

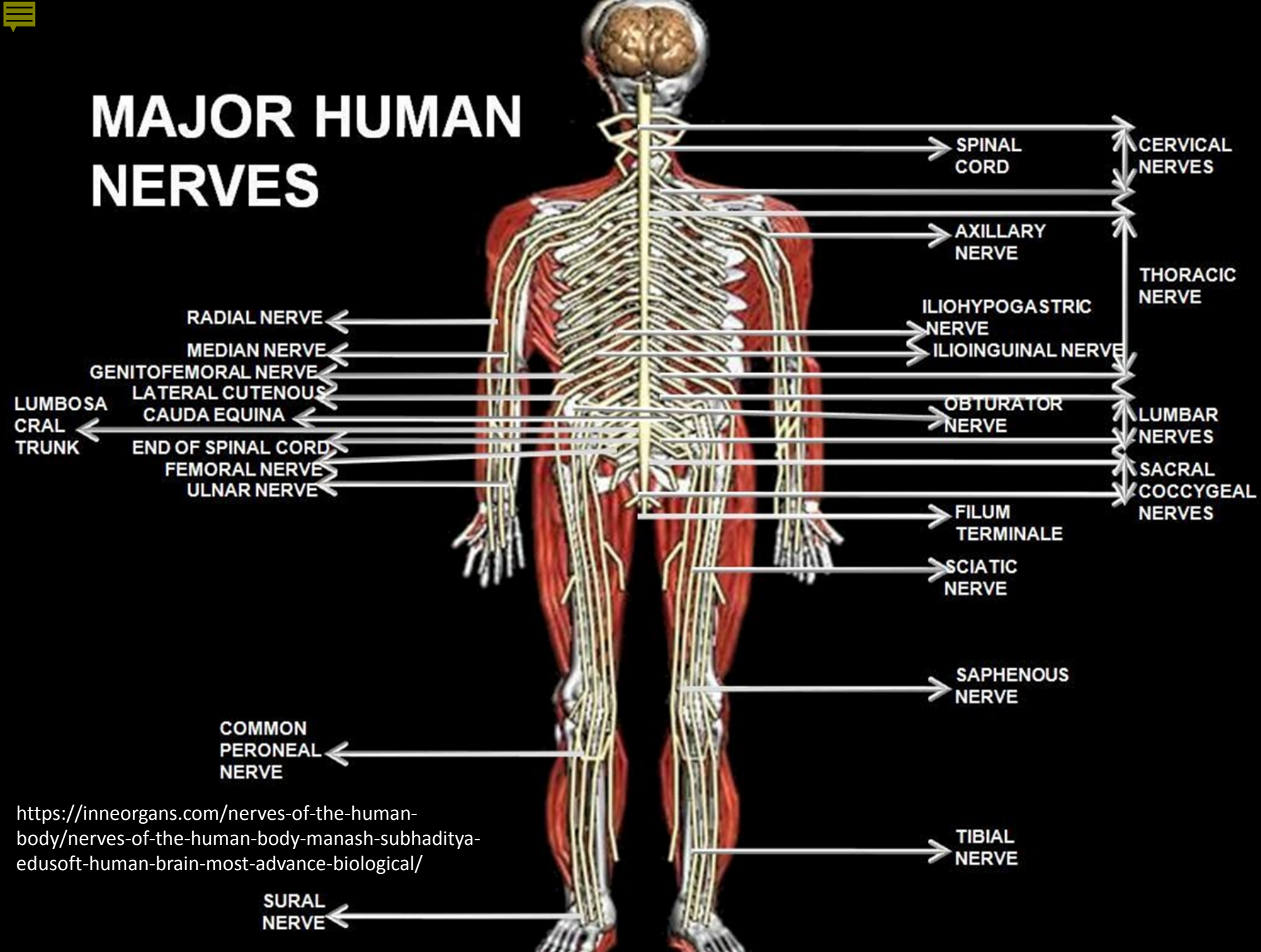
# Cranial Nerves

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# MAJOR HUMAN NERVES

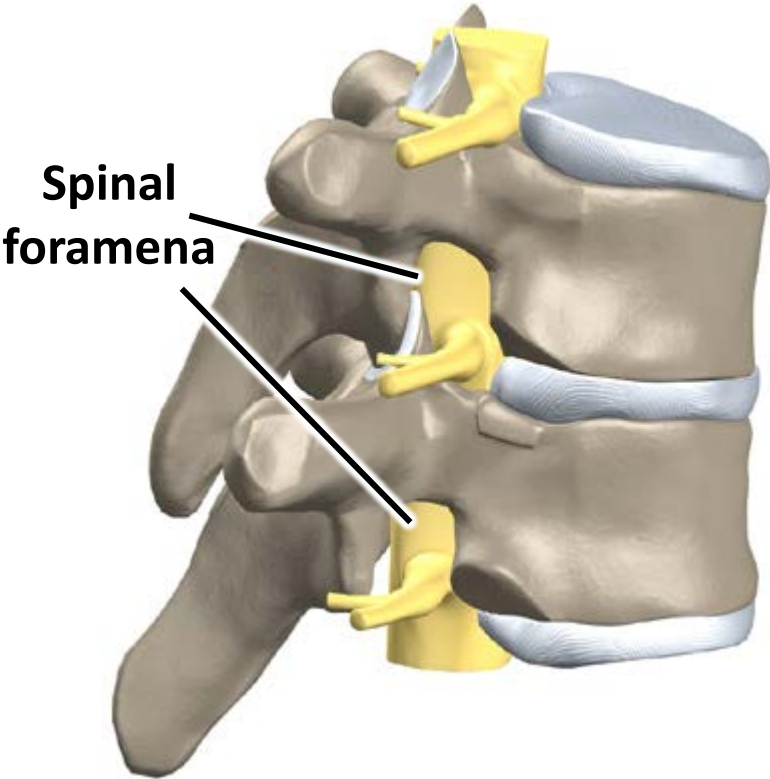


<https://inneorgans.com/nerves-of-the-human-body/nerves-of-the-human-body-manash-subhaditya-edusoft-human-brain-most-advance-biological/>

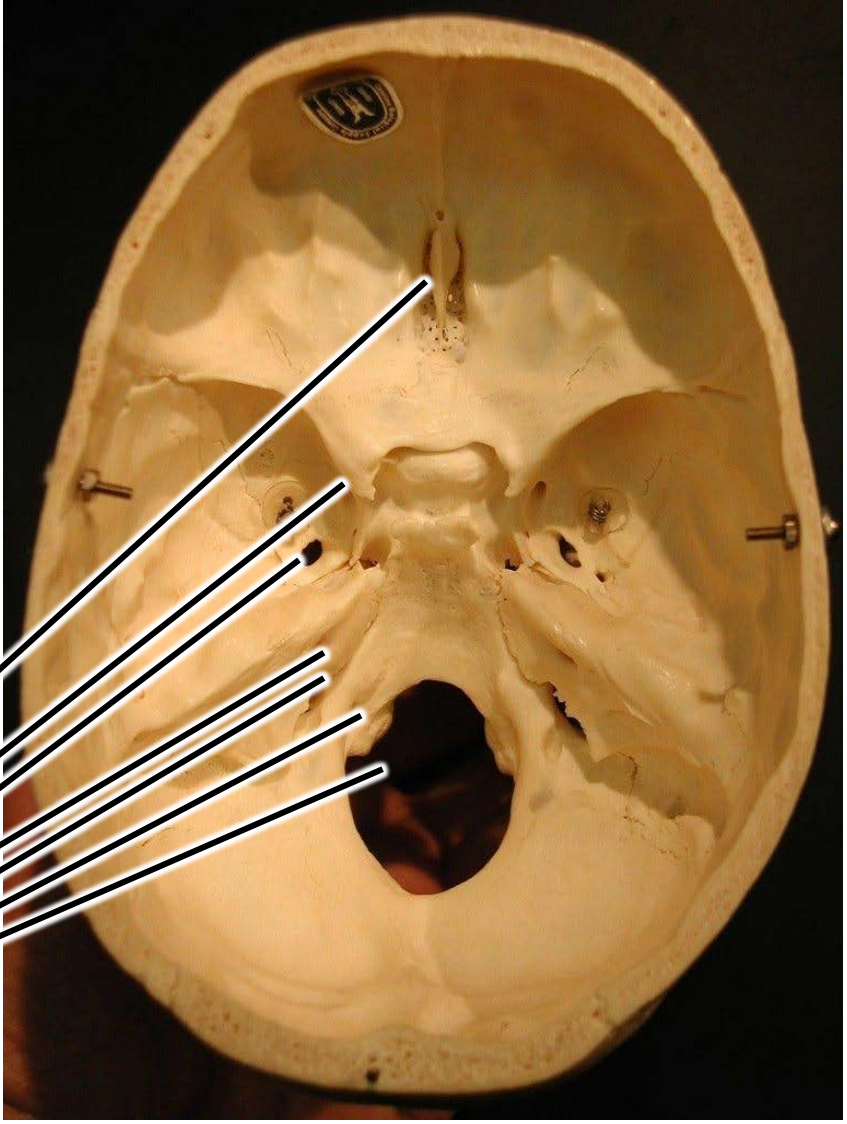
# What is a cranial nerve?

- Cranial nerves exit or enter the CNS through foramina in the skull, rather than through spinal foramina.
- 12 cranial nerves

# Spinal foramina vs. cranial foramina



Cranial foramina



# Cranial nerves 1-6

1. Olfactory (smell)
2. Optic (vision)
3. Oculomotor (5 muscles of orbit)
4. Trochlear (one muscle of orbit)
5. Trigeminal (sensation to face + muscles for chewing)
6. Abducens (one muscle of orbit)

# Cranial nerves 7-12

7. Facial (muscles of facial expression)
8. Vestibulocochlear (hearing & balance)
9. Glossopharyngeal (swallowing)
10. Vagus (control of the heart & gut)
11. Spinal accessory/accessory (muscles of throat & shoulders)
12. Hypoglossal (muscles of tongue)

# Mnemonic for cranial nerves

*“On old Olympus’s towering tops, a Finn and German viewed some hops.”*



# Mnemonic for cranial nerves

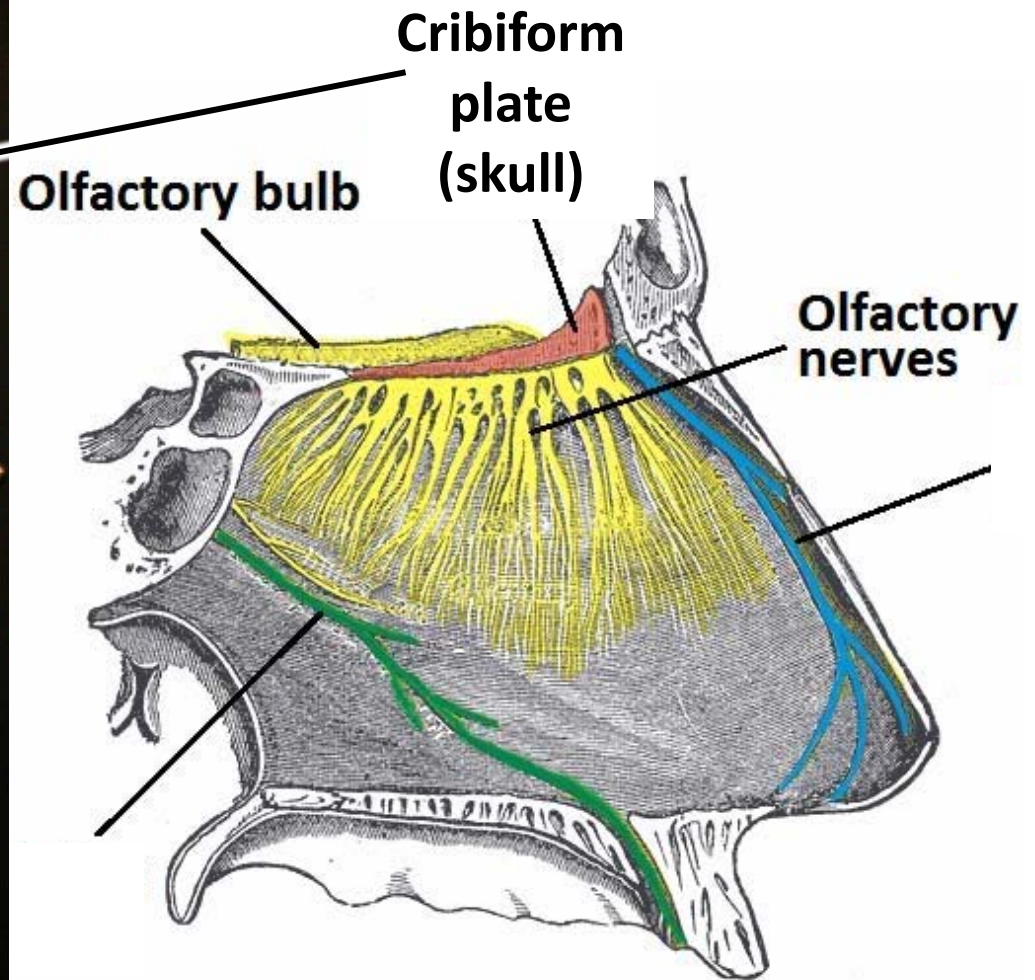
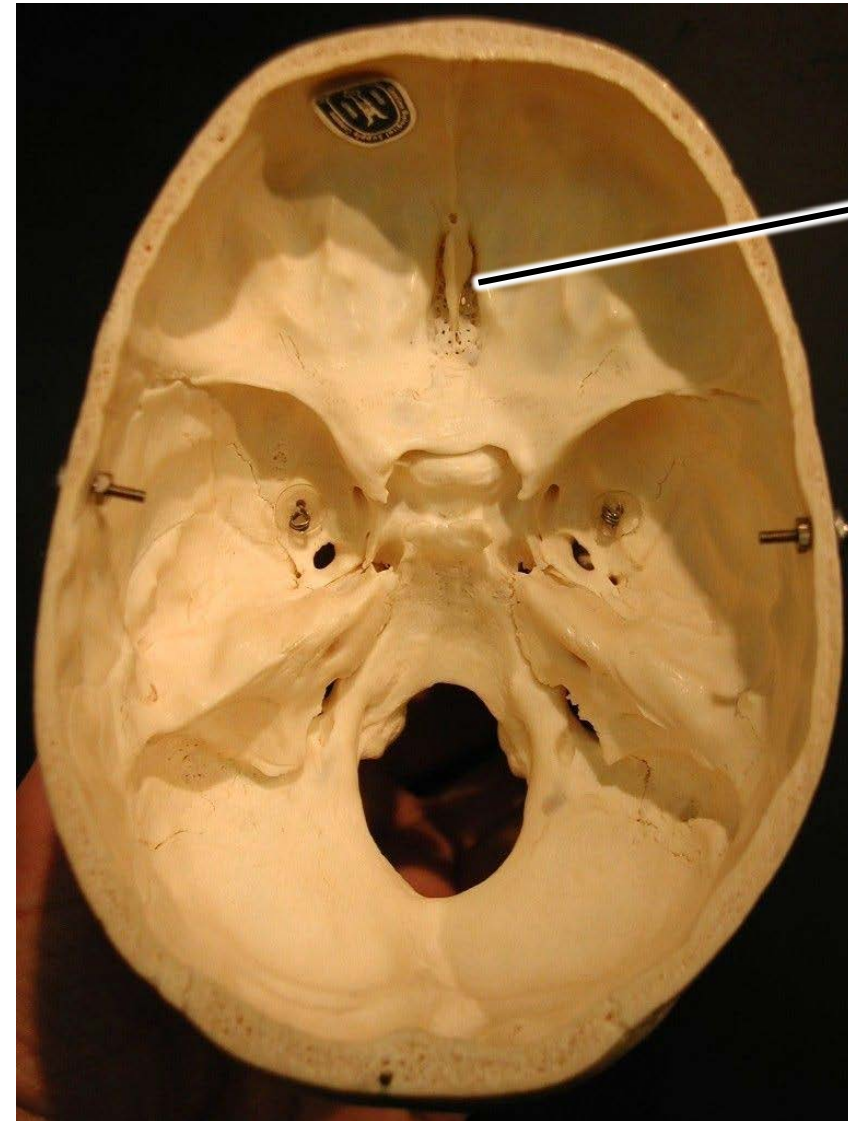
1. On (*olfactory*)
2. Old (*optic*)
3. Olympus's (*oculomotor*)
4. Towering (*trochlear*)
5. Tops (*trigeminal*)
6. A (*abducens*)
7. Finn (*facial*)
8. And ("*auditory*", i.e. *vestibulocochlear*)
9. German (*glossopharyngeal*)
10. Viewed (*vagus*)
11. Some (*spinal accessory*)
12. Hops (*hypoglossal*)



# Functions of cranial nerves

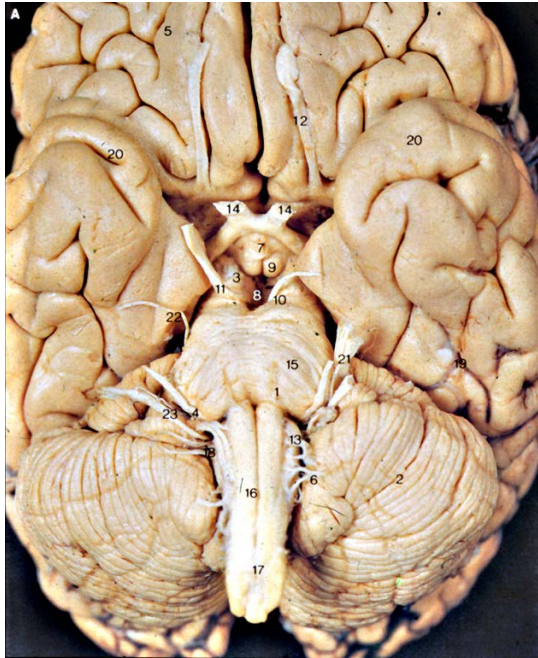
- Special sensation
  - Smell, vision, hearing, balance, taste, oxygen, CO<sub>2</sub>
- Cutaneous sensation
  - Touch, temperature, vibration, pain, etc.
- Visceral sensation
  - E.g., sensors for blood pressure & stomach fullness
- Skeletal muscles
  - E.g., facial muscles; muscles of chewing
- Visceral motor output
  - E.g., vagus slowing heart or increasing gut contraction

# CN 1: Olfactory nerve

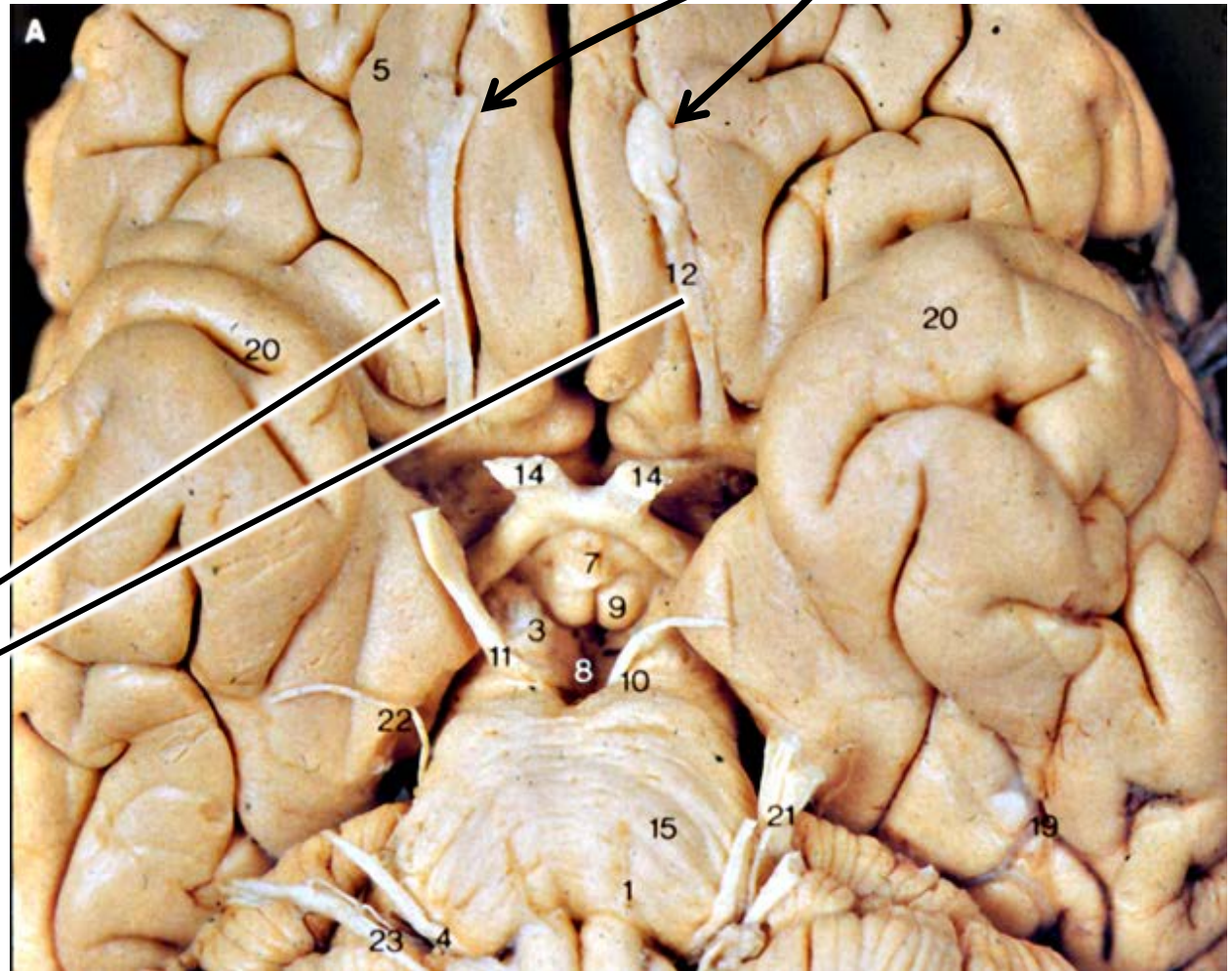


Midline view of nasal septum

# Olfactory nerves synapse onto olfactory bulbs



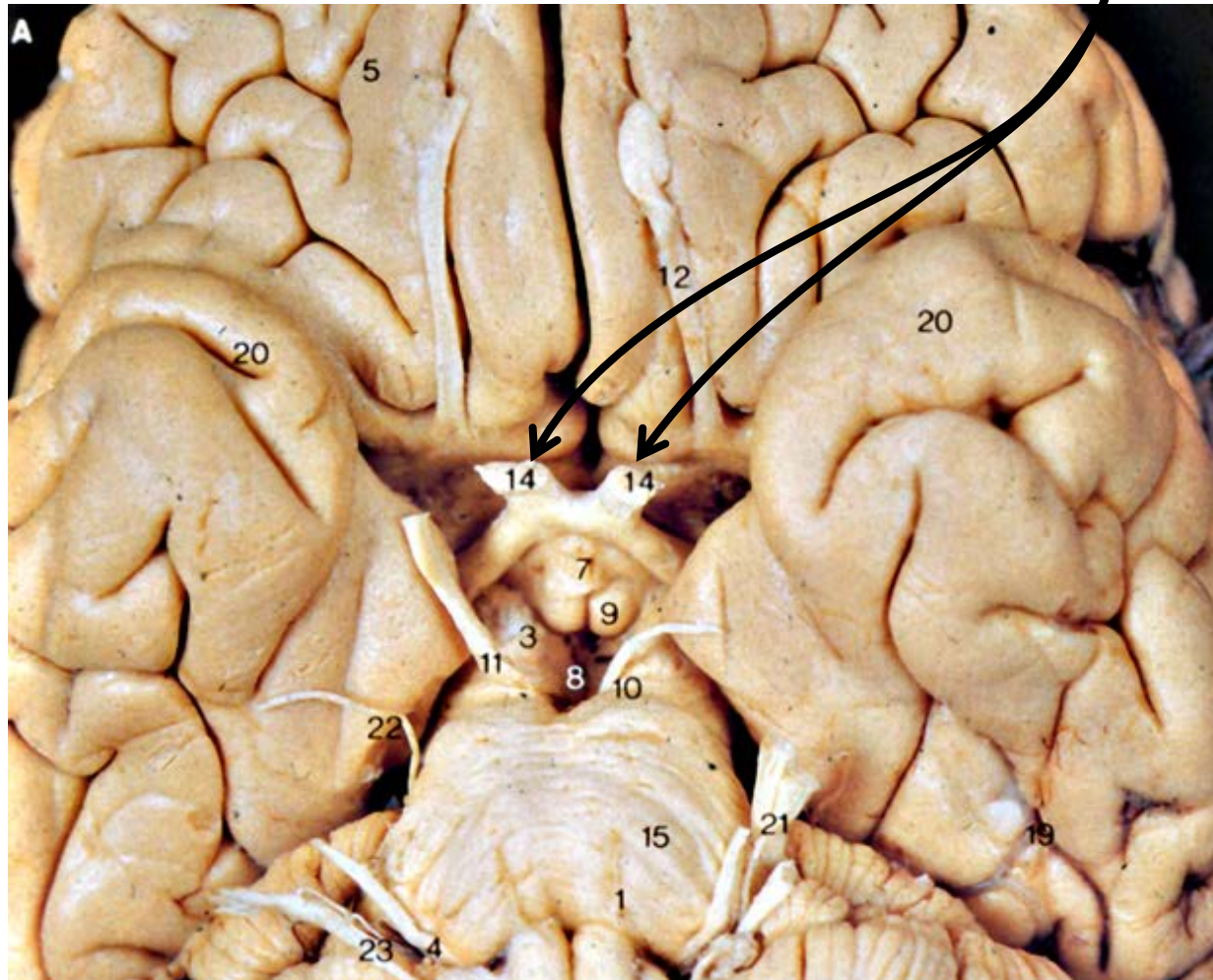
Olfactory tracts: carry information about smell into cerebral cortex



# Functions of olfactory nerve

- Special sensation
  - Smell
- Cutaneous sensation
  - Touch, temperature, vibration, pain, etc.
- Visceral sensation
  - E.g., sensors for blood pressure & stomach fullness
- Skeletal muscles
  - E.g., facial muscles; muscles of chewing
- Visceral motor output
  - E.g., vagus slowing heart or increasing gut contraction

# CN 2: Optic nerve



# Visual system

Retinal ganglion neurons

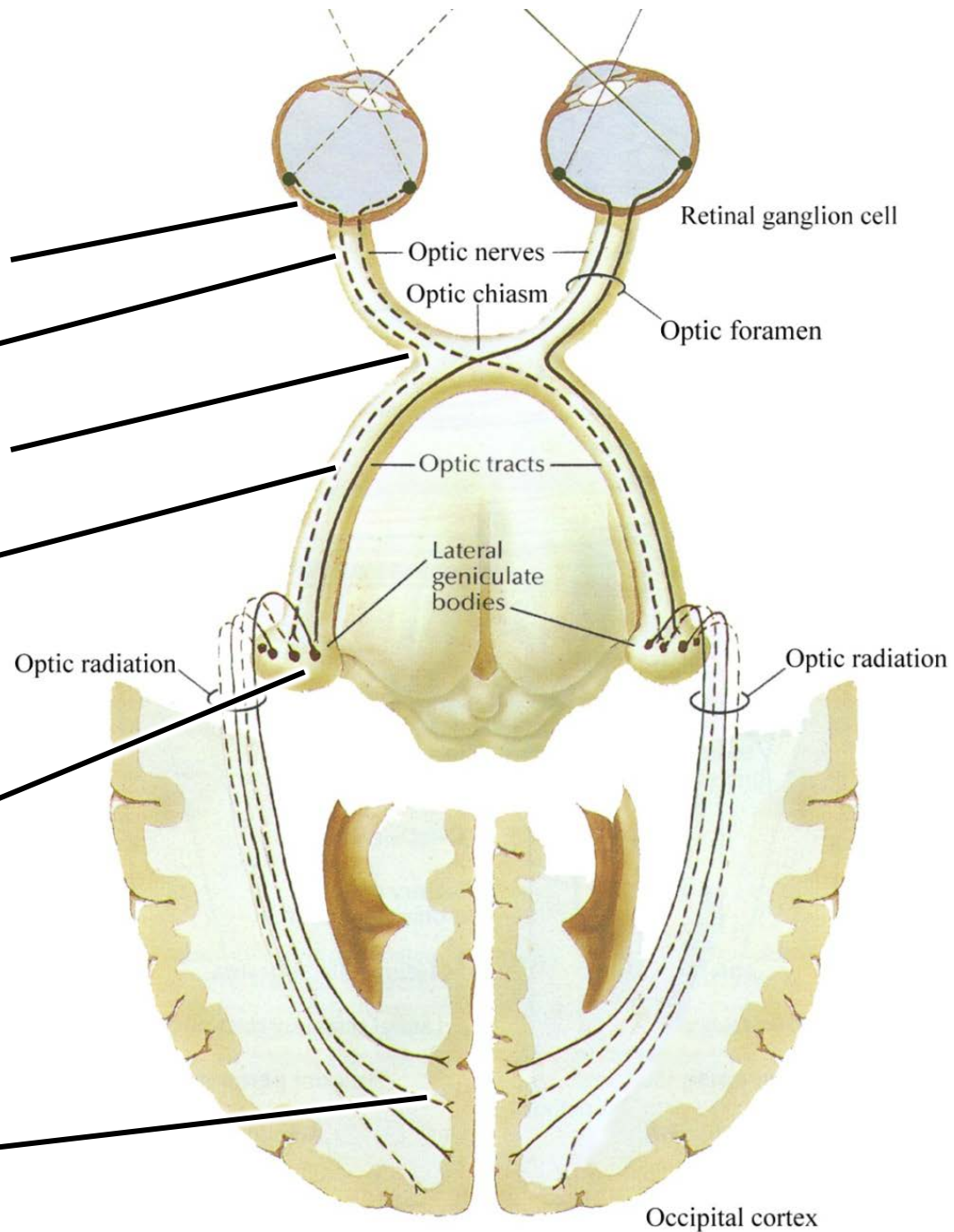
Optic nerve

Optic chiasm

Optic tract

Lateral geniculate nucleus (thalamus)

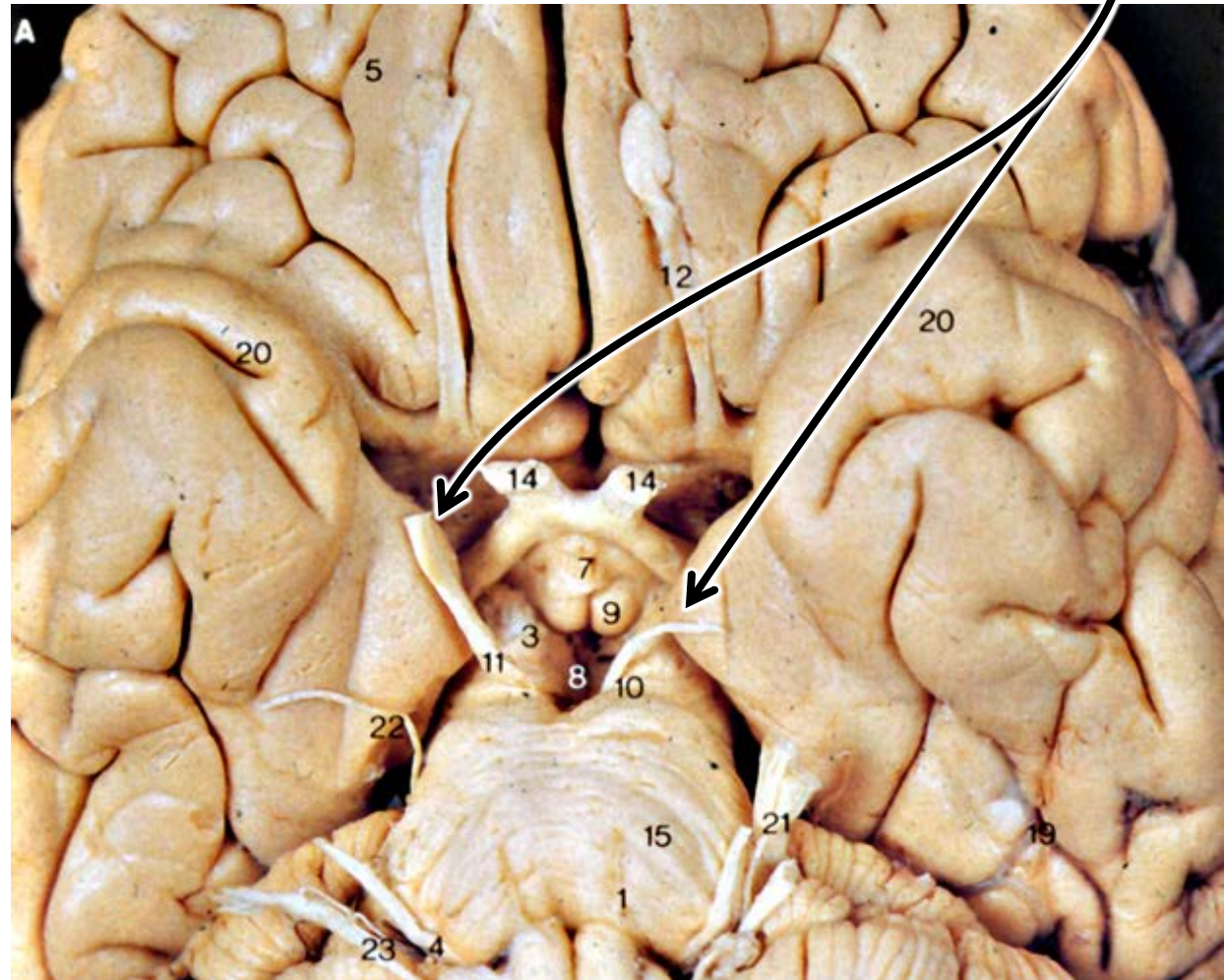
Visual cortex (occipital lobe)



# Functions of optic nerve

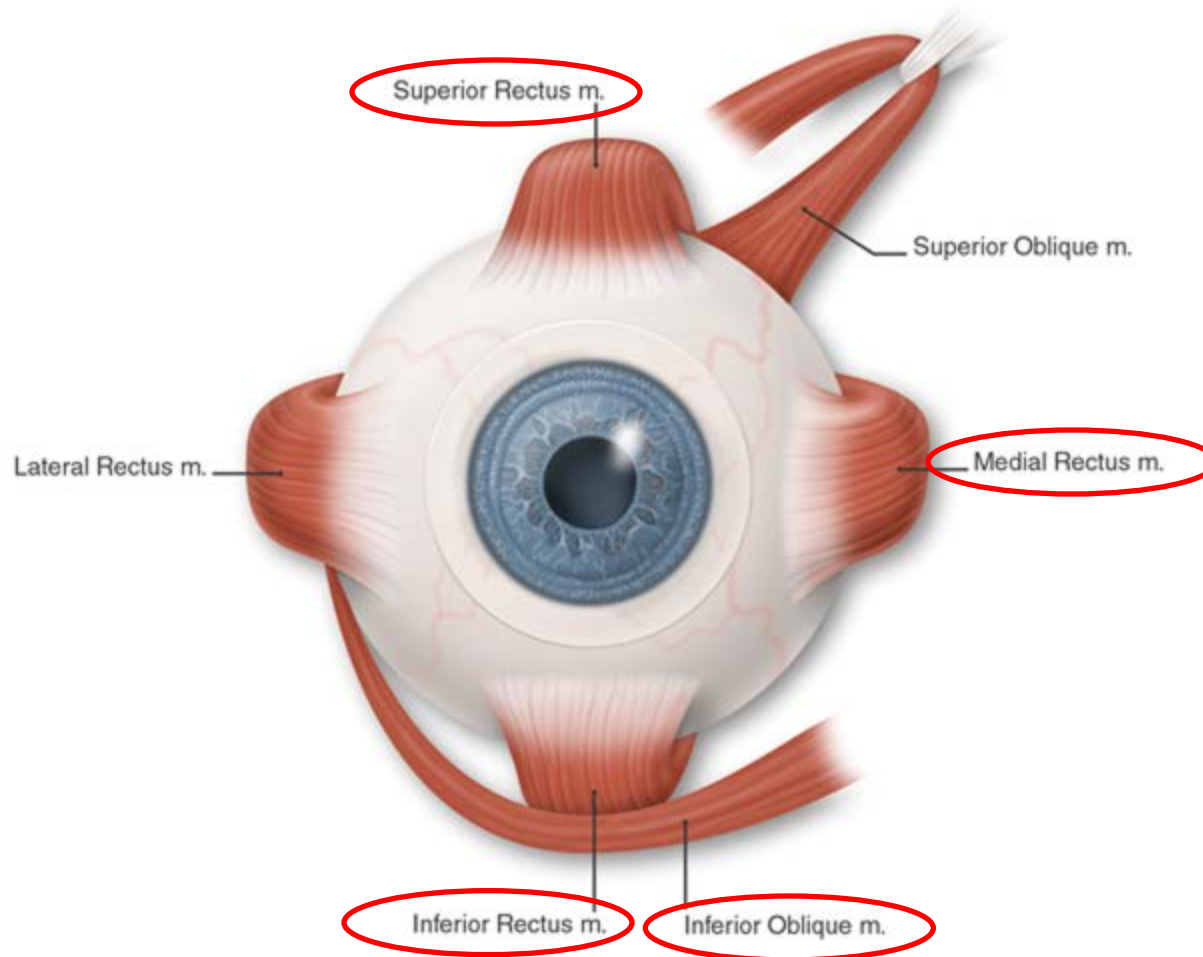
- Special sensation
  - Vision
- Cutaneous sensation
  - Touch, temperature, vibration, pain, etc.
- Visceral sensation
  - E.g., sensors for blood pressure & stomach fullness
- Skeletal muscles
  - E.g., facial muscles; muscles of chewing
- Visceral motor output
  - E.g., vagus slowing heart or increasing gut contraction

# CN 3: Oculomotor nerve

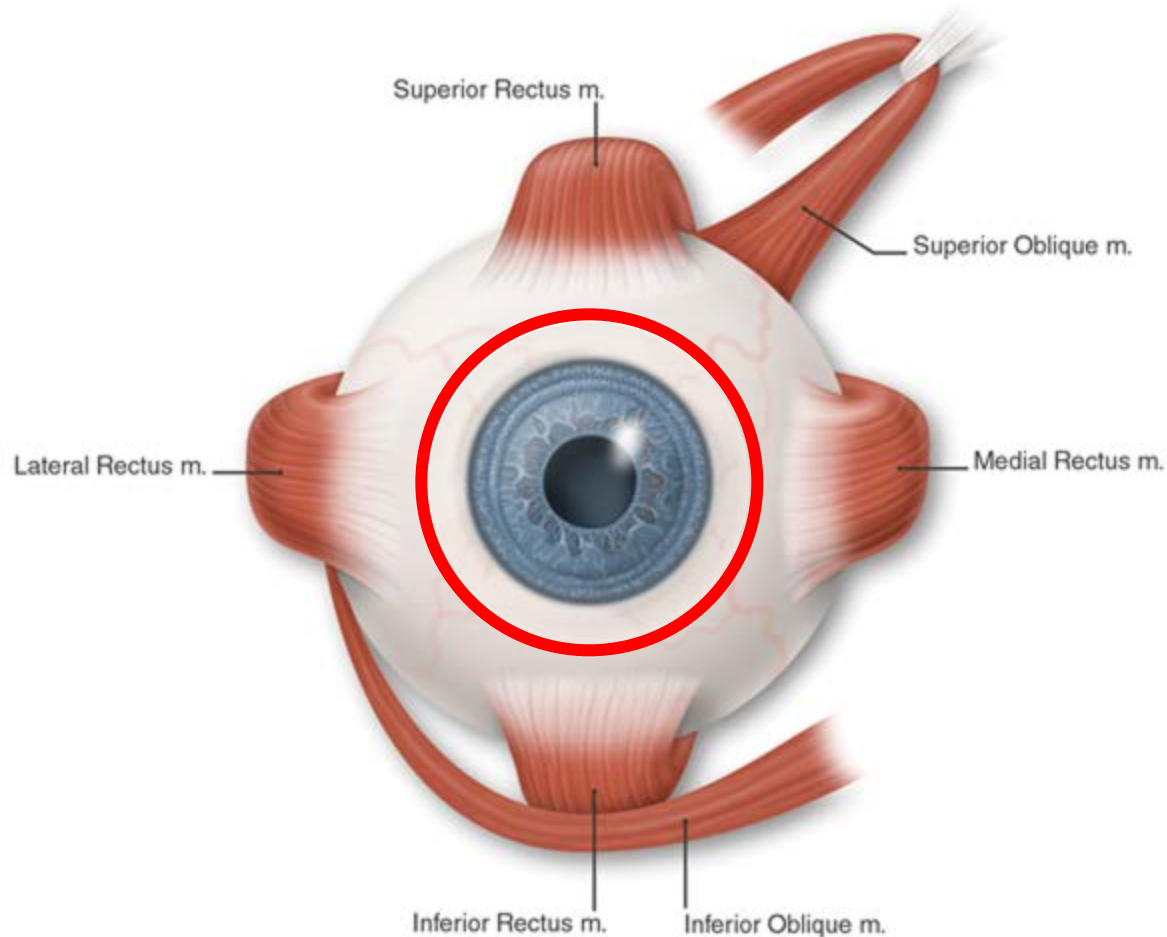




# Oculomotor nerve: 4 of 6 extraocular muscles (plus eyelid)



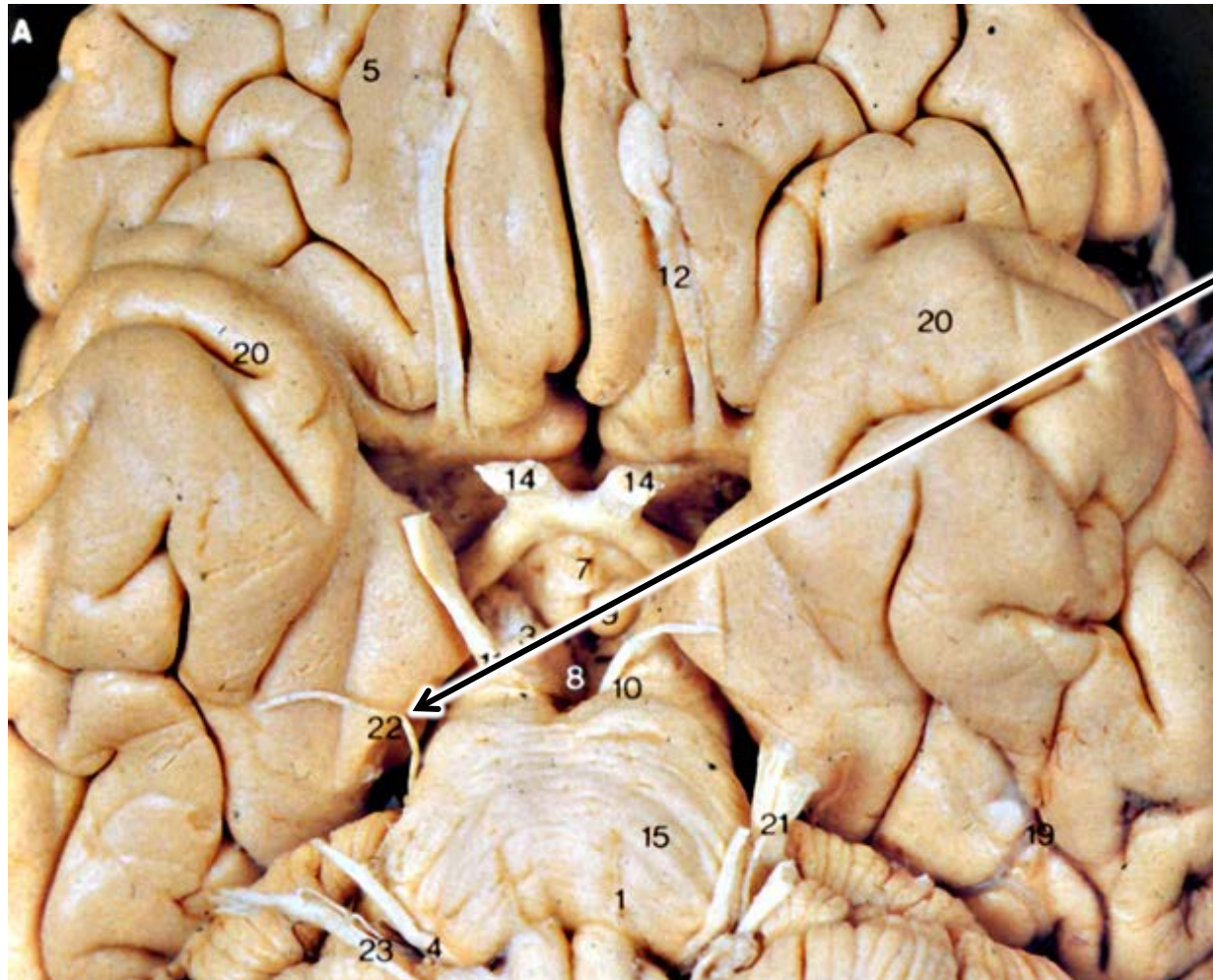
# Visceral motor (parasympathetic) output of CN3: focuses lens; constricts pupil



# Functions of oculomotor nerve

- Special sensation
  - Smell, vision, hearing, balance, taste, oxygen, CO<sub>2</sub>
- Cutaneous sensation
  - Touch, temperature, vibration, pain, etc.
- Visceral sensation
  - E.g., sensors for blood pressure & stomach fullness
- Skeletal muscles
  - 4 of 6 extraocular muscles; eyelid
- Visceral motor output
  - Pupil constriction; focusing lens (both parasympathetic)

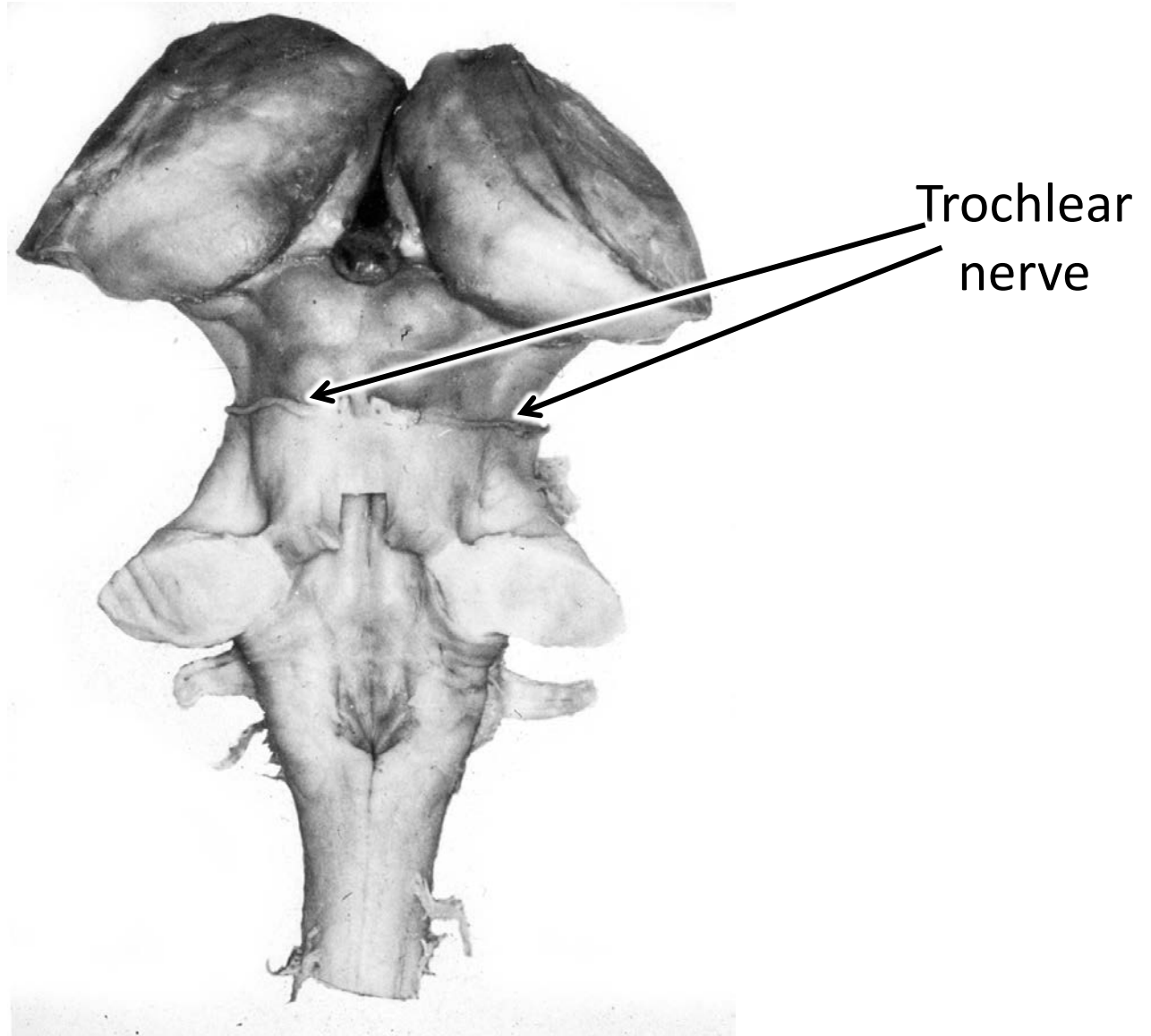
# CN 4: Trochlear nerve



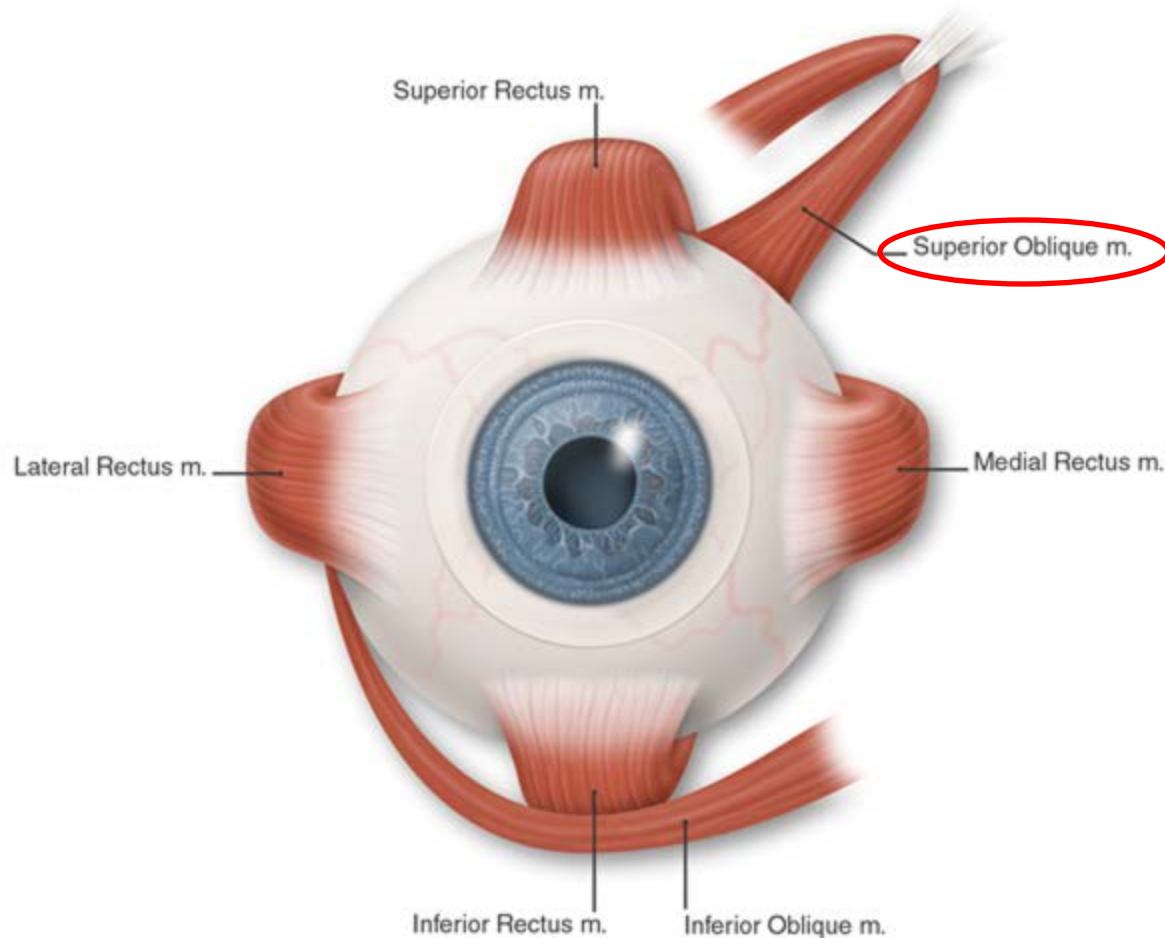
Trochlear  
nerve

# CN 4: Trochlear nerve

- Only cranial nerve to exit the dorsal surface of brain
- Cell bodies are on contralateral side of innervated muscles: unique



# Trochlear nerve: 1 extraocular muscle (superior oblique)

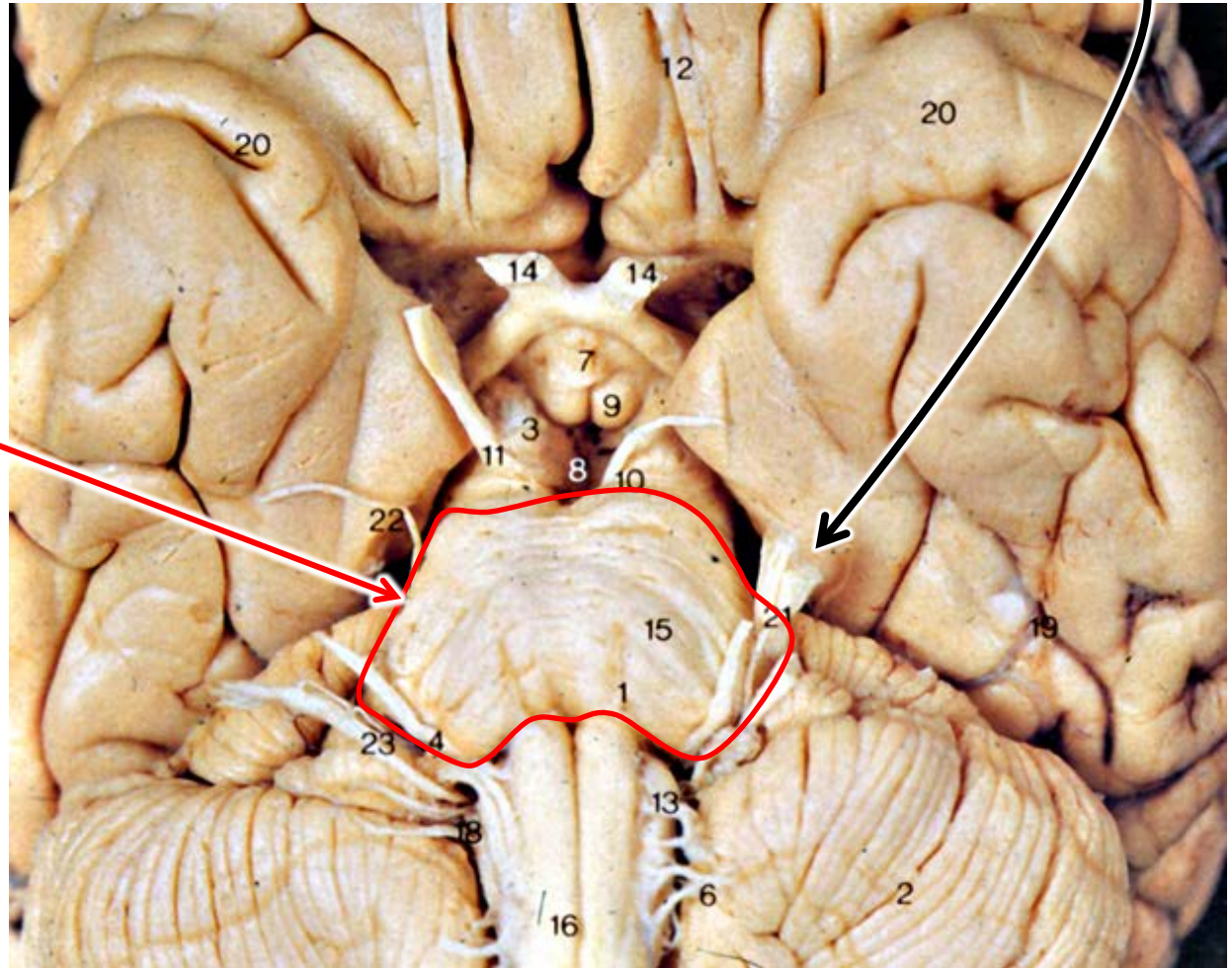


# Functions of trochlear nerve

- Special sensation
  - Smell, vision, hearing, balance, taste, oxygen, CO<sub>2</sub>
- Cutaneous sensation
  - Touch, temperature, vibration, pain, etc.
- Visceral sensation
  - E.g., sensors for blood pressure & stomach fullness
- **Skeletal muscles**
  - Superior oblique (extraocular muscle)
- Visceral motor output
  - E.g., vagus slowing heart or increasing gut contraction

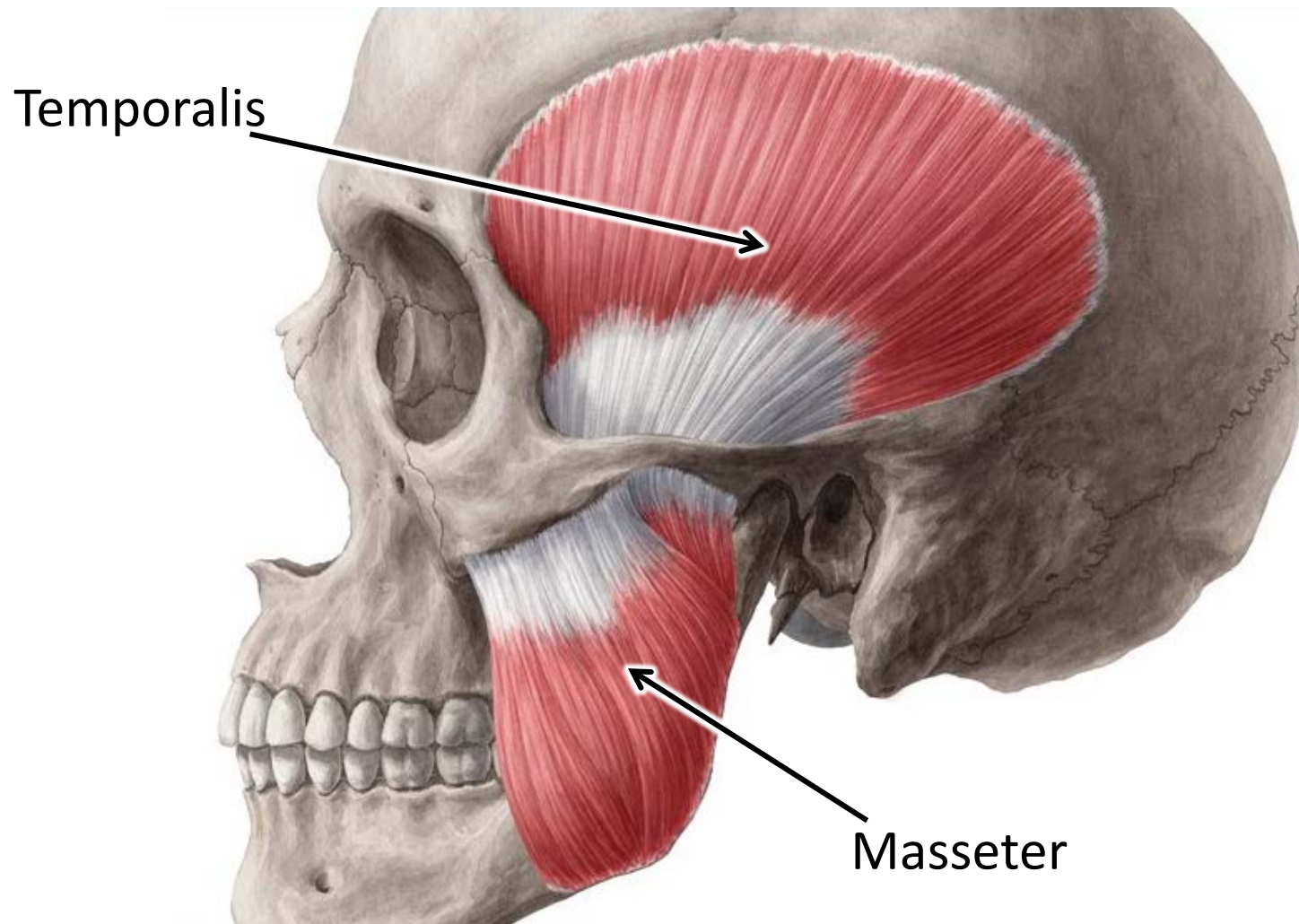
# CN 5: Trigeminal nerve

Trigeminal  
nerve: only  
cranial nerve to  
exit **pons**

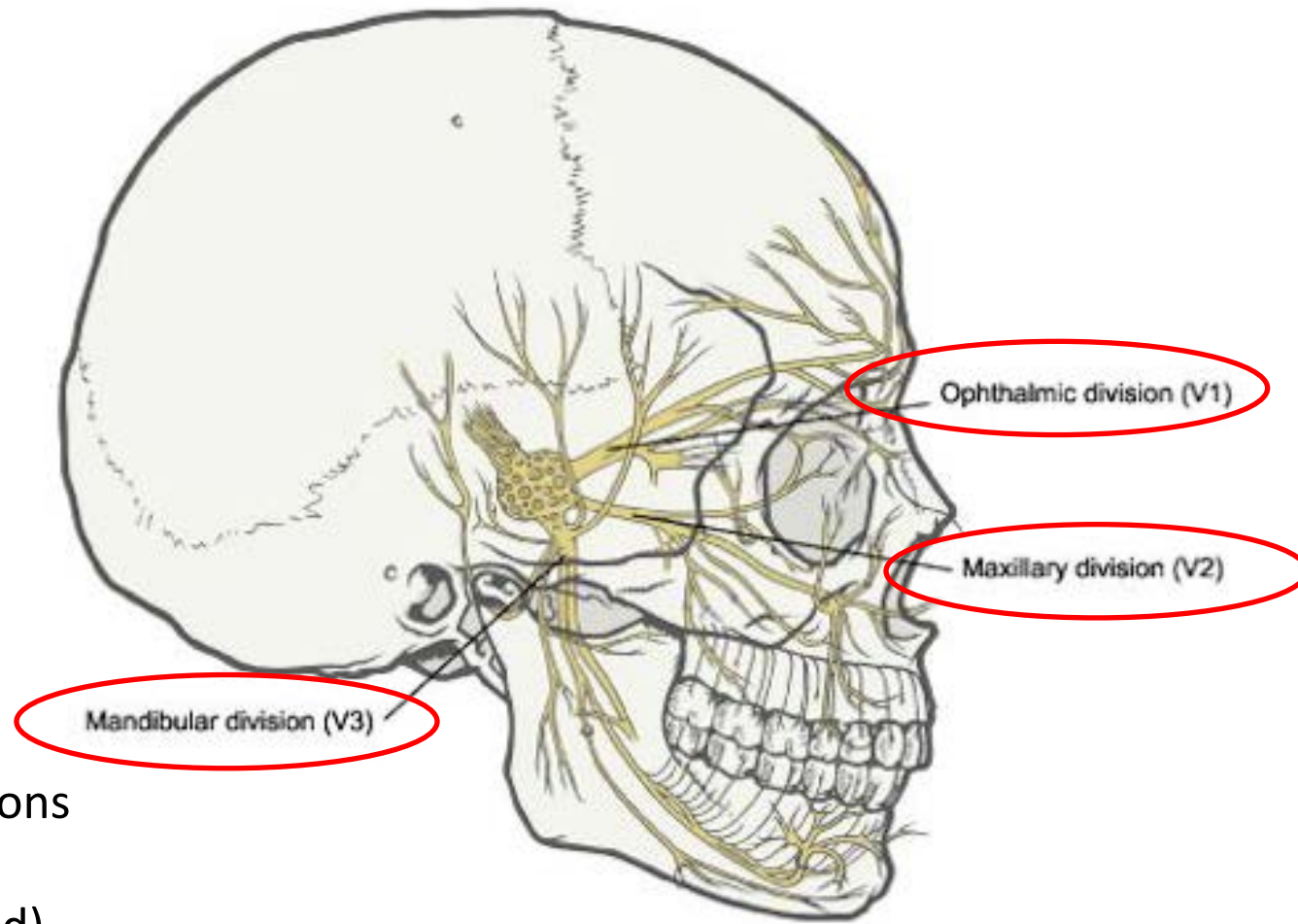




# CN 5: Trigeminal nerve: muscles of chewing



# CN 5: Trigeminal nerve: cutaneous sensation to face & head



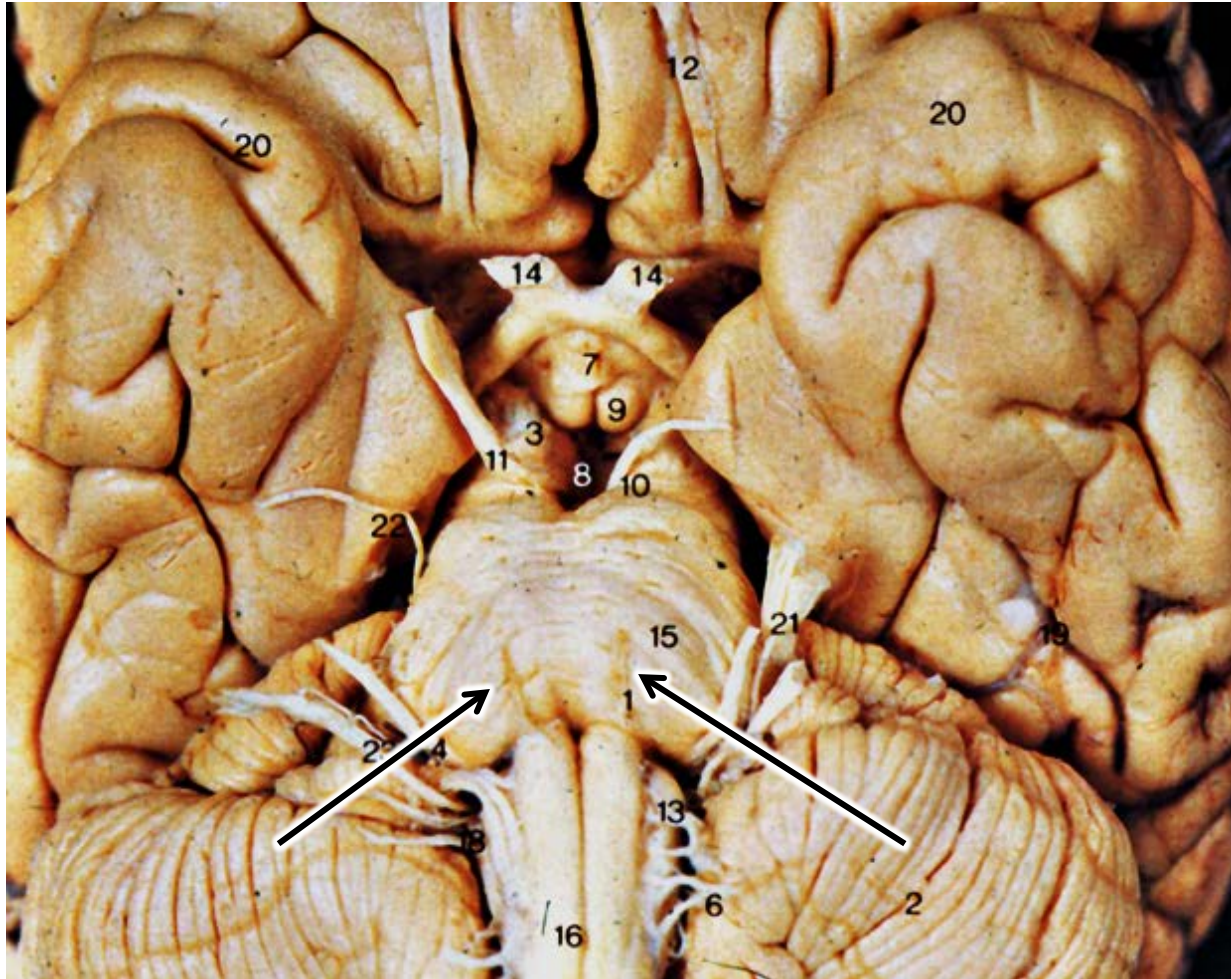
Three sensory subdivisions of trigeminal:

- Ophthalmic (forehead)
- Maxillary (cheek & nose)
- Mandibular (lower jaw)

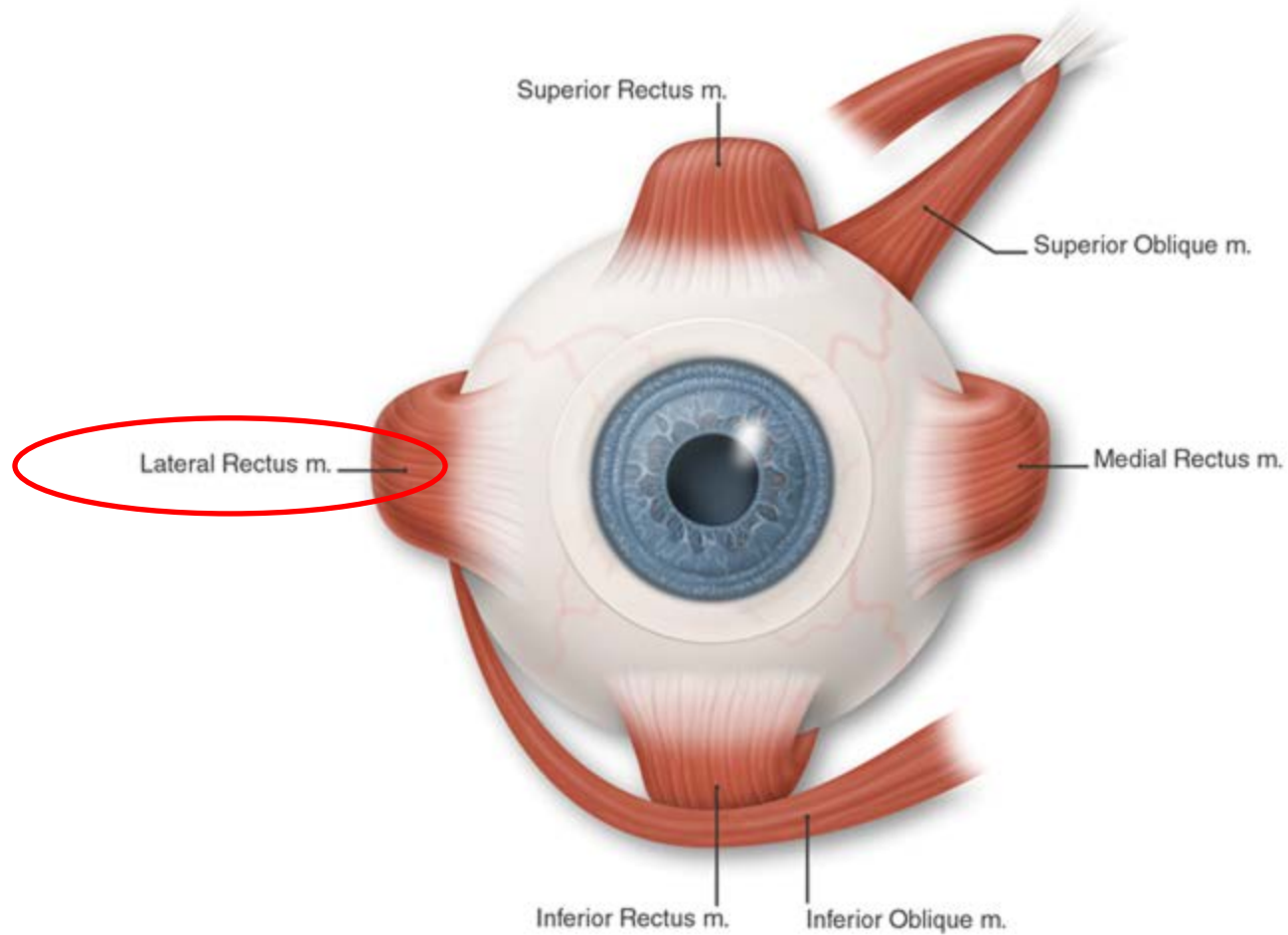
# Functions of Trigeminal nerve

- Special sensation
  - Smell, vision, hearing, balance, taste, oxygen, CO<sub>2</sub>
- Cutaneous sensation
  - Touch, temperature, vibration, pain, etc.
- Visceral sensation
  - E.g., sensors for blood pressure & stomach fullness
- Skeletal muscles
  - E.g., facial muscles; muscles of chewing
- Visceral motor output
  - E.g., vagus slowing heart or increasing gut contraction

# CN 6: Abducens nerve



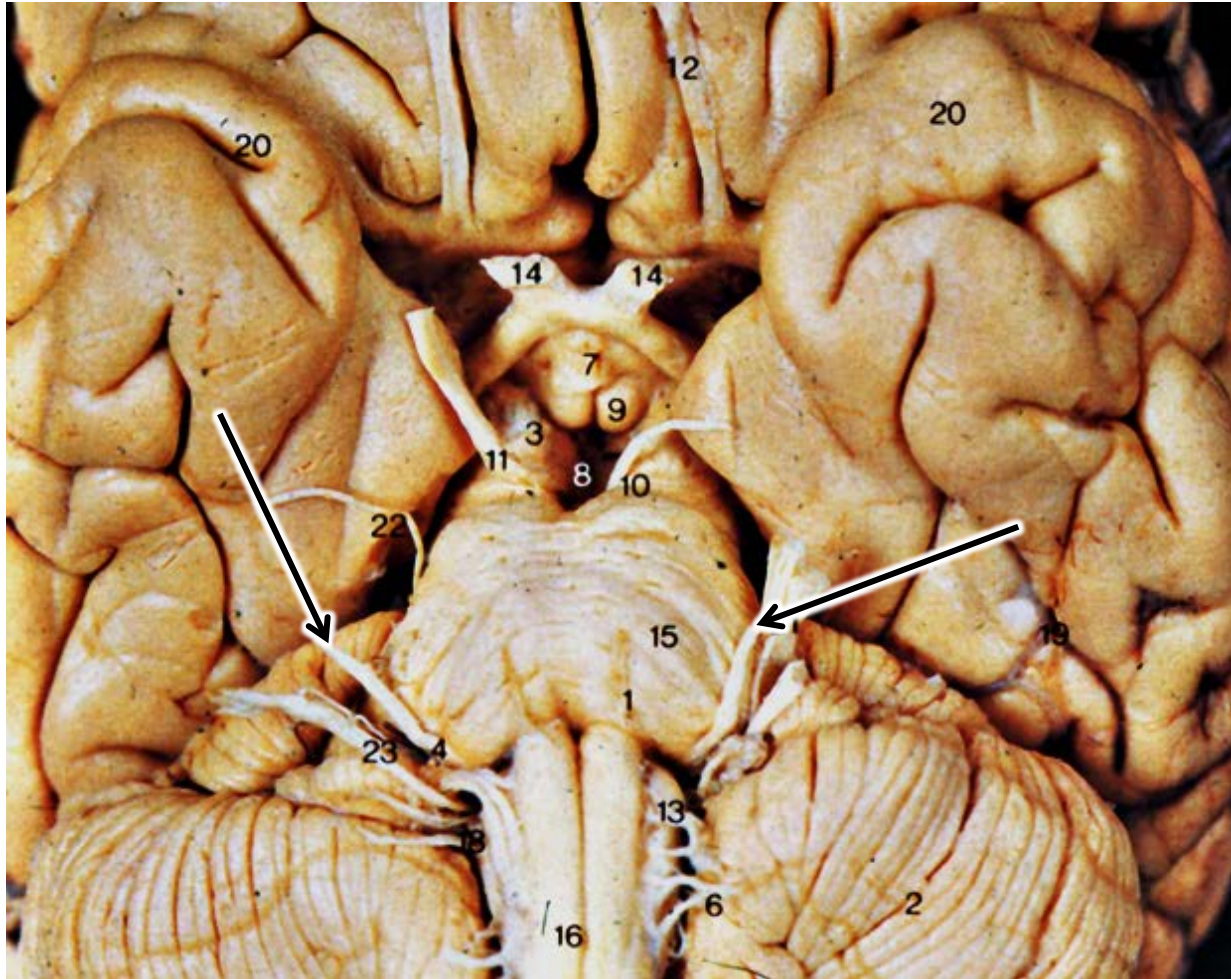
# CN 6: Abducens nerve



# Functions of cranial nerves

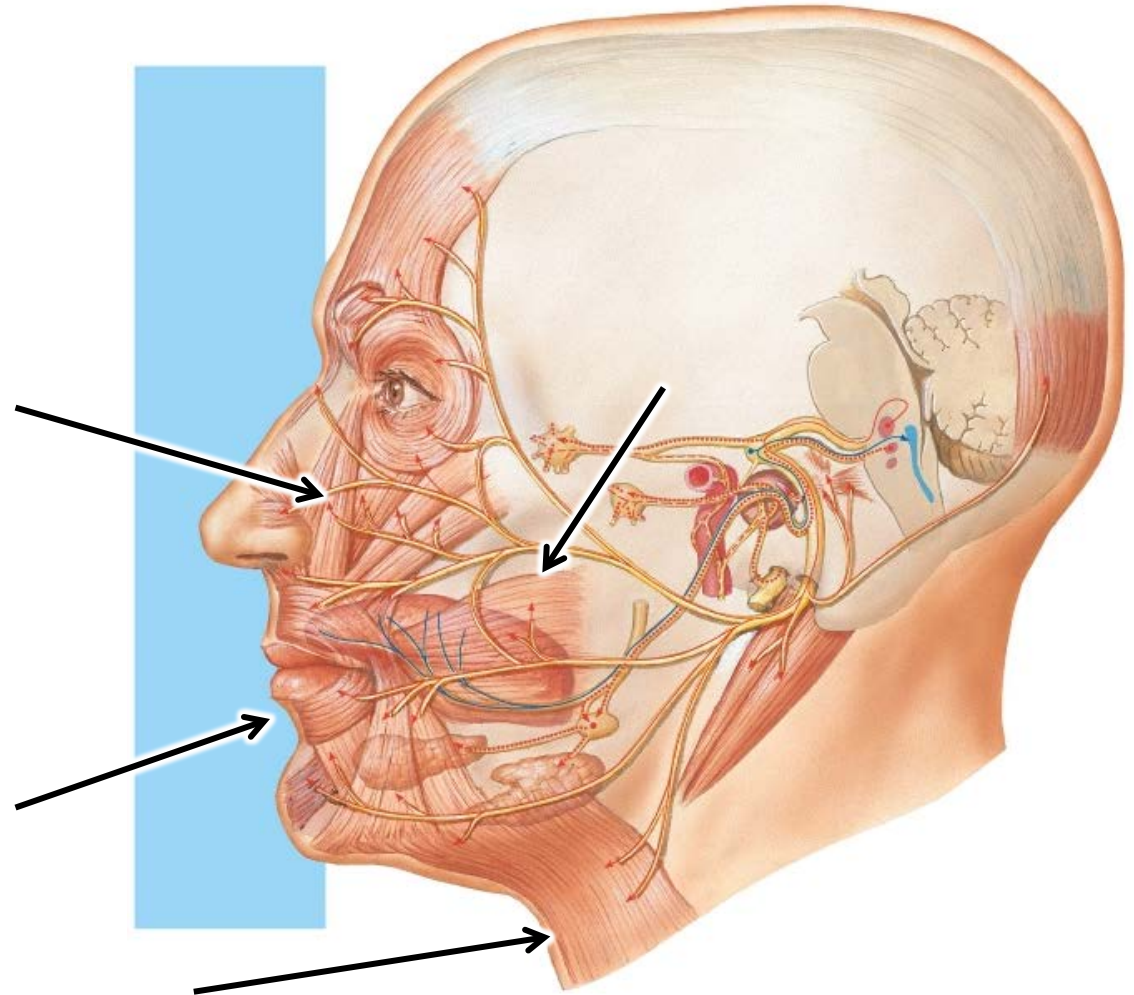
- Special sensation
  - Smell, vision, hearing, balance, taste, oxygen, CO<sub>2</sub>
- Cutaneous sensation
  - Touch, temperature, vibration, pain, etc.
- Visceral sensation
  - E.g., sensors for blood pressure & stomach fullness
- **Skeletal muscles**
  - Lateral rectus (“shifty eye”)
- Visceral motor output
  - E.g., vagus slowing heart or increasing gut contraction

# CN 7: Facial nerve



# CN 7: Facial nerve

## Muscles of facial expression

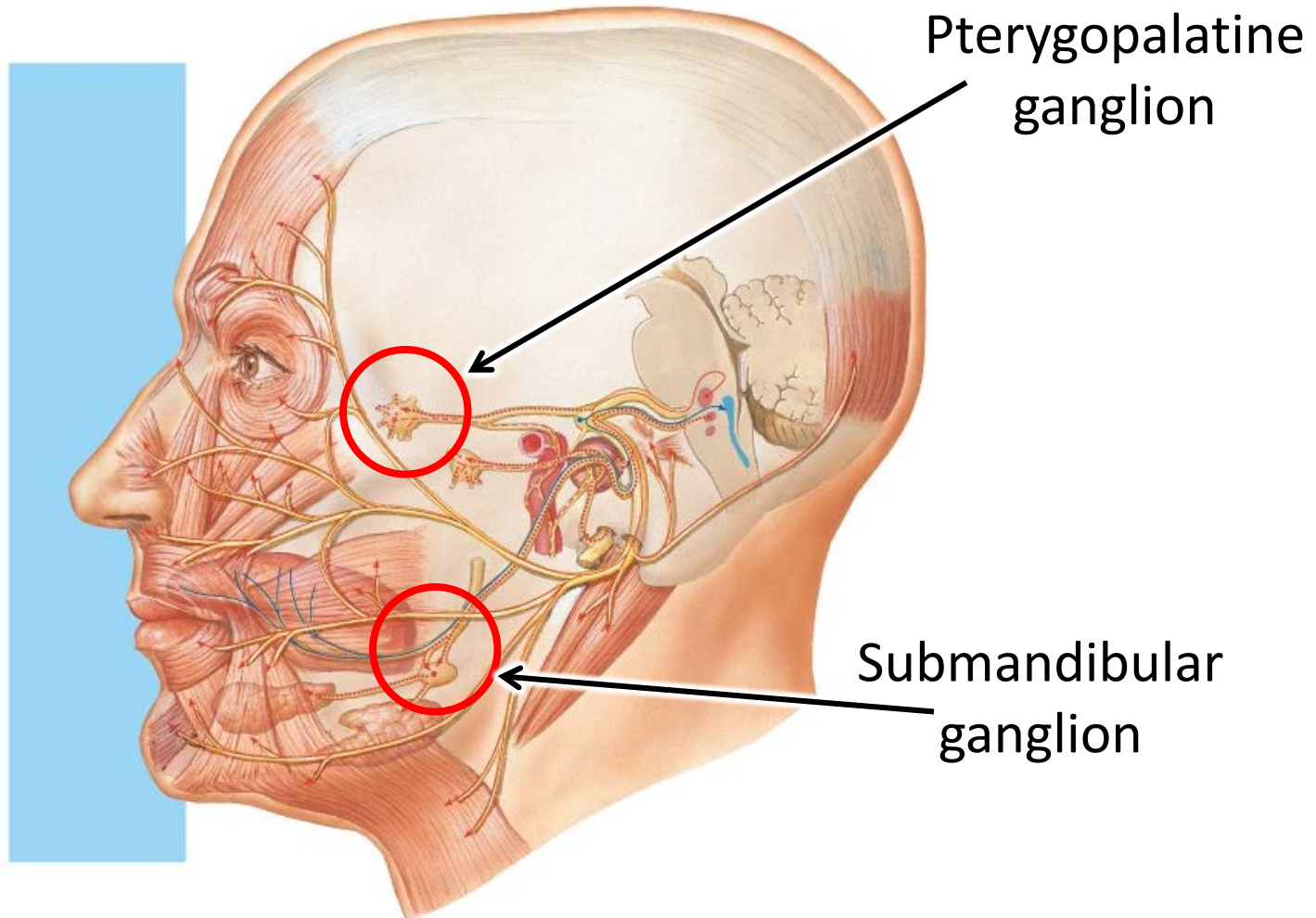


Superficial muscles embedded in, and attached to, the skin of the face.



# CN 7: Facial nerve

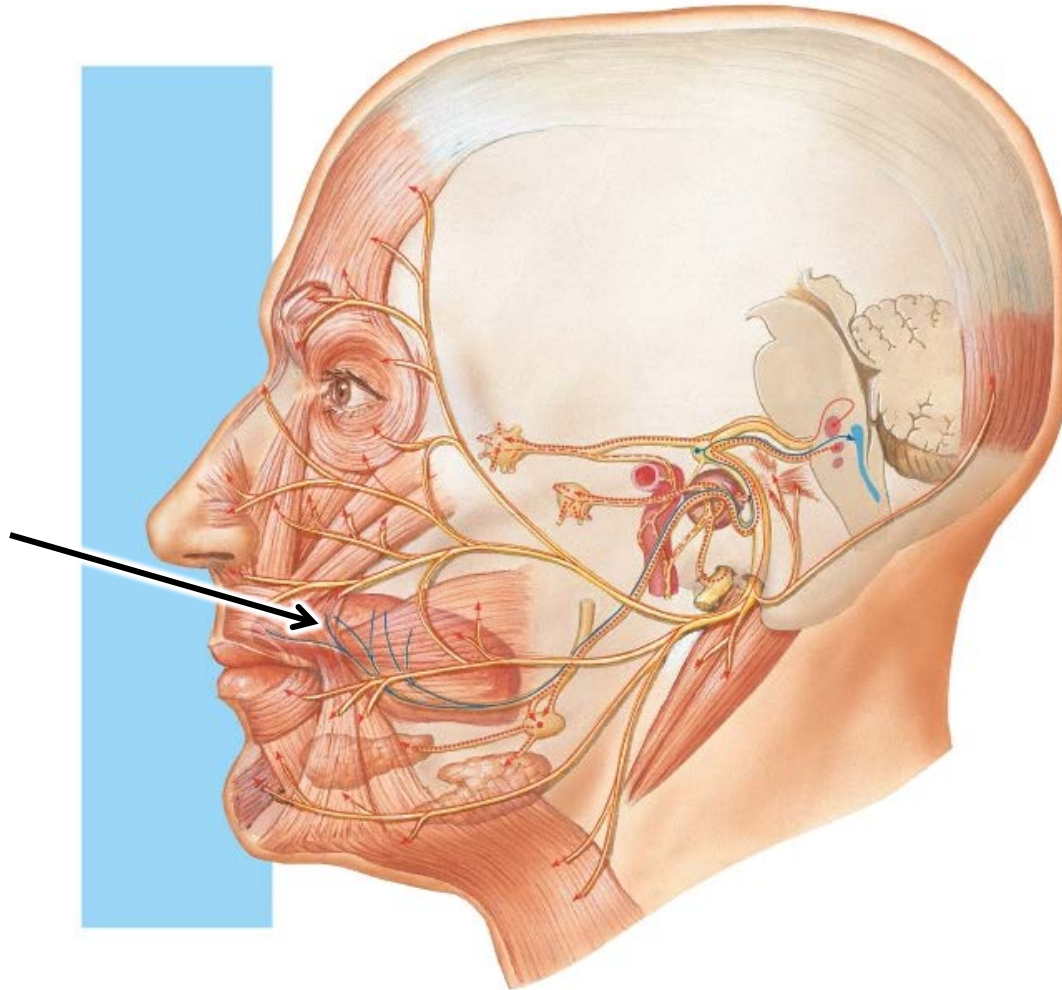
## Visceral motor



**Tears, snot, and saliva**

# CN 7: Facial nerve

## Special sensory

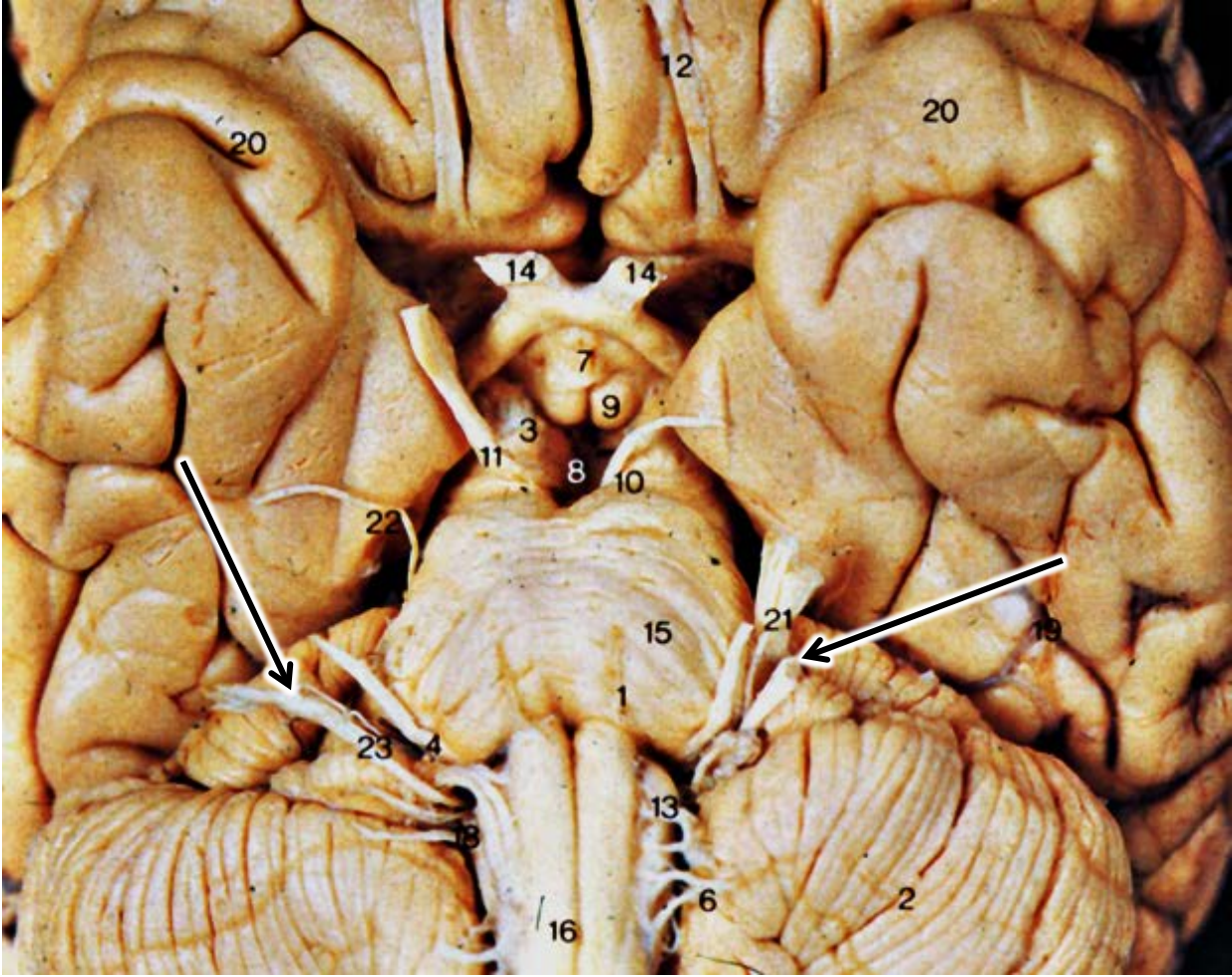


Mediates taste in the anterior 2/3 of the tongue

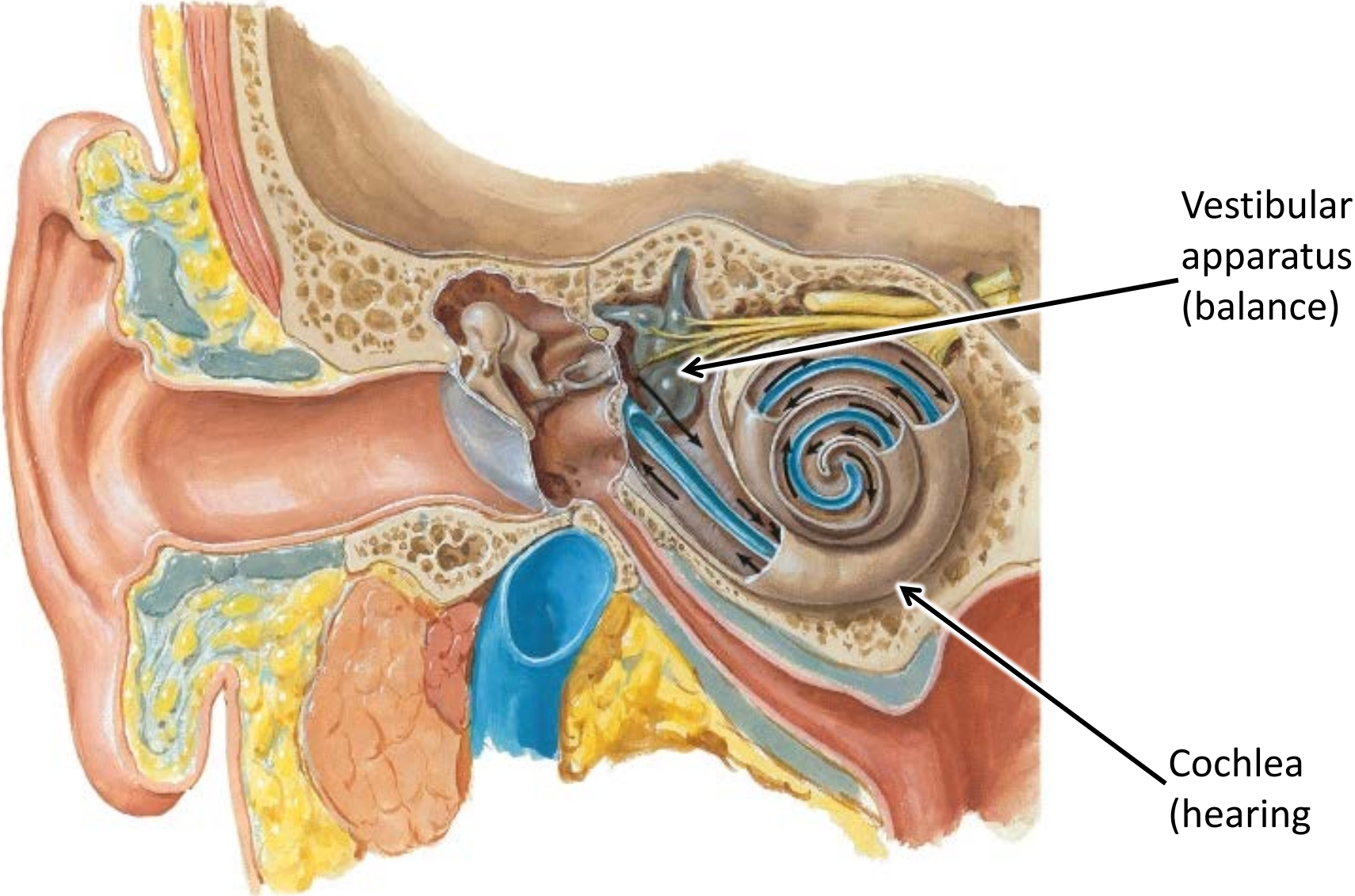
# Functions of facial nerve

- Special sensation
  - Taste to anterior 2/3 of tongue
- Cutaneous sensation
  - A small area around the ear is innervated by CN7
- Visceral sensation
  - E.g., sensors for blood pressure & stomach fullness
- Skeletal muscles
  - Muscles of facial expression
- Visceral motor output
  - Control of sublingual & submandibular salivary glands via submandibular ganglion; to nasal cavity and lachrymal glands (tears) via pterygopalatine ganglion

# CN 8: Vestibulocochlear nerve



# CN 8: Vestibulocochlear nerve

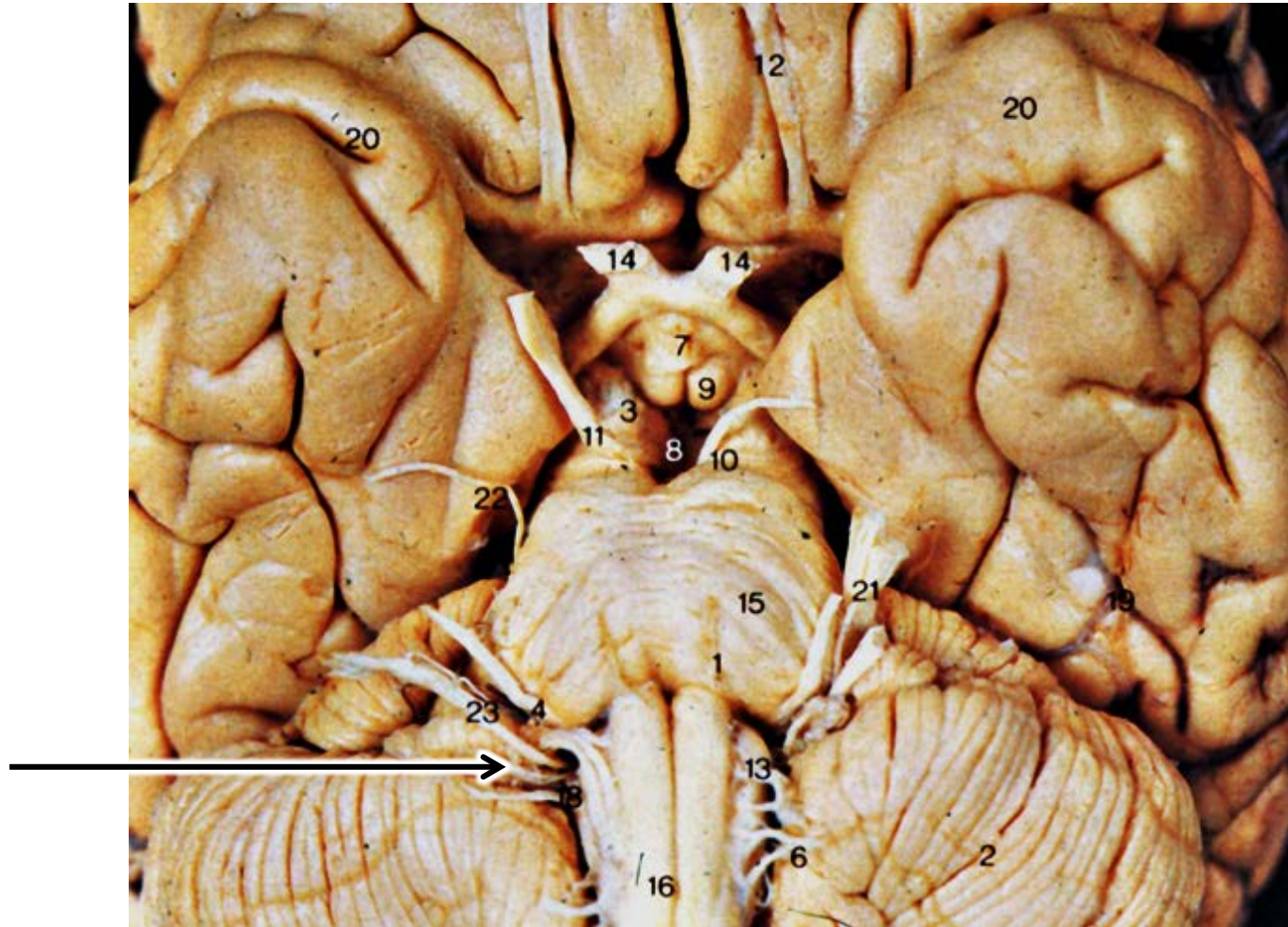




# Functions of vestibulocochlear nerve

- **Special sensation**
  - Hearing and balance
- **Cutaneous sensation**
  - Touch, temperature, vibration, pain, etc.
- **Visceral sensation**
  - E.g., sensors for blood pressure & stomach fullness
- **Skeletal muscles**
  - E.g., facial muscles; muscles of chewing
- **Visceral motor output**
  - E.g., vagus slowing heart or increasing gut contraction

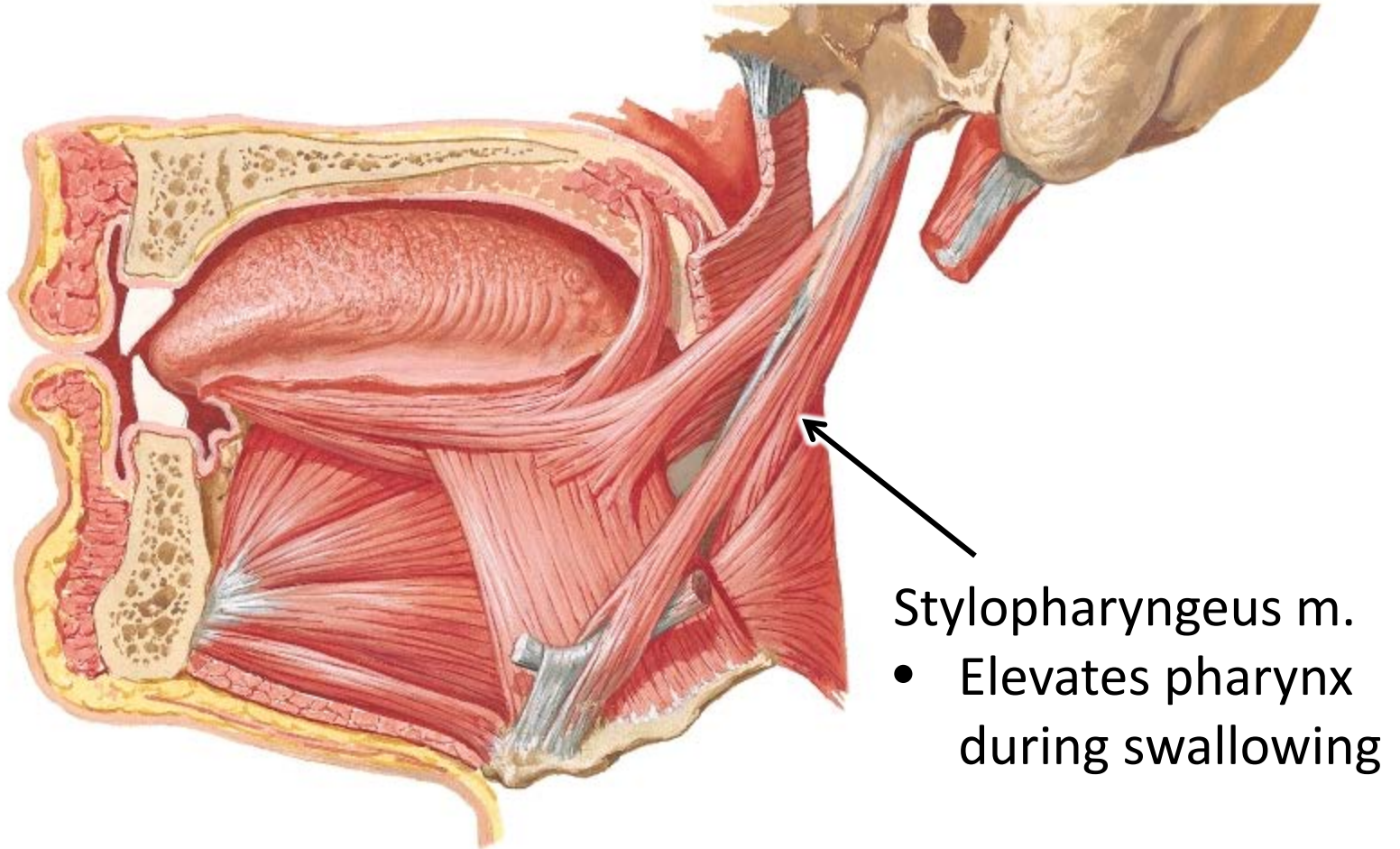
# CN 9: Glossopharyngeal nerve



Small nerve with complicated function

# CN 9: Glossopharyngeal nerve

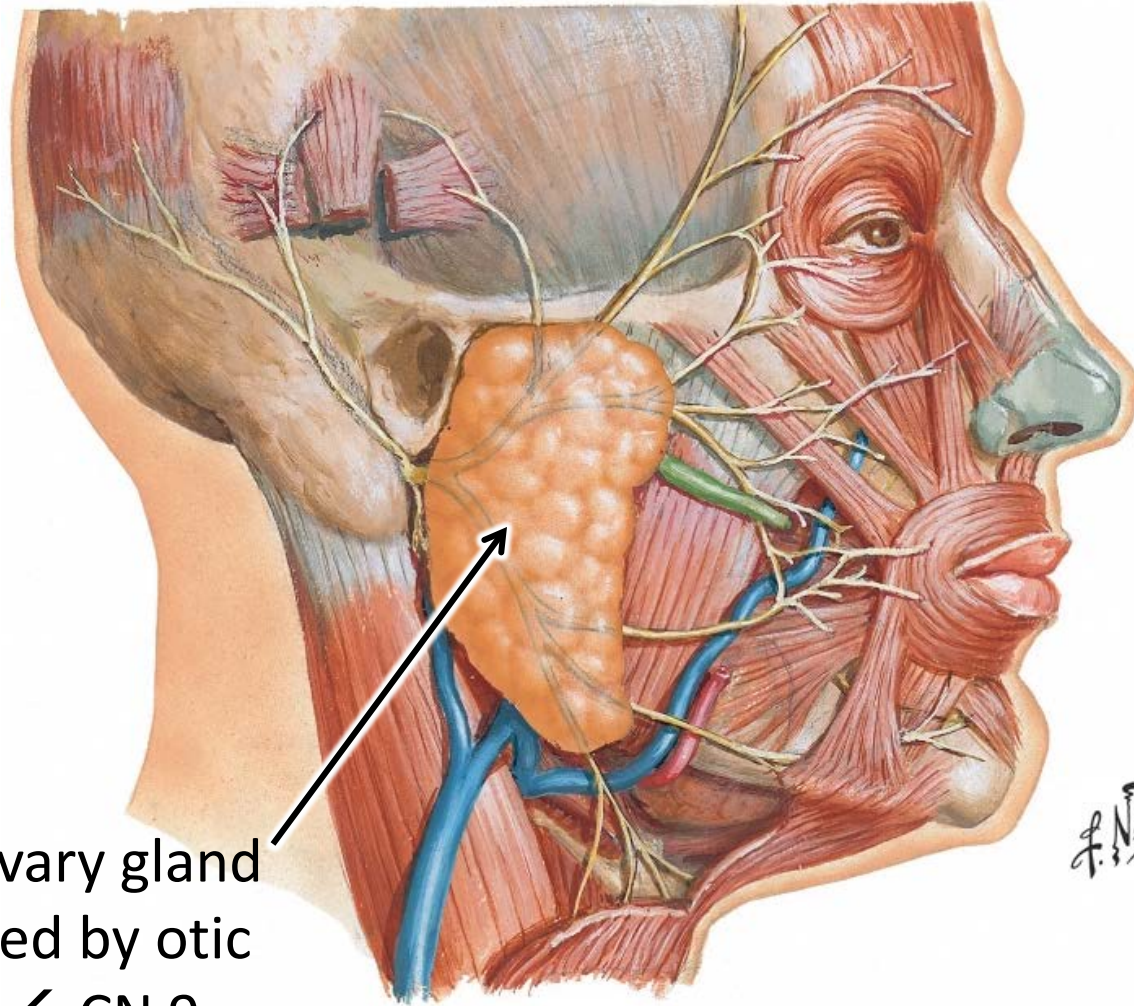
## Skeletal muscle of throat





# CN 9: Glossopharyngeal nerve

## Visceral motor

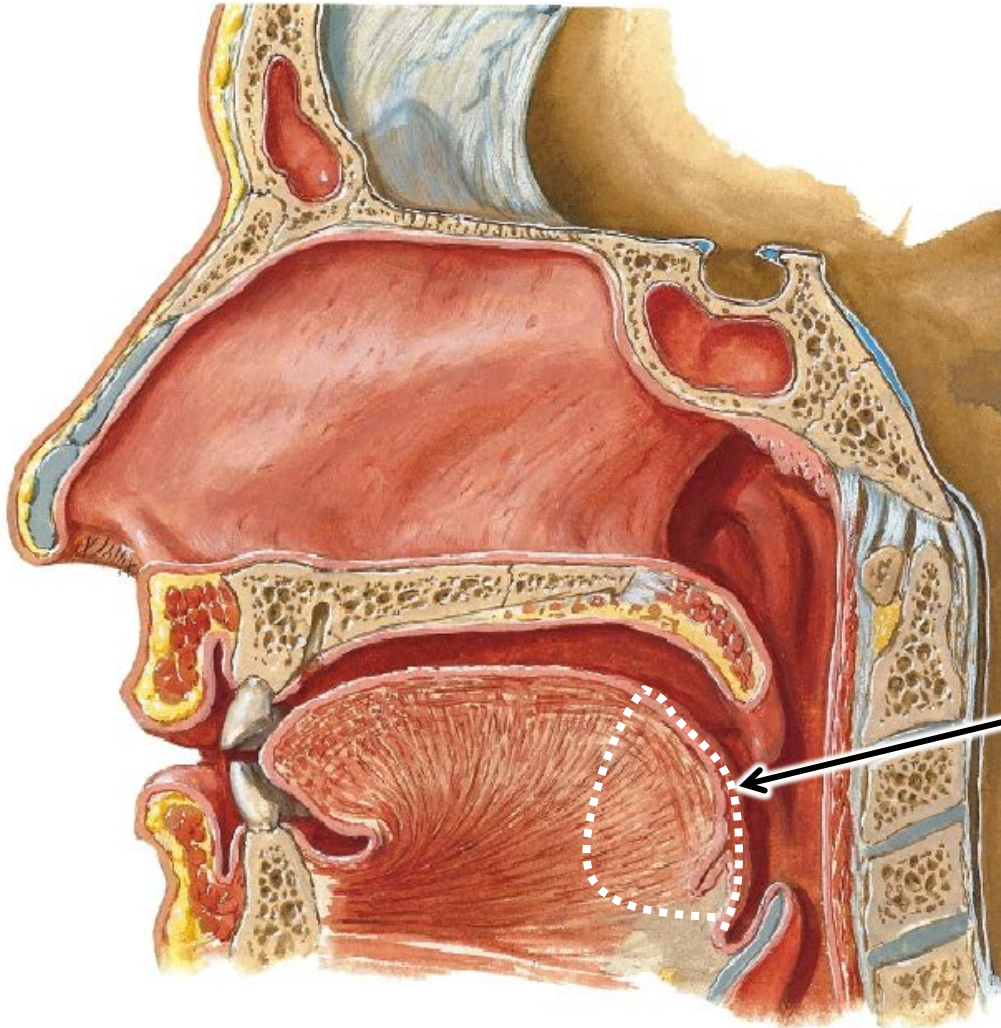


Parotid salivary gland

- Innervated by otic ganglion ← CN 9

# CN 9: Glossopharyngeal nerve

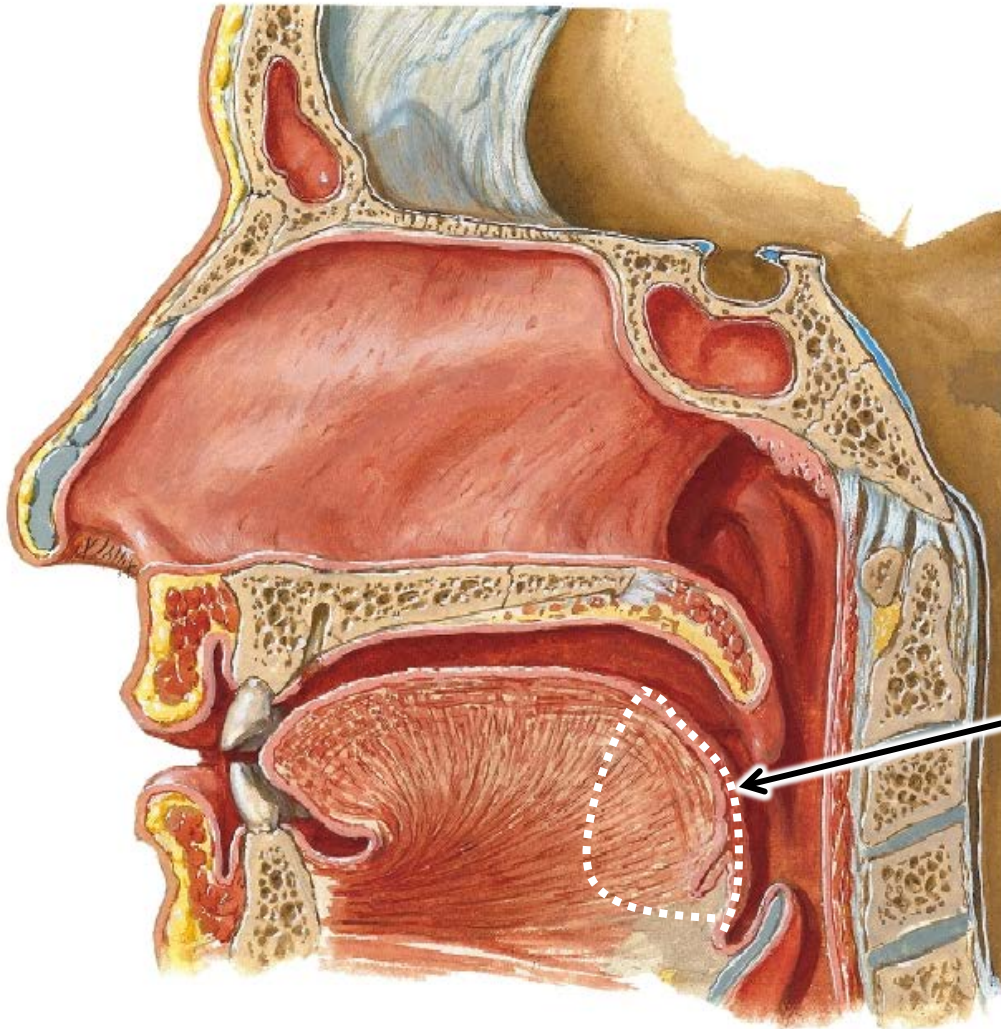
## General sensation



Touch, pain, etc.  
from posterior  
1/3 of tongue

# CN 9: Glossopharyngeal nerve

## Special sensation



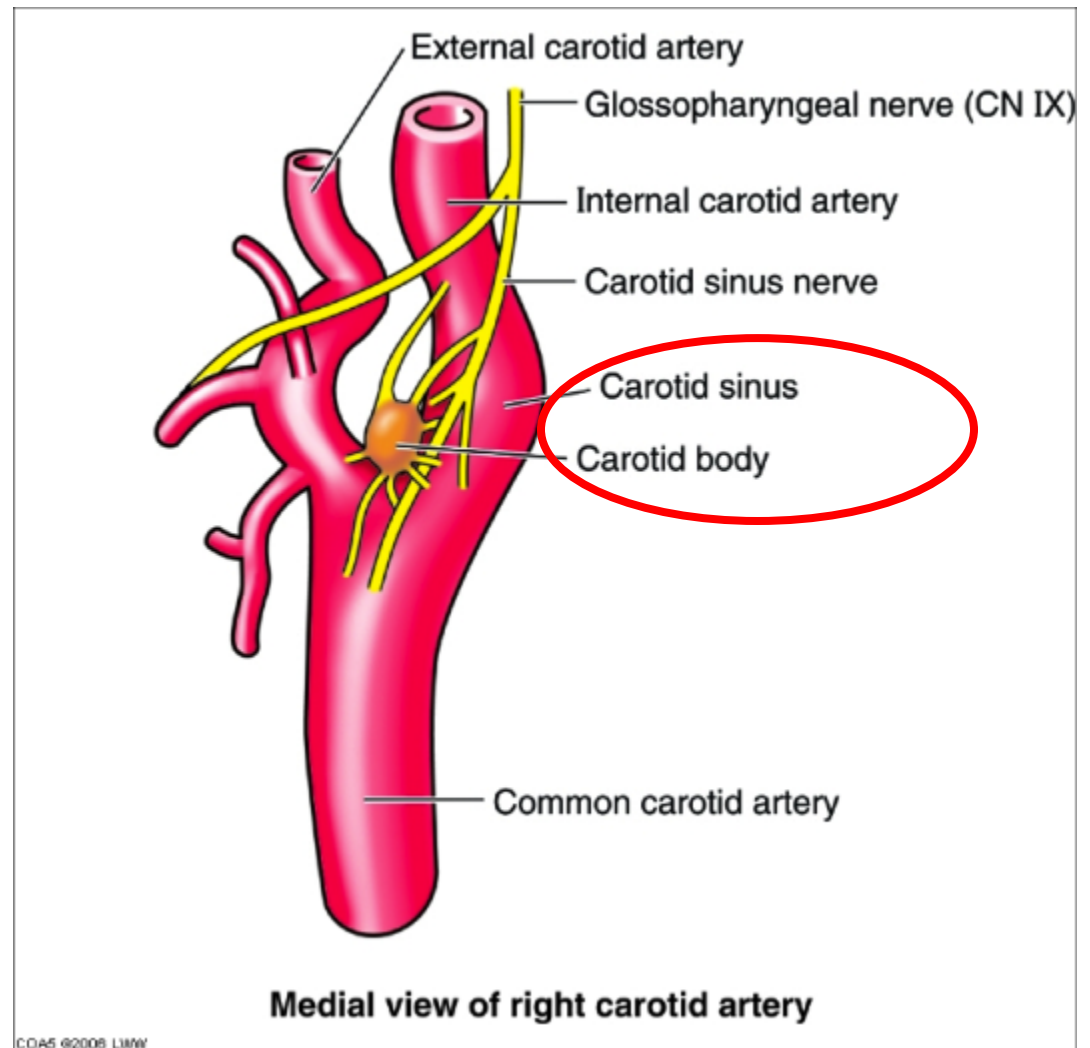
Taste from  
posterior 1/3 of  
tongue

# CN 9: Glossopharyngeal nerve

## Sensation: carotid body & sinus

Carotid **sinus**: senses blood pressure (general sensation)

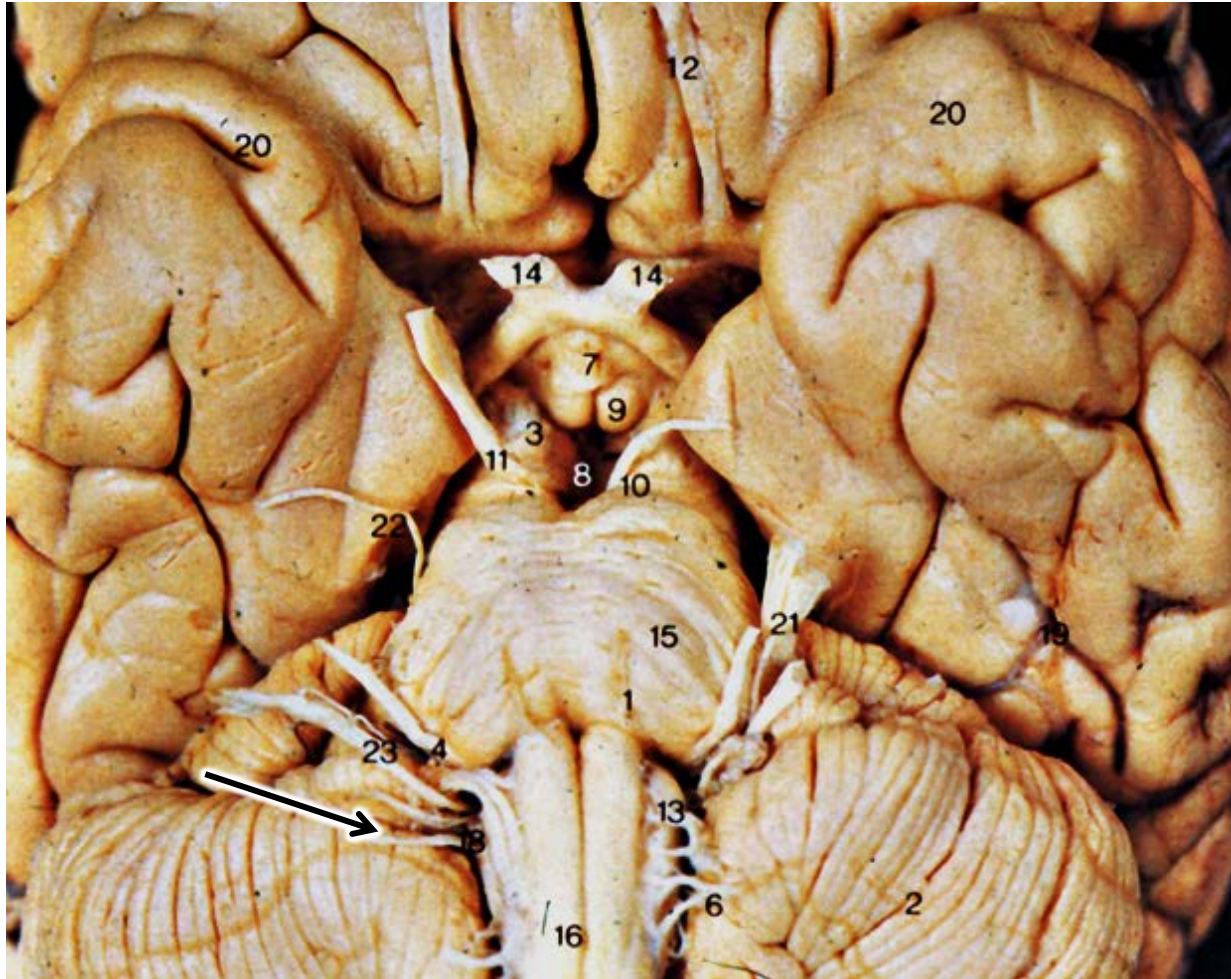
Carotid **body**: senses oxygen concentration in blood (special sensation)



# Functions of glossopharyngeal nerve

- Special sensation
  - Taste receptors in posterior 1/3 of tongue; oxygen receptors in carotid body
- Cutaneous sensation
  - Touch, temperature, vibration, pain, etc. in posterior 1/3 of tongue
- Visceral sensation
  - Blood pressure sensors in carotid body
- Skeletal muscles
  - Stylopharyngeus muscle
- Visceral motor output
  - Salivation from parotid gland (via otic ganglion)

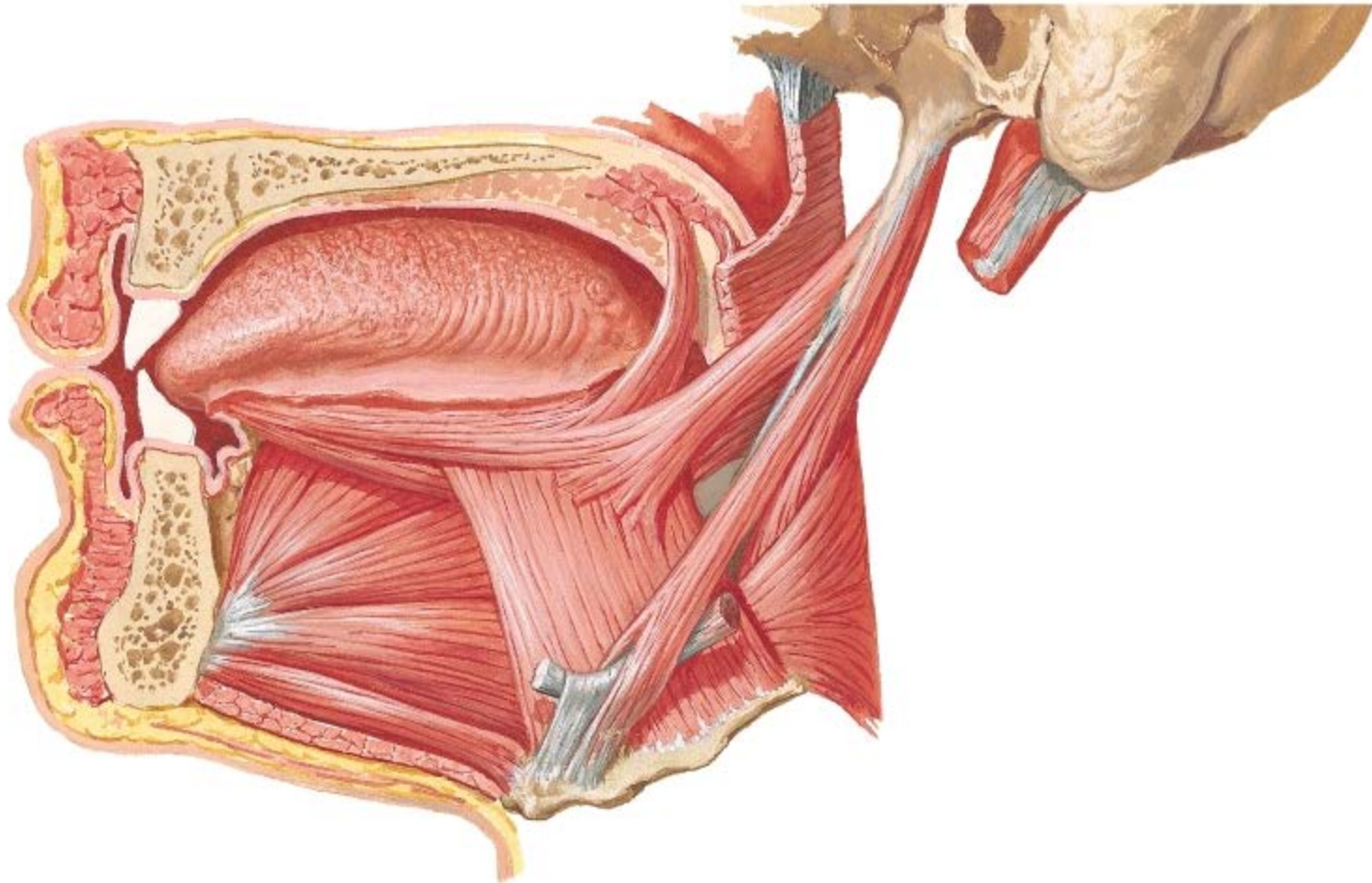
# CN 10: Vagus nerve



Major cranial nerve with complicated function

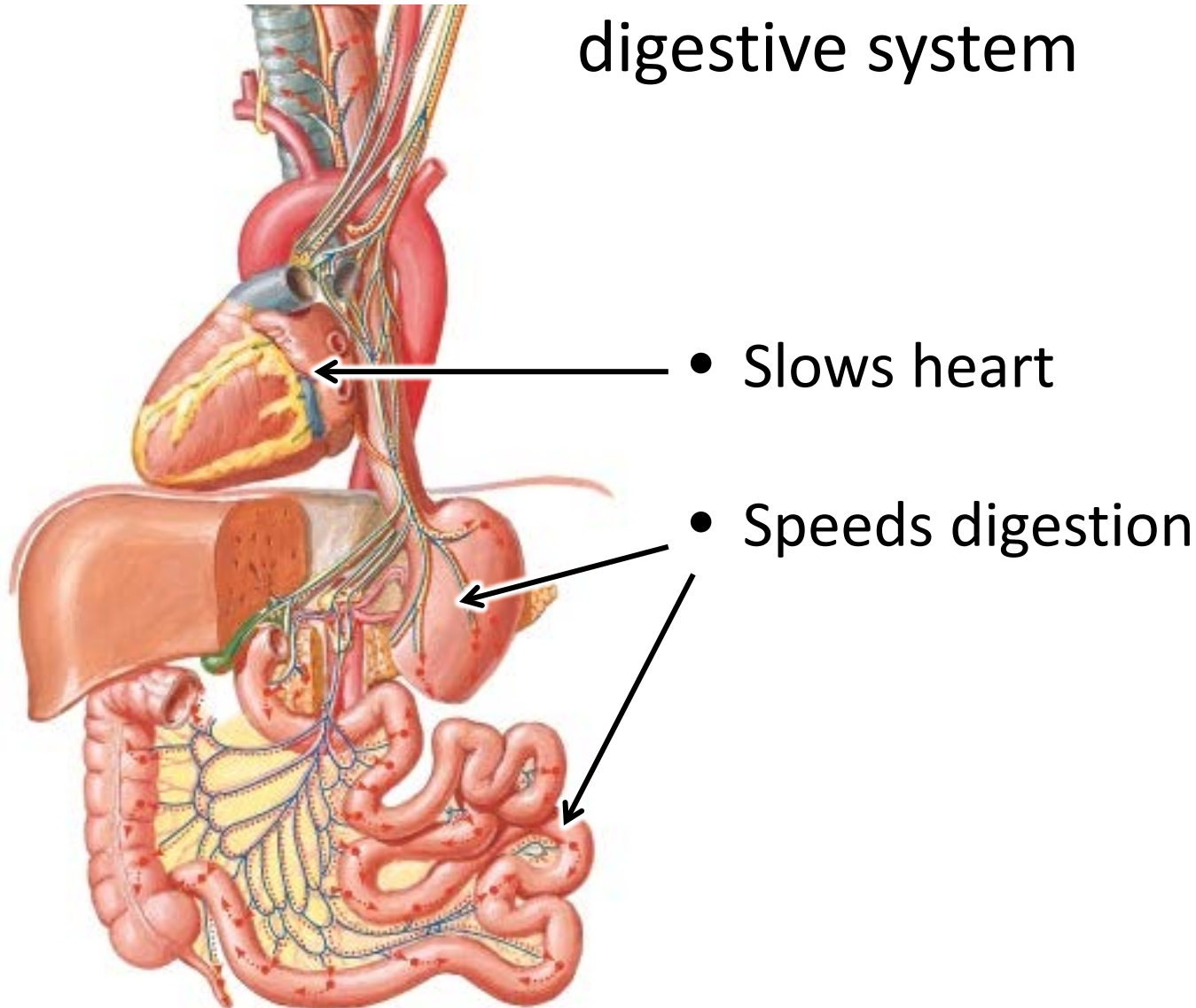
# CN 10: Vagus nerve

## Skeletal muscles of throat & larynx



# CN 10: Vagus nerve

Visceral motor output to heart & most of digestive system





# CN 10: Vagus nerve

- General sensation
  - Behind ear (small region)
  - Larynx
- Special visceral sensation
  - Blood oxygenation & CO<sub>2</sub>
    - Sensors in aortic arch
  - Taste receptors in back of throat

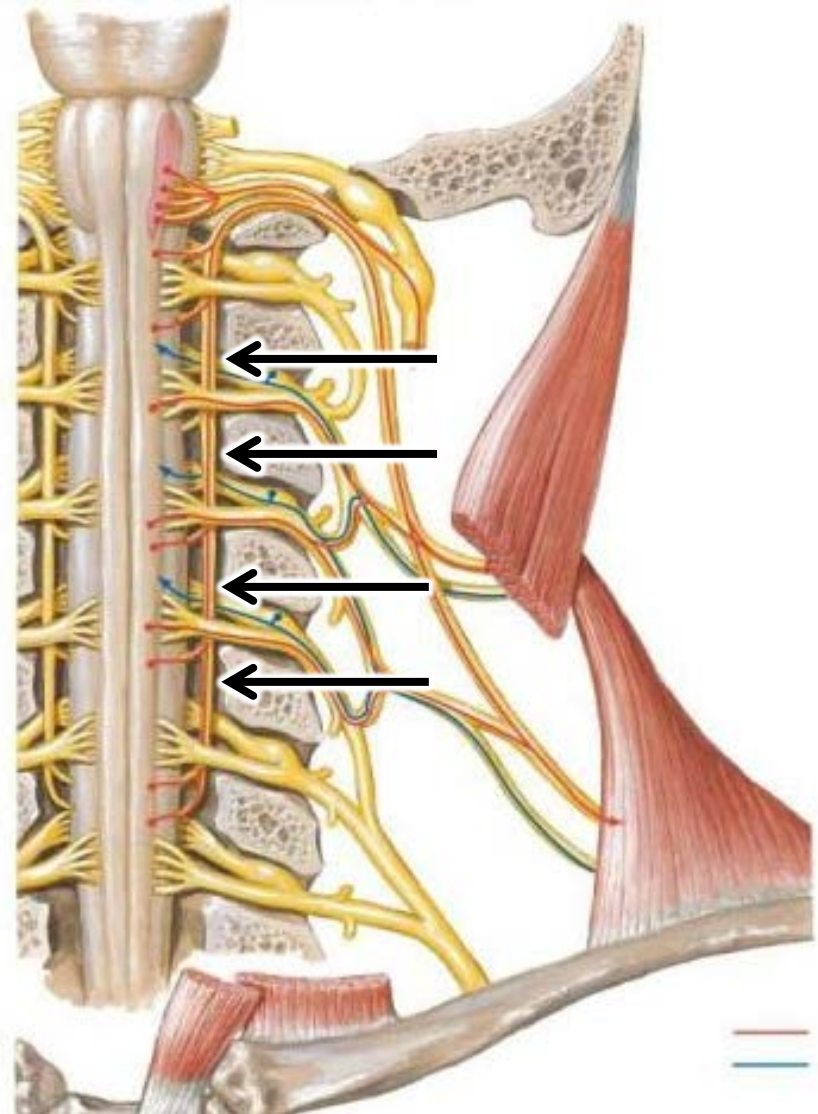
# Functions of Vagus nerve

- Special sensation
  - Taste to back of throat; O<sub>2</sub> & CO<sub>2</sub> sensors in aorta
- General sensation
  - Touch, temperature, vibration, pain, etc. behind ear and in digestive system
- Visceral sensation
  - Sensors for blood pressure in aortic arch
- Skeletal muscles
  - Muscles of throat (swallowing)
- Visceral motor output
  - To heart (slowing) and gut (contracting)

# CN 11: Spinal accessory nerve

## Unusual cranial nerve

- One component arises from brain stem
- Another component arises from spinal cord—fibers form bundle (arrows) that enters skull through foramen magnum
- Components join, & exit through jugular foramen





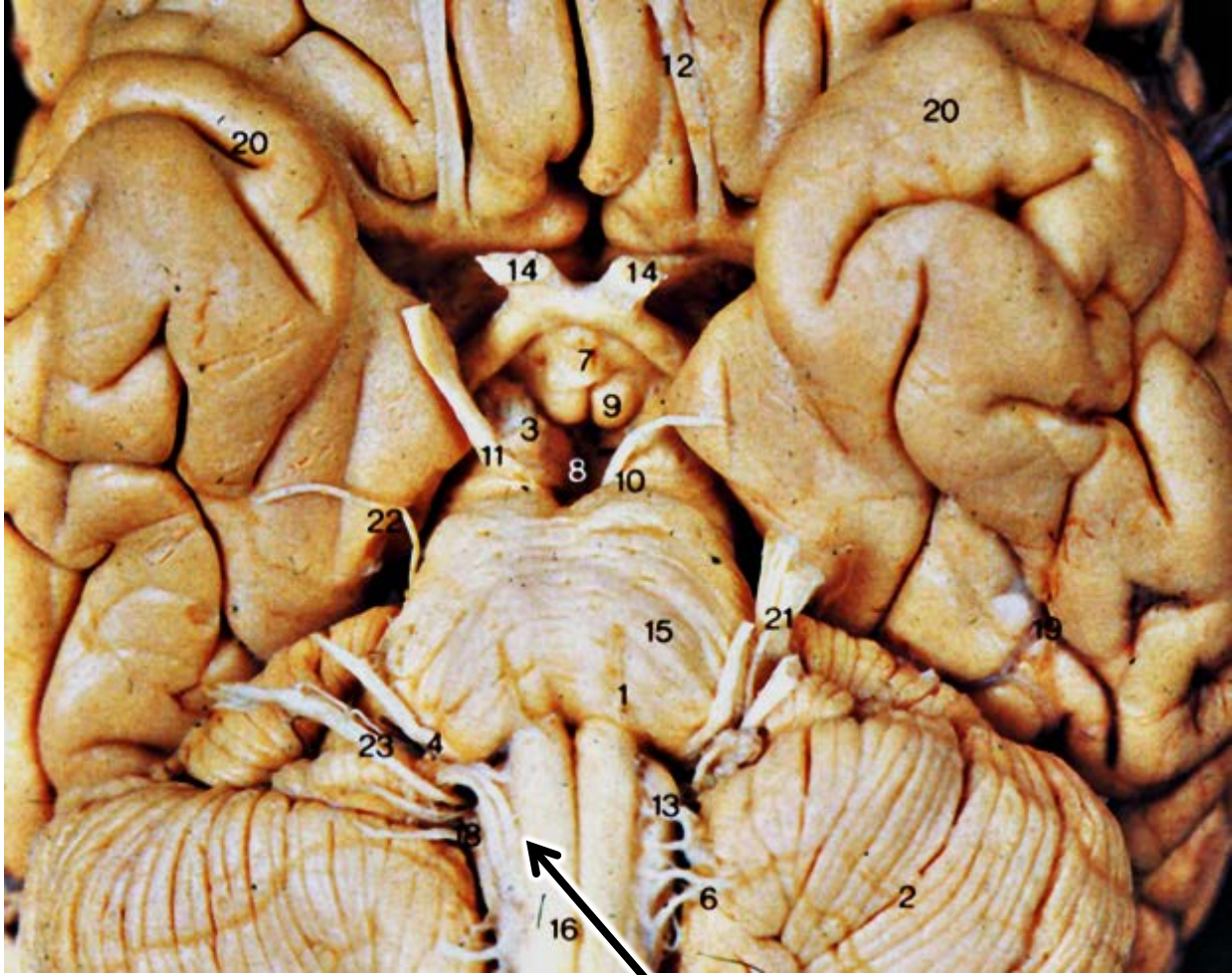
# CN 11: Spinal accessory nerve

- Skeletal muscle
  - Spinal component innervates sternocleidomastoid and trapezius
  - Cranial component innervates parts of larynx

# Functions of spinal accessory nerve

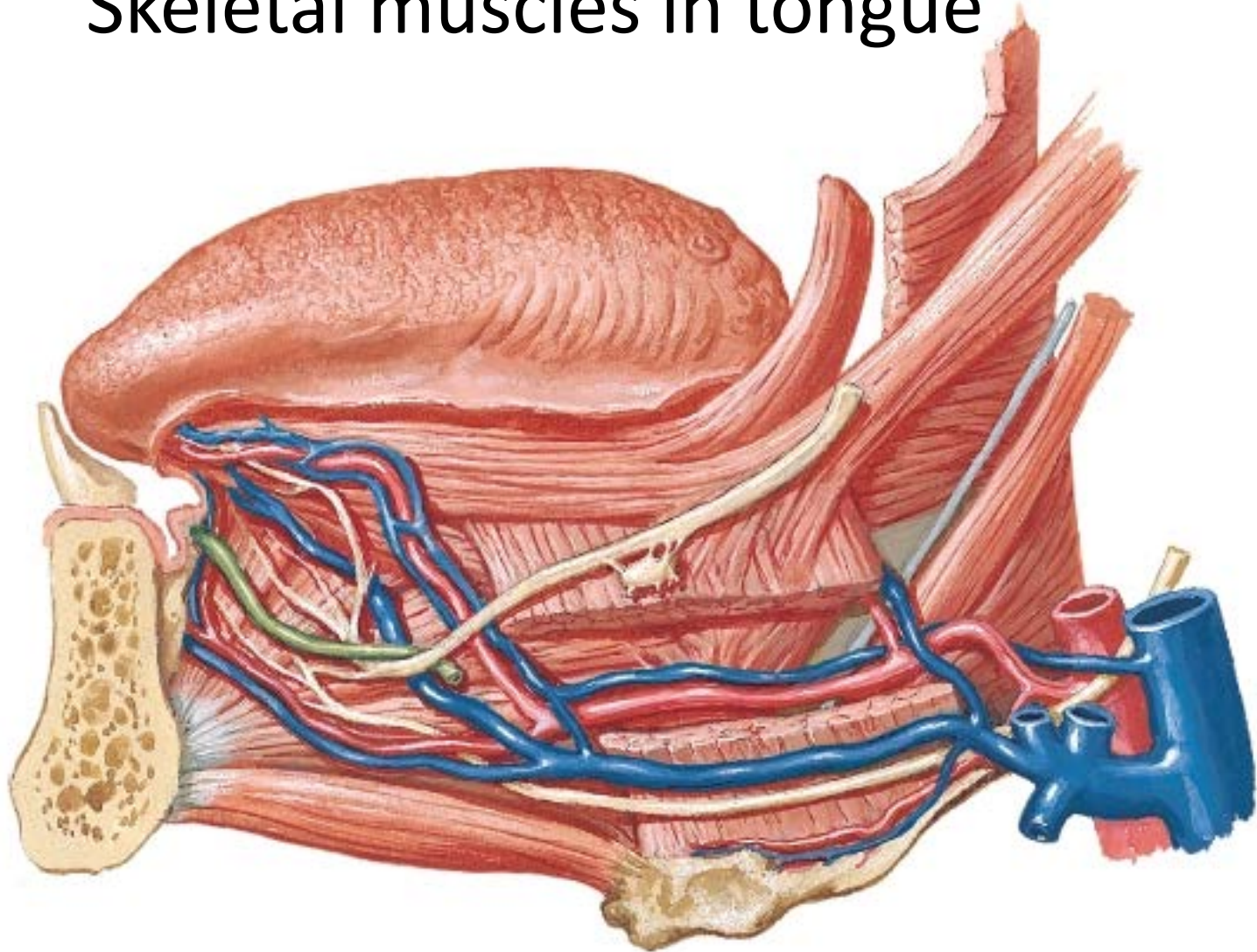
- Special sensation
  - Smell, vision, hearing, balance, taste, oxygen, CO<sub>2</sub>
- Cutaneous sensation
  - Touch, temperature, vibration, pain, etc.
- Visceral sensation
  - E.g., sensors for blood pressure & stomach fullness
- **Skeletal muscles**
  - Sternocleidomastoid, trapezius; larynx
- Visceral motor output
  - E.g., vagus slowing heart or increasing gut contraction

# CN 12: Hypoglossal nerve



# CN 12: Hypoglossal nerve

## Skeletal muscles in tongue



# Functions of hypoglossal nerve

- Special sensation
  - Smell, vision, hearing, balance, taste, O<sub>2</sub>, CO<sub>2</sub>
- Cutaneous sensation
  - Touch, temperature, vibration, pain, etc.
- Visceral sensation
  - E.g., sensors for blood pressure & stomach fullness
- **Skeletal muscles**
  - Muscles of tongue
- Visceral motor output
  - E.g., vagus slowing heart or increasing gut contraction