilkins, source of this picture)

Test yourself: Mark the location of the DCML at the following levels (then try coloring in the location of the ALS tract at these same levels. Finally, think back to your brainstem motor nuclei at each level:

- Hypoglossal and Ambiguus
- Abducons and Facial
- Motor nucleus of V
- Trochlear and Oculomotor

and add them. It would not hurt to have an atlas to refer to!