Cranial Nerves

- Twelve pairs of cranial nerves arise from the brain
- They have sensory, motor, or both sensory and motor functions
- Each nerve is identified by a number (I through XII) and a name
- Four cranial nerves carry parasympathetic fibers that serve muscles and glands
Summary of Function of Cranial Nerves

<table>
<thead>
<tr>
<th>Cranial nerves I – VI</th>
<th>Sensory function</th>
<th>Motor function</th>
<th>PS* fibers</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Olfactory</td>
<td>Yes (smell)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>II Optic</td>
<td>Yes (vision)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>III Oculomotor</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>IV Trochlear</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>V Trigeminal</td>
<td>Yes (general sensation)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>VI Abducens</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cranial nerves VII – XII</th>
<th>Sensory function</th>
<th>Motor function</th>
<th>PS* fibers</th>
</tr>
</thead>
<tbody>
<tr>
<td>VII Facial</td>
<td>Yes (taste)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>VIII Vestibulocochlear</td>
<td>Yes (hearing and balance)</td>
<td>Some</td>
<td>No</td>
</tr>
<tr>
<td>IX Glossopharyngeal</td>
<td>Yes (taste)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>X Vagus</td>
<td>Yes (taste)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>XI Accessory</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>XII Hypoglossal</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

(b) *PS = parasympathetic

Cranial Nerve I: Olfactory

- Arises from the olfactory epithelium
- Passes through the cribriform plate of the ethmoid bone
- Fibers run through the olfactory bulb and terminate in the primary olfactory cortex
- Functions solely by carrying afferent impulses for the sense of smell
Cranial Nerve II: Optic

- Arises from the retina of the eye
- Optic nerves pass through the optic canals and converge at the optic chiasm
- They continue to the thalamus where they synapse
- From there, the optic radiation fibers run to the visual cortex
- Functions solely by carrying afferent impulses for vision

Cranial Nerves and The Eye: A note on eye muscles and structures.

There are 6 extra-ocular or extrinsic eye muscles that move the eye around

- Four muscles rectus muscles
  - Superior, Inferior, Medial and Lateral Rectus muscle
    - They are attached on the North, South, West and East poles of the eye
    - They run straight backwards and result in obvious motions
- Two oblique muscles (attach on an angle)
  - Superior oblique and Inferior oblique
Cranial Nerves and The Eye: A note on eye muscles and structures.

Cranial Nerve III: The oculomotor Nerve

The somatic motor component of CN III innervates the following four extraocular muscles of the eyes:

- superior rectus muscle
- medial rectus muscle
- inferior oblique muscle
- inferior rectus muscle
Cranial Nerve III: The oculomotor Nerve

The **visceral motor** component of CN III (a parasympathetic action) is involved in the pupillary light and accommodation reflexes.

- **Constriction** of the pupil (via circular smooth muscles in iris)
- **Adjustment** of the lens via the ciliary body (smooth muscles)

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Cranial Nerve IV: Trochlear

- Fibers emerge from the dorsal midbrain and enter the orbits via the superior orbital fissures; **innervate the superior oblique muscle**
- Primarily a motor nerve that directs the eyeball laterally and upwards
**Cranial Nerve V: Trigeminal**

- Three divisions: ophthalmic (V₁), maxillary (V₂), and mandibular (V₃)
- It has the greatest sensory function of all cranial nerves and is the only cranial nerve involved in sensory cutaneous innervation

**Ophthalmic branch (V1)**

Sensory afferent nerves that provides sensory information from the scalp, forehead, nose, upper eyelid, cornea.

**Maxillary branch (V2)**

Sensory afferent nerves that provides sensory information from the palate, upper jaw, upper teeth and gums, skin of cheek, lower eyelid, upper lip

**Mandibular branch (V3)**

Sensory afferent nerves that provides sensory information from the lower jaw, lower teeth, lower lip, tongue sensation.
Cranial Nerve V: Trigeminal

The trigeminal nerve also has a somatic **motor function**, in that it provides motor nerves to the muscles of mastication (chewing muscles).

**Clinical Correlation: Tic Douloureux**

Also called Trigeminal neuralgia

Inflammation and disorder in T.N.

Small touches to the face elicit enormous pain responses on other parts of the face.

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Cranial Nerve VI: Abduccens

Primarily a motor nerve innervating the lateral rectus muscle.
Cranial Nerve VII: Facial

- Mixed nerve with five major branches and 3 major functions

  **Somatic motor function**

  (efferent) Supplies all the muscles of **facial expression**

  **Visceral motor**

  (visceral efferent) Parasympathetic innervation of the **lacrimal, submandibular, and sublingual glands**, as well as mucous membranes of nasopharynx, hard and soft palate.

  **Special sensory**

  (special afferent) **Taste sensation** from the anterior 2/3 of tongue; hard and soft palates.
Cranial Nerve VII: Facial

* Marked facial asymmetry
* Atrophy of facial muscles
* Eyebrow droop
* Drooping of the mouth corner
* Uncontrolled tearing
* cannot close eye
* Lips cannot be held tightly together or pursed
* Difficulty keeping food in mouth while chewing on the affected side

Bell’s Palsy

Cranial Nerve VIII: Vestibulocochlear

- Fibers arise from the hearing and equilibrium apparatus of the inner ear, pass through the internal acoustic meatus, and enter the brainstem at the pons-medulla border
- Two divisions – cochlear (hearing) and vestibular (balance)
- Functions are solely sensory – equilibrium and hearing
Cranial Nerve VIII: Vestibulocochlear

Cranial Nerve IX: Glossopharyngeal

The glossopharyngeal nerve consists of 3 main components with distinct functions:

**Somatic motor**

Supplies the stylopharyngeus muscle which elevates the pharynx during swallowing and speech. Controls action of swallowing.

**Visceral motor**

Parasympathetic innervation of the smooth muscle and glands of the pharynx, larynx (especially parotid gland)

**Sensory**

Provides taste sensation from the posterior one-third of the tongue. Also provides info from receptors that monitor blood pressure in major arteries
Cranial Nerve IX: Glossopharyngeal

- Fibers emerge from the medulla via the jugular foramen
- The vagus is a mixed nerve
- Most motor fibers are parasympathetic fibers to the heart, lungs, and visceral organs
- Has some minor somatic motor functions that aid in swallowing as well as activation of a tongue muscle.
- Its sensory function is in taste of tastebuds in deeper region of the throat

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Cranial Nerve X: Vagus

- Supplies fibers to the larynx, pharynx, and soft palate
- Innervates the trapezius and sternocleidomastoid, which move the head and neck

Cranial Nerve XI: Accessory

- Primarily a motor nerve
- Supplies fibers to the larynx, pharynx, and soft palate
- Innervates the trapezius and sternocleidomastoid, which move the head and neck
Cranial Nerve XII: Hypoglossal

- Fibers arise from the medulla and exit the skull via the hypoglossal canal
- Innervates both extrinsic and intrinsic muscles of the tongue, which contribute to swallowing and speech
- Extrinsic tongue muscles supplied are genioglossus, styloglossus, and hyoglossus.

The palatoglossus muscle is supplied by CN X (vagus nerve).
### Cranial Nerves and Their Origin

<table>
<thead>
<tr>
<th>Number</th>
<th>Origin</th>
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<tbody>
<tr>
<td>I</td>
<td>Olfactory bulb</td>
</tr>
<tr>
<td>II</td>
<td>Retina of eye</td>
</tr>
<tr>
<td>III, IV</td>
<td>Midbrain</td>
</tr>
<tr>
<td>V, VI, VII</td>
<td>Pons</td>
</tr>
<tr>
<td>VIII</td>
<td>Ear</td>
</tr>
<tr>
<td>IX, X, XI, XII</td>
<td>Medulla</td>
</tr>
</tbody>
</table>

### Cranial Nerves and Their Actions

- **Pure Sensory**: S
- **Pure Motor**: M
- **Mixed S + M**: 
- **ParaSymp. Activity**: PS

<table>
<thead>
<tr>
<th>Number</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>S</td>
</tr>
<tr>
<td>II</td>
<td>S</td>
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<tr>
<td>III</td>
<td>M, PS</td>
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