(Trigeminal system)

- Carry all the sensation modalities from the face to the brain
Inputs to the spinal trigeminal nucleus – pain and thermal from the face and oral cavity

Look at the **thin Green** Lines
Inputs to the spinal trigeminal nucleus – sensations from from ear and external auditory meatus traveling in CN VII, IX, and X

Look at the **thin Black** line
Clinical correlation
Brown-Séquard syndrome
Normal sensation

Zone of complete loss of sensation

Reduced sensation of temperature and pain

Reduced sensation of two-point discrimination, vibration, and proprioception
tabes dorsalis (progressive locomotor ataxia).

This disease is caused by infection with *Treponema pallidum* and is associated with neurosyphilis. The fibers of the posterior columns degenerate, and the patient has ataxia (related to the lack of sensory input, clinically referred to as *sensory ataxia*), loss of muscle stretch (tendon) reflexes, and proprioceptive losses from the extremities. In *sensory ataxia*, the patient may also have a wide-based stance and may place the feet to the floor with force in an effort to create the missing proprioceptive input.
Degeneration of the major spinocerebellar tracts occurs in diseases such as Friedrich ataxia. The result is cerebellar ataxia—lack of coordination during walking and other movements that occurs because the cerebellum is not receiving the sensory feedback necessary to regulate movement.
Motor Units – Large Versus Small
Major receptors involved in spinal cord reflexes: muscle spindle and Golgi tendon organ

Muscle spindle sense change and rate of change in muscle length

Golgi tendon organ sense the force of muscle contraction (tension)
The Muscle Spindle When Activated
Spinal cord Reflexes
Muscle stretch reflex

1. Stretching stimulates SENSORY RECEPTOR (muscle spindle)
2. SENSORY NEURON excited
3. Within INTEGRATING CENTER (spinal cord), sensory neuron activates motor neuron
4. MOTOR NEURON excited
5. EFFECTOR (same muscle) contracts and relieves the stretching

Antagonistic muscles relax
Motor neuron to antagonistic muscles is inhibited

To brain
Inhibitory interneuron
Muscle stretch reflex / Reciprocal inhibition

1. Stretching stimulates SENSORY RECEPTOR (muscle spindle)
2. SENSORY NEURON excited
3. Within INTEGRATING CENTER (spinal cord), sensory neuron activates motor neuron
4. MOTOR NEURON excited
5. EFFECTOR (same muscle) contracts and relieves the stretching

Spinal Nerve

Antagonistic muscles relax

Motor neuron to antagonistic muscles is inhibited

Inhibitory interneuron

To brain
Tendon reflex
(autogenic inhibition)
Flexor (withdrawal) reflex
(nociceptive reflex)
Crossed Extension Reflex
Crossed Extension Reflex

1. Stepping on a tack stimulates SENSORY NEURON (dendrites of pain-sensitive neuron) in right foot.
2. SENSORY NEURON excited.
3. Within INTEGRATING CENTER (spinal cord), sensory neuron activates several interneurons.
4. MOTOR NEURONS excited.
5. EFFECTORS (extensor muscles) contract, and extend left leg.
6. Descending interneurons.
7. Ascending interneurons.
8. MOTOR NEURON excited.
9. Interneurons from other side.
10. Spinal nerve.

Leg extensors
Leg flexors

Muscles of foot
Dorsiflexors
Plantar flexors

Nociceptive input

Withdrawal of right leg (flexor reflex)
Extension of left leg (crossed extensor reflex)
Anatomical overview of the trigeminal nuclei

*Pars caudalis* extends from C2 or C3 rostrally to the level of the obex.

*Pars interpolaris* is located between the level of the obex and the rostral pole of the hypoglossal (XII) nucleus.

*Pars oralis* extends from the level of the rostral pole of the hypoglossal nucleus to the caudal end of the trigeminal motor nucleus.
Overview
Trigeminal pathway

Origin of SA Data
GSA, skin of face, forehead and part of scalp; membranes of nose and of nasai, maxillary and frontal sinuses; oral cavity, teeth; ant. 2/3 of tongue; muscles of mastication, TMJ; cornea and conjunctiva; dura of mid. and ant. cranial fossae

GSA, external auditory meatus, med. and lat. surfaces of ear (conchae)
GSA, small area on ear
GSA, med. and lat. surfaces of ear (conchae); post. wall and floor of external auditory meatus; tympanic membrane; dura of post. cranial fossa
Trigeminal Mesencephalic nucleus
Trigeminal Motor nucleus

- Mesencephalic nucleus – provides proprioceptive sensations from the muscles of mastication, TMJ and PDL

- Mes V neurons transmit the proprioceptive signals from periodontal ligaments to 2\(^{nd}\) order neurons in the principle sensory nucleus

- Trigeminal motor nucleus – motor control for muscles of mastication
Trigeminal mesencephalic and motor nuclei
Jaw jerk reflex pathway

Afferent limb involves Mesencephalic neurons
Efferent limb involves motor fibers via V3 to the muscles of mastication
Corneal blink reflex pathway

Afferent limb – sensory signals via V1
Efferent limb - motor fibers to the orbicularis oculi muscle via CN VII