THE CRANIAL NERVES

Nerve	Course	Innervation	Lesion	Test
Olfactory nerve (I)	Can be considered an extension of brain. 20 olfactory nerve bundles pass from the bulb of the olfactory nerve → through cribiform plate of ethmoid in anterior cranial fossa → roof of nose	Only innervate roof of nose – sensory to smell	Loss of smell (**anosmia**) can result from damage, perhaps from: Fracture of cribifrom plate Neuroma/meingioma compressing the olfactory bulb	Test by asking patient to identify strong smells (coffee / chocolate) through each individual nostral.
Optic nerve (II)	Pass from back of eye → through orbit → through optic canal in sphenoid ▪ Nerve impulses from lateral retina: → visual cortex of same side ▪ Nerve impulses from nasal side of retina: → cross to other side in the optic chiasma Optic chiasma lies in front of pituitary stalk & between the terminal parts of internal carotid on either side.	Retina	Pituitary tumour → compression of optic chiasma: ➔ **Bitemporal hemianopia** – nasal ½ of retina (which recieves light from temporal field) is insensitive to light Pressure to the <u>side</u> of the optic chiasma: ➔ **Nasal hemianopia**	Careful testing of the visual field of each eye
Occulomotor nerve (III)	Passes from front of midbrain → between posterior cerebral and superior cerebral arteries → into cleft of dura between free edge of tentorium & dura over petroclinoid ligament → through lateral wall of cavernosus sinus → superior orbital fissure (within tendinous ring) → into orbit	All extrinsic muscle of the eye *except* ▪ Superior oblique ▪ Lateral rectus ▪ Involuntary levator palpebrae superioris	Lesions can lead to: ▪ Impaired eye movements ▪ Double vision ▪ Drooping eyelid	Tested by asking the patient to look side to side, and then up and down with the eye in the medial, and then lateral position.
Trochlear nerve (IV)	Small & thread-like Arises from back of midbrain → runs forwards under free edge of tentorium → passes beneath & lateral to III → enters dura of lateral wall of cavernosus sinus → lateral part of superior orbital fissure (outside tendinous ring) → enters orbit → passes medially to superior oblique muscle.	Superior oblique muscle	Inability to look down at nose (although lesions are very rare)	Ask the patient to look towards the nose (medially) and then downwards.

<table>
<tr><td>Trigeminal nerve (V)</td><td>Leaves anterolateral surface of <u>pons</u> → forwards over petrous crest with extension of dura and arachnoid from posterior cranial fossa → forms a trigeminal ganglion in Meckel's cave in apex of petrous bone → <u>3 large sensory divisions</u> & a motor part which joins the madibular (3rd) division</td><td colspan="3">➢ Opthalmic division (V_i): passes through <u>superior orbital fissure</u> → orbit
➢ Maxillary nerve (V_{ii}): passes forwards through the <u>foramen rotundum</u> → pterygopalatine fossa
➢ Mandibular division (V_{iii}): passes directly downwards through <u>foramen ovale</u> into the infratemporal fossa.</td></tr>
<tr><td>Opthalmic (V_i)
Sensory</td><td colspan="2">Runs through lateral wall of cavernus sinus → divides into 3 branches:
▪ Frontal (→ supra-orbital + supra-trochlear) – outside ring
▪ Lacrimal – outside ring
▪ Nasociliary – inside ring
o Long ciliary nerves
o Short ciliary nerves
o Anterior ethmoidal nerve (sensation to nose)

Long ciliary nerves: sensory + symp
Short ciliary nerves: sensory + symp + parasymp

Lacrimal nerve carries automomics to lacrimal gland:
Parasymp: CNVII → greater petrosal nerve
Symp: internal carotid plexus → deep petrosal nerve
Greater petrosal nerve + deep petrosal nerve = nerve of the pterygoid canal
Both→ pterygoid canal → pterygopalatine ganglion → synapse (PS) → maxillary nerve (Vii) → zygomatic nerve → zygomaticotemporal nerve → lacrimal nerve → lacrimal gland.</td><td><u>Sensory:</u>
▪ Conjunctiva
▪ Skin of upper eyelid
▪ Bridge of nose & forehead
Cornea & sclera (via ciliary branches)</td><td rowspan="2">Tested for by touch, temperature, pressure and pain, on dermatome of skin in the forehead and face</td></tr>
<tr><td>Maxillary division (V_{ii})
Sensory

All happens in pterygopalatine fossa</td><td colspan="2">Lateral wall of cavernosus sinus → foramen rotundum → pterygopalatine fossa.
In the pterygopalatine fossa gives off branches through the:
• Infraorbital nerve: infraorbital fissure → infraorbital canal → infraorbital foramen (to front of face)
• Nasopalatine nerve: Sphenopalatine foramen → nasal cavity → incisive foramen → hard palate
• Greater palatine nerve: palatine canal → hard palate (through greater + lesser palatine foramina)
• Superior alveolar nerves (anterior/middle/post)
o Post: own branch through alveolar foramen</td><td><u>Sensory:</u>
▪ Mid-face
▪ Nasal cavity
▪ Palate

Infraorbital:
▪ Lower eylid + associated conjunctiva
▪ Skin of midface + upper e

Superior alveolar:</td></tr>
</table>

	○ **Mid + ant:** branches of infraorbital nerve in the maxilla • **Zygomatic nerve:** carrying automonics which will end up in lacrimal nerve Associated with the pterygopalatine ganglion which recieves parasympathetic from facial (VII) [greater superficial petrosal nerve], and gives autonomic to each of the branches of the maxillary.	▪ Maxillary teeth ▪ Maxillary antrum ▪ *Anterior* – nose *Zygomatic* Skin over zygomatic + temple *Autonomic:* ▪ lacrimal gland, secretion from nose, palate & sinuses	
Mandibular division (V_{iii}) *Sensory + motor* All happens in **infratemporal fossa**	Passes through **foramen ovale** → infratemporal fossa In the infratemporal fossa gives off: • **Meningeal nerve (nervus spinosus)** – through foramen spinosum • **Anterior division – <u>motor</u> to muscles of mastication** **(+ long buccal nerve)** • **Posterior division – <u>sensory:</u>** ○ **Lingual nerve:** runs on surface of lateral and medial pterygoid muscle → onto bone of mandible → travels medially across floor of mouth → hooks underneath submandibular duct → runs into the substance of the tongue ○ **Inferior alveolar nerve**: enters mandible via mandibular foramen → exits onto face through mental foramen to become ***mental nerve*** ○ **Auriculotemporal nerve** (splits either side of the middle meningeal artery) – *carries parasymp to parotid* **(+ small <u>motor</u> branch to mylohyoid + anterior digastric muscle)**	*Meningeal nerve:* ▪ Dura of middle cranial fossa ▪ Mucosa of mastoid air cells. *Anterior division – motor:* ▪ All the muscles of **mastication** ▪ **Tensor tympani** (of middle ear) ▪ **Tensor veli palatini** (only palate muscle not supplied by pharyngeal plexus) ▪ + sensory to cheek via long buccal nerve. *Inferior alveolar nerve:* ▪ Sensation to pulp cavities of teeth	Test by asking the patient to clench jaw together and protrude jaw (checks motor supply to muscles of mastication). Sensory component of mandibular division is tested by testing sensation over the dermatome supplied by this nerve.

	Associated with otic ganglion which recieves parasympathetic from glossopharyngeal (via ***lesser superficial petrosal nerve***) and sends it to parotid gland (via auriculotemporal). Parasymps: *Chorda tympani:* Branch of facial nerve in middle ear → leaves the petrous temporal bone of middle ear through the **petrotympanic fissure** → submandibular ganglion → s/l + s/m salivary glands *Lesser superficial petrosal nerve:* CNIX (jugular foramen) → LSPN → through petrous temporal bone and exits through foamen ovale → otic → auriculotemporal → parotid		*Mental nerve supplies:* ▪ Skin and mucosa of lower lip and skin of chin. *Lingual nerve:* ▪ Carries general sensation to anterior 2/3 of tongue. ▪ Carries pregang. parasymp from chorda tympani (VII) → submandibular ganglion → postgangs. to submandibular & sublingual salivary glands. ▪ Taste sensation from anterior 2/3 of tongue → chorda tympani → facial nerve VII *Auriculotemporal:* ▪ Skin of temple, scalp, front of auricle. ▪ **Anterior of external auditory meatus.** ▪ Carries postganglionic parasymps → parotid (from IX → lesser superficial petrosal → otic ganglion → auriculotemporal → parotid)	
Abducent (VI)	Leaves lower anterior aspect of the pons → runs long way up clivis before piercing the dura → under petroclinoid ligament → within substance of cavernosus sinus → accompanies internal carotid through the sinus	Supplies the lateral rectus muscle	Long course makes it vulnerable to injury	Ask the subject to follow an object held out to the edge of the temporal field with the eye of the same side.

	→ passes through medial superior orbital fissure (through fibrous ring)			
Facial (VII)	Emerges between pons & medulla → passes laterally into **internal acoustic meatus** → laterally in meatus → medial wall of middle ear cavity → **geniculate ganglion** (contains sensory cell bodies) → turns posteriorly (genu) in boney canal → runs to posterior wall of middle ear cavity → travels down posterior wall in middle ear cavity → leaves skull through **stylomastoid foramen** → <u>enters the parotid gland</u> → runs forwards through substance of parotid (most superficial structure) → splits into branches at anterior margin of parotid gland: ▪ **Temporal, zygomatic, buccal, marginal mandibular, cervical branches** Branches within middle ear: ▪ **Greater superficial petrosal nerve** (close to geniculate ganglion). Travels in pterygoid canal. Gives parasymp to pterygopalatine ganglion (Vii). ▪ **Stapedius nerve** (in middle ear cavity) ▪ **Chorda tympani** (just before it leaves through the stylomastoid foramen, exits through **pterotympanic fissure** → parasymp to submandibular ganglion via lingual nerve)	Motor to all the muscles of facial expression.	**Bell's palsy** – often due to inflammation of the facial nerve in the facial canal of petrous temporal bone. →inability to blink →inability to show teeth →paralysis of buccinator Stroke (upper motoneuron lesion): →patient <u>can</u> still screw up eyes and blink →paralysis of muslces below level of eyes in face.	Tested by asking the patient to blink/screw up eyes and show their teeth.
	Chorda tympani	Branch of facial nerve just before it leaves through the stylomastoid foramen → travels up over tympanic membrane & handle of the malleus → leaves skull through **petrotympanic fissue** → immediately **joins lingual nerve**		Carries parasympathetic fibres to the submandibular ganglion. Carries special taste fibres from anterior 2/3 of tongue → facial nerve VII
Vestibulocochlear (VIII)	Emerges close to facial nerve between pons & medulla → internal acoustic meatus → **runs with facial nerve & labyrinthine artery** → cochlear & vestibular apparatus. Divides into: ▪ Cochlear division ▪ Vestibular division	Nerve of hearing & balance		
Cochlear division	Have their sensory gangia in the modiolus of the cochlea	Hearing	Usually air-conducted sound is louder than bone-conducted	

			sound. BUT if sound conducting pathway is damaged, then bone-conduction becomes louder. A tuning for placed 1st on the mastoid process (bone-conduction), then beside the ear (air-conduction), will distinguish this.
Vestibular division	Have their sensory ganglia in the internal acoustic meatus.	Balance	Ask patient to stand with feet together & eyes closed – patient will sway and fall to the side of the vestibular lesion.
Glossopharyngeal (IX)	Leaves through <u>jugular foramen</u> (posterior cranial fossa). There is a sensory ganglion just above and just below the jugualr foramen Passes down neck **between internal & external carotid** Travels in close association with **stylopharyngeus**. →enters pharynx **between superior and middle constrictor muscles.** ▪ Contributes to sensory pharyngeal plexus ▪ Runs to the back of tongue Branch passes up to the middle ear, and forms **<u>lesser superficial petrosal nerve</u>** → through foramen ovale → otic ganglion (PS to the parotid) Branch down to carotid body & sinus	*Motor:* • Stylopharyngeus *Sensory:* • Middle ear • Posterior 1/3 of tongue (both general sensation and taste) • Oropharynx • Baroreceptors and chemoreceptors of carotid body & sinus • Parasympathetic to the otic ganglion	Stimulate the back of the oropharynx. 'Gag-reflex' signals normal function of the glossopharyngeal.
Vagus (X)	Leaves skull in <u>jugular foramen</u> – has 2 ganglia here which contain the sensory cell bodies. →passes down neck in the **<u>carotid sheath</u>** Branches along its course: ▪ **Auricular branch** – through petrous temporal bone ▪ **Pharyngeal branch** – <u>motor</u> to pharyngeal plexus *Note this is mainly **vagoaccessory fibres*** ▪ **Superior laryngeal** – arises high in neck and travels down behind the internal carotid	*Auricular branch:* ▪ Skin behind ear ▪ **Posterior wall of external auditory meat**. *Pharyngeal branch:* ▪ Muscles of pharynx ▪ **levator palati** *External superior laryngeal:*	(Stimulation of auricular branch during operations may → vomitting via a vagal reflex) Test of vagal function: Ask patient to raise the soft palate (say 'aaaah') and swallow Also check that there is sensation in the piriform fossa and epiglottis.

	○ **External superior laryngeal** – motor to cricithyroid ○ **Internal superior laryngeal** – sensory ▪ **Recurrent laryngeal**: left (around aorta), right (around subclavian artery). ▪ **Vagal trunks** continue through thoracic inlet, found in the thorax lying against: Trachea on the right Arch of aorta on the left	▪ Motor to cricothyroid *Internal superior laryngeal:* ▪ Sensory to mucosa of larynx **above vocal folds** ▪ Inc vallecula *Recurrent laryngeal:* ▪ **Supply all intrinsic muscles of larynx except cricothyroid.** ▪ **Sensation to mucosa of larynx below vocal folds.**		
Accessory nerve (XI)	Arises from both medulla (cranial root) and upper cervical spinal segment (spinal root). Spinal root enters posterior cranial fossa through the foramen magnum & joins with the cranial root. Leaves the posterior fossa through the <u>jugular foramen</u> ▪ <u>Cranial root</u> immediately joins the vagus → vagoaccessory nerve → distributed to: ○ With pharyngeal nerve → pharyngeal plexus ○ With laryngeal nerves ▪ <u>Spinal root</u> runs into deep sternocleidomastoid → obliquely across the posterior triangle → trapezius	*Cranial accessory:* ▪ Larynx and pharynx with branches of vagus *Spinal accessory:* ▪ Motor to sternocleidomastoid & trapezius		*Spinal accessory nerve:* ▪ Ask patient to shrug their shoulders against reistance from your hand ▪ Turn their face against the palm of your hand ➢ Tests the force of the sternocleidomastoid & trapezius (right SCM turns face to the left, and vice versa)
Hypoglossal (XII)	Leaves skull through <u>foramen magnum</u> but then immediately enters the <u>hypoglossal canal</u> just above the occipital condyle Swings outwards & <u>laterally behind the vagus and internal & external carotids</u> – quite superficial At the level of the hyoid bone, the hypoglossal nerve runs forwards with the <u>lingual artery</u>	Motor to all intrinsic and extrinsic muscles of the tongue *except* palatoglossus.		Tested by asking patient to stick their tongue out – the tongue deviates to the side of any hypoglossal nerve lesion.

	Runs over lateral aspect of hyoglossus			

PARASYMP:

Note: for cranial nerve contributions to the ganglion of the head and neck: COPS 3977 (i.e. ciliary CN III, otic CN IX, pterygopalatine CN VII, and submandibular CN VII)

Lesser petrosal nerve (IX)
CNIX (jugular foramen) → LSPN → through petrous temporal bone and exits through **foamen ovale** → **otic ganglion** → auriculotemporal nerve (branch of Viii)→ parotid

Greater petrosal nerve (VII)
Facial nerve (close to geniculate ganglion in middle ear) → GSPN (pterygoid canal) → **pterygopalatine ganglion** → parasymp to branches of Vii

Occulomotor nerve (III)
Pregang PS (CNIII) → **ciliary ganglion** in orbit → postgang PS (short cilliary nerve, branch of Vi) → eye

Chorda tympani (VII)
Branch of facial nerve in middle ear → leaves the petrous temporal bone of middle ear through the petrotympanic fissure → joins lingual nerve → **submandibular ganglion** → parasym to submandibular + lingual salivary glands

			Origin of pregang PS	Carrier of postgang PS (CNV)	
V1	**Ciliary ganglion**	Orbit	CNIII	Short ciliary (Vi)	Ciliary body + iris
V2	**Pterygopalatine ganglion**	Pterygopalatine fossa	CNVII (GPN)	Vii branches	E.g. lacrimal
V3	**Otic ganglion**	Infratemporal fossa	CNIX (LPN)	Auriculotemporal nerve (Viii)	Parotid
V3	**Submandibular ganglion**	Floor of mouth	CNVII (chorda tympani)	Lingual nerve (Viii)	Sublingual + submandib g

CN	3	9	7	7
Ganglion	C	O	P	S
V nerve	C	A	L	L

SYMPATHETIC:

Pterygopalatine ganglion
Carotid plexus → deep petrosal nerve → pterygopalatine canal → pterygopalatine ganglion → branches of Vii

Orbit
Carotid plexus → nasociliary branch of Vi → long ciliary nerve + short ciliary nerve (via ciliary ganglion)

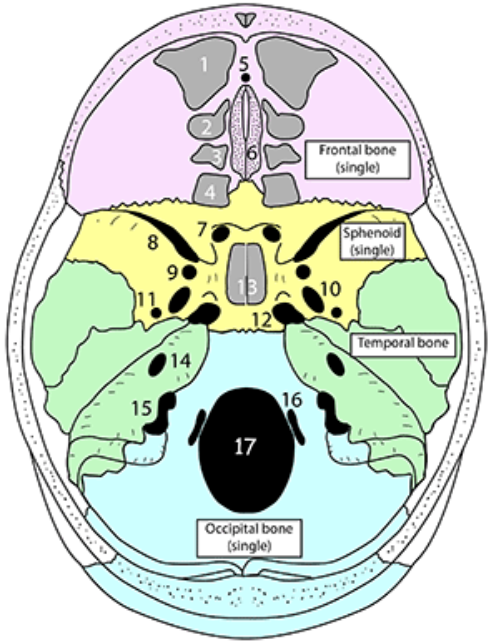
FACE
Sesory: V
Motor: VII

Vi 5 branches	Supra-orbital Supra-trochlear Infra-trochlear Lacrimal External nasal
Vii 3 branches	Infra-orbital Zygomatotemporal Zygomatofacial
Viii 3 branches	Auriculotemporal Buccal Mental

VII	Posterior auricular

6 branches	Temporal Zygomatic Buccal Marginal mandibular Cervical

INTERNAL VIEW OF BASE OF SKULL TO SHOW SINUSES AND FORAMINA



FORAMINA AND AIR SINUSES

1 Frontal air sinuses
2 Anterior ethmoidal air sinuses
3 Middle ethmoidal air sinuses
4 Posterior ethmoidal air sinuses
5 Foramen caecum (single midline)
6 Cribriform plate of ethmoid
7 Optic canal
8 Superior orbital fissure
9 Foramen rotundum
10 Foramen ovale
11 Foramen spinosum
12 Foramen lacerum
13 Sphenoid air sinuses
14 Internal acoustic (auditory) meatus
15 Jugular foramen
16 Hypoglossal canal
17 Foramen magnum (single midline)

Frontal	County Cricket	Caecum (foramen) Cribiform plate	Emissary vein (nose to superior sag sinus) Olfactory nerve
Sphenoid	Oh So Radiaent, Oh So Lovely	Optic canal Superior orbital fissure Rotundum (foramen) Ovale (foramen) Spinosum (foramen) Lacerum (foramen)	Optic nerve + ophthalmic artery III (S+I), IV, Vi (NC + F + L), VI Vii (maxillary trigeminal) Viii + accessory meningeal artery (MALE) Middle meningeal artery + vein + meningeal branch Viii Nerve + artery pterygoid canal
Temporal-occipital	I'm Jack Hello!	Internal acoustic meatus Jugular (foramen) Hypoglossal canal	CN VII + VIII (facial + vestibulocochlear) CN IX, X, XI + jugular vein + inf petrosal sinus CN XII (hypoglossal)

Superior orbital fissure:
III
superior division of the oculomotor nerve
inferior division of the oculomotor nerve

IV: trochlear nerve

Vi
lacrimal nerve
frontal nerve
nasociliary nerve

VI: abducens nerve (CN VI)

Foramen ovale: MALE
M: mandibular branch of trigeminal (Viii)
A: accessory meningeal artery
L: lesser petrosal nerve
E: emissary vein

Ovale = Otic ganglion

Foramen lacerum → pterygoid canal
Nerve of pterygoid canal:

- Greater petrosal nerve (parasymp from facial nerve CN VII)
- Deep petrosal nerve (symp from carotid plexus)

Foramen spinosum

Middle meningeal artery + vein
Meningeal branch Viii

SUMMARY OF CRANIAL NERVES

I	OLFACTORY	SMELL (special sensory)
II	OPTIC	SIGHT (special sensory)
III	OCULOMOTOR	EYE MOVEMENTS (somatic motor)
IV	TROCHLEAR	EYE MOVEMENTS (somatic motor)
V	TRIGEMINAL	SENSORY (branchiomotor for mastication)
VI	ABDUCENT	EYE MOVEMENTS (somatic motor)
VII	FACIAL	BRANCHIOMOTOR (facial expression)
VIII	VESTIBULOCOCHLEAR	HEARING/BALANCE (special sensory)
IX	GLOSSOPHARYNGEAL	SENSORY TO OROPHARYNX (branchiomotor to a single muscle)
X	VAGUS	PARASYMPATHETIC (branchiomotor from XI to palate,etc)
XI	ACCESSORY	CRANIAL ROOT (branchiomotor) JOINS VAGUS. SPINAL ROOT (somatic motor) TO STERNOCLEIDOMASTOID AND TRAPEZIUS
XII	HYPOGLOSSAL	MOTOR TO TONGUE

- Special senses
- Somatic motor
- Branchiomotor
- General sensory
- Parasympathetic

This is a very simplified outline of the cranial nerves. Several of them carry sympathetic and parasympathetic fibres

CRANIAL NERVES WITH MOTOR SUPPLY TO MUSCLES OF BRANCHIAL ORIGIN

	BRANCHIOMOTOR (MUSCLES OF BRANCHIAL ORIGIN)
V	**Nucleus:** Motor of trigeminal M of mastication, mylohyoid, ant digastric, tensors palati & tympani
VII	**Nucleus:** Facial M of facial expression, buccinator, post digastric, stylohyoid, stapedius, occipitalis
IX	**Nucleus:** Ambiguus Stylopharyngeus
X	**Nucleus:** Ambiguus M of pharynx, upper oesophagus, palate, larynx (from cranial XI)
XI	**Nucleus:** Ambiguus M of palate & pharynx via vagus

CRANIAL NERVES THAT CARRY PARASYMPATHETIC FIBRES

III **Nucleus: Edinger - Westphal**
Ganglion: Ciliary
Ciliary body & muscle
Sphincter pupillae

VII **Nucleus: Superior salivary**
Ganglia: Pterygopalatine & submandibular
Lacrimal, submandibular, sublingual & palatine glands

IX **Nucleus: Inferior salivary**
Ganglion: Otic
Parotid, glands in posterior third of tongue & oropharynx

X **Nucleus: Dorsal motor of vagus**
Cardiac & visceral muscle in thorax & abdomen

Cranial nerves III, VII, IX & X all carry parasympathetic fibres from the various central parasympathetic nuclei and they take these fibres to their respective parasympathetic ganglia where they synapse and then are distributed via a branch of the trigeminal nerve to the end organ

Facial:
Greater superficial petrosal nerve → pterygopalatine
Chorda tympani → submandibular
CNIX:
Lesser superficial petrosal nerve → otic → auriculotemporal

CRANIAL NERVES THAT SUPPLY SOMATIC FIBRES TO SKELETAL MUSCLES

III Nucleus: Oculomotor
Recti (sup, med, inf), inf oblique,
levator palpebrae superioris

V Nucleus: Trochlear
Superior oblique

VI Nucleus: Abducent
Lateral rectus

XI Nucleus: Lateral roots C1-5
Sternocleidomastoid & trapezius

XII Nucleus: Hypoglossal
Muscles of tongue except palatoglossus

Cranial nerves III, IV, VI, XI and XII carry somatic nerve fibres to head and neck muscles that have NOT originated from the branchial arches

SHOULD SAY IV not V

CRANIAL NERVES THAT CARRY SOMATIC SENSORY FIBRES

V Nucleus: Sensory of trigeminal
Mesencephalic: Proprioception
Main: Touch
Spinal: Pain & temperature
For trigeminal supplying face, orbit, tongue

VII Nucleus: Sensory of trigeminal
Some skin of external auditory meatus & tympanic membrane

IX Nucleus: Sensory of trigeminal
Posterior 1/3 of tongue, palate, pharynx tonsil, middle ear

X Nucleus: Sensory of trigeminal
Skin of posterior/inferior auricle, external auditory meatus, pharynx, larynx

NB Cell bodies are all outside the central nervous system except for mesencaphalic nucleus where they are inside

Thus, the trigeminal nerve is the main sensory nerve for the head. Note that whichever nerve carries the sensation, the fibres eventually reach the sensory nucleus of the trigeminal nerve. Note also that the facial nerve (VII) is essentially a motor nerve even though it does have a small sensory component

CRANIAL NERVES CARRYING GENERAL AND SPECIAL SENSORY FIBRES

	GENERAL VISCERAL SENSORY	SPECIAL VISCERAL SENSORY
VII		Nucleus: Solitarius Chorda tympani Taste: Ant 2/3 tongue
IX		Nucleus: Solitarius Taste: Post 1/3 tongue, vallate papillae, oropharynx, baro-, chemoreceptors
X	Nucleus: Solitarius or dorsal sensory of vagus From heart, lungs & abdominal viscera	Nucleus: Solitarius Taste: Vallecula & epiglottis, baro-, chemoreceptors
NB	From heart, lungs & gut	Taste & baroreception

Note that in the case of the vagus the sensation travels with this parasympathetic nerve but the fibres are really general visceral sensory and not parasympathetic.
Special visceral sensory comprises taste and baroreception

CRANIAL NERVES FOR SPECIAL SENSES

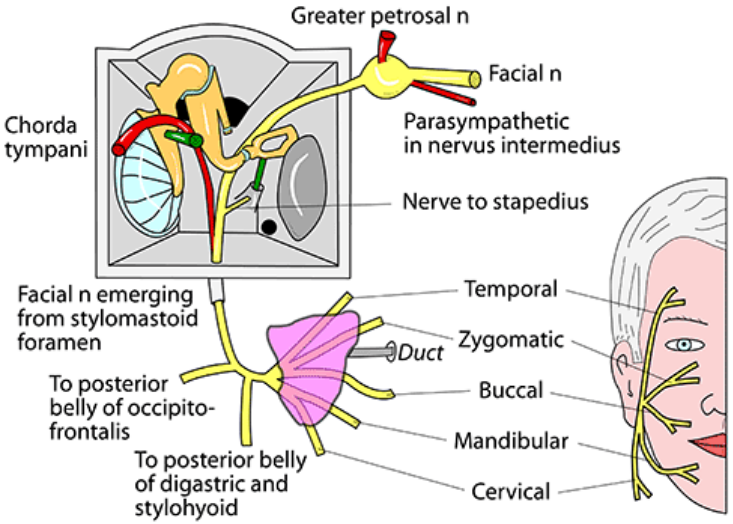
I Smell
- Limbic system

II Sight
- Lateral geniculate body

VIII Hearing
- 2 nuclei

Equilibrium
- 4 nuclei

VII FACIAL NERVE



Branchiomotor: Muscles of facial expression, stapedius, posterior belly of digastric, stylohyoid, occipitalis

Carries: **Parasympathetic** in greater petrosal nerve to pterygopalatine ganglion then via Vb to "hay fever" glands & via Vb and Va to lacrimal gland.

Chorda tympani to submandibular ganglion and then to submandibular and sublingual glands via Vc

Taste: Via nervus intermedius from palate in greater petrosal nerve & from anterior 2/3 tongue via chorda tympani

Sensation: Small area in external ear and tympanic membrane

Main branches:

As above

greater petrosal

chorda tympani

V carries all parasympathetics to their end organs

IX GLOSSOPHARYNGEAL (3RD ARCH)

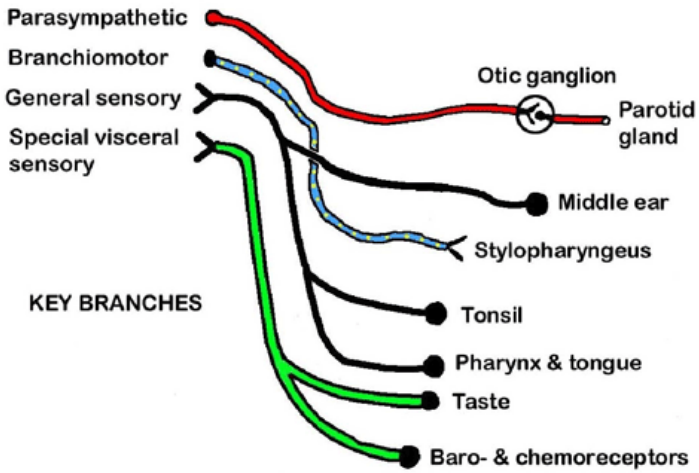
SENSORY
- Oropharynx
- Post 1/3 tongue
- Tonsil
- Middle ear

SPECIAL VISCERAL SENSORY
- Carotid body/sinus

BRANCHIOMOTOR
- Stylopharyngeus

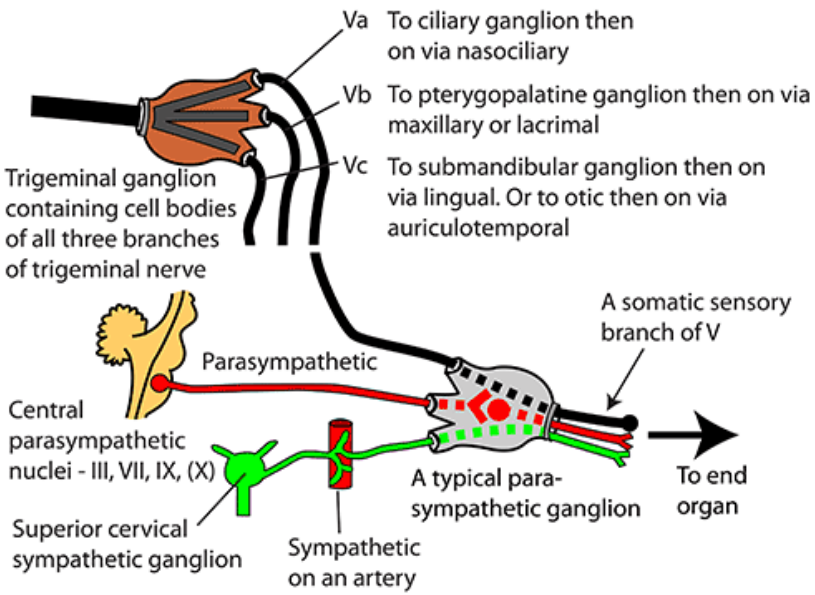
PARASYMPATHETIC
- Lesser petrosal n to otic ganglion to parotid gland via Vc

TASTE
- Post 1/3 tongue & oropharynx



PATTERN OF PARASYMPATHETICS IN HEAD

In summary, the final nerve that emerges from the parasympathetic ganglion is always a combination of a sensory branch of V, a synapsed (postganglionic) parasympathetic nerve and a sympathetic nerve that supplies vasoconstriction only to the organ.



This typical parasympathetic ganglion could be either the **CILIARY, OTIC, SUBMANDIBULAR** or **PTERYGOPALATINE.** Irrespective of which one it is, there is always a parasympathetic nerve from either III, VII, or IX synapsing within it. Passing through it, and carrying the parasympathetic on to its end organ, is always a branch of the trigeminal.
Here we see a branch of Va but it could have been a branch of Vb or Vc.
Also through each ganglion passes a branch of the sympathetic from the superior cervical ganglion via an appropriate artery (internal carotid for the ciliary and ptery gopalatine ganglia and external carotid for the submandibular and otic ganglia)

CILIARY GANGLION: DETAILED PATHWAYS TO AND FROM IT

CENTRAL NUCLEUS: Edinger-Wesphal (mid brain)

EMERGING WITH CRANIAL NERVE: III (oculomotor)

NERVE CARRYING PREGANGLIONIC FIBRES: III. Nerve to inferior oblique

PATHWAY & FORAMEN: Cavernous sinus and superior orbital fissure

SITE OF GANGLION: Between optic nerve and lateral rectus in apex of orbit

NAME OF GANGLION: Ciliary

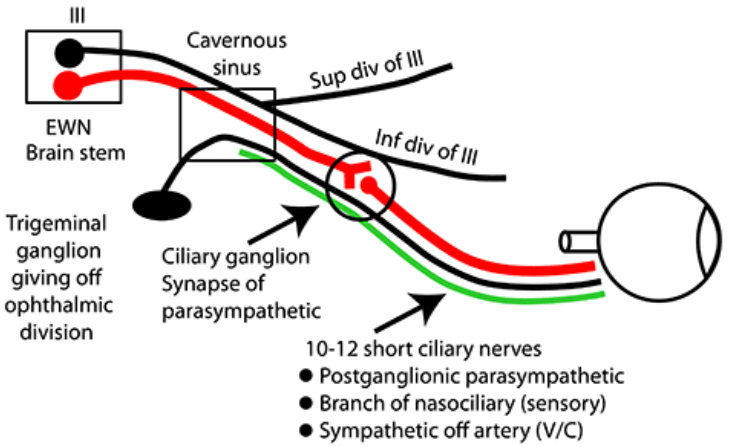
NERVE CARRYING POSTGANGLIONIC FIBRES: Va: nasociliary and short ciliary

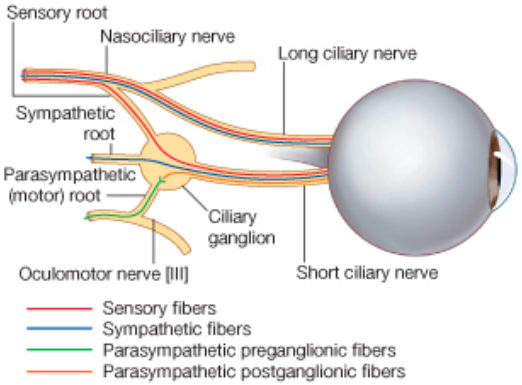
ORGAN(S) SUPPIED: Ciliary muscle for accommodation. Circular iris muscle for pupil constriction

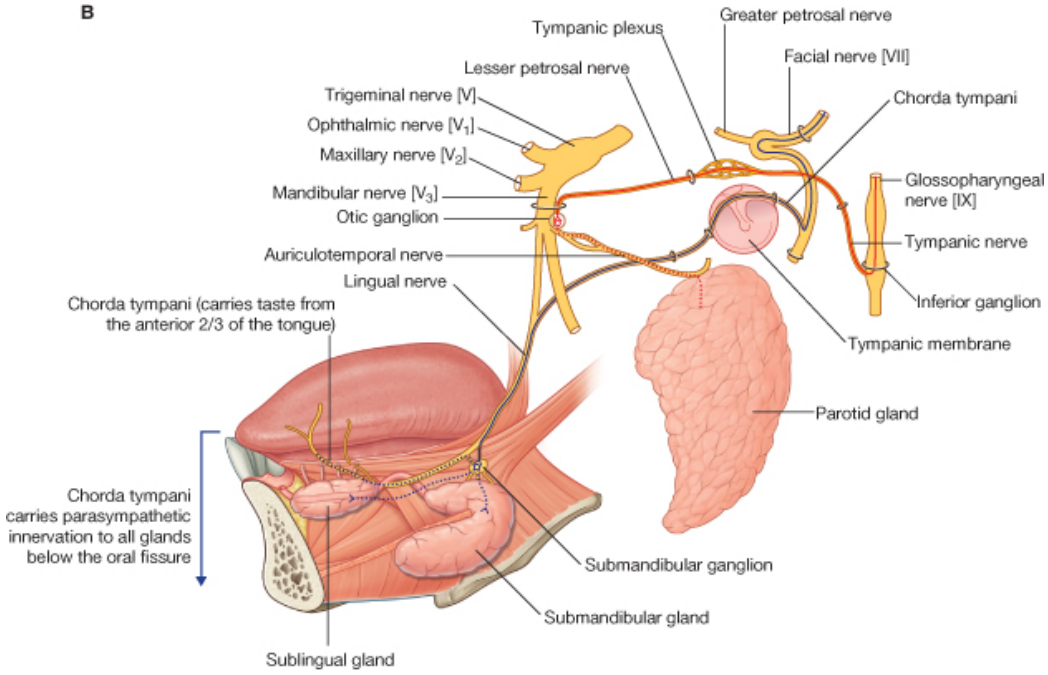
SOURCE OF SYMPATHETIC THROUGH GANGLION: Ophthalmic artery (internal carotid)

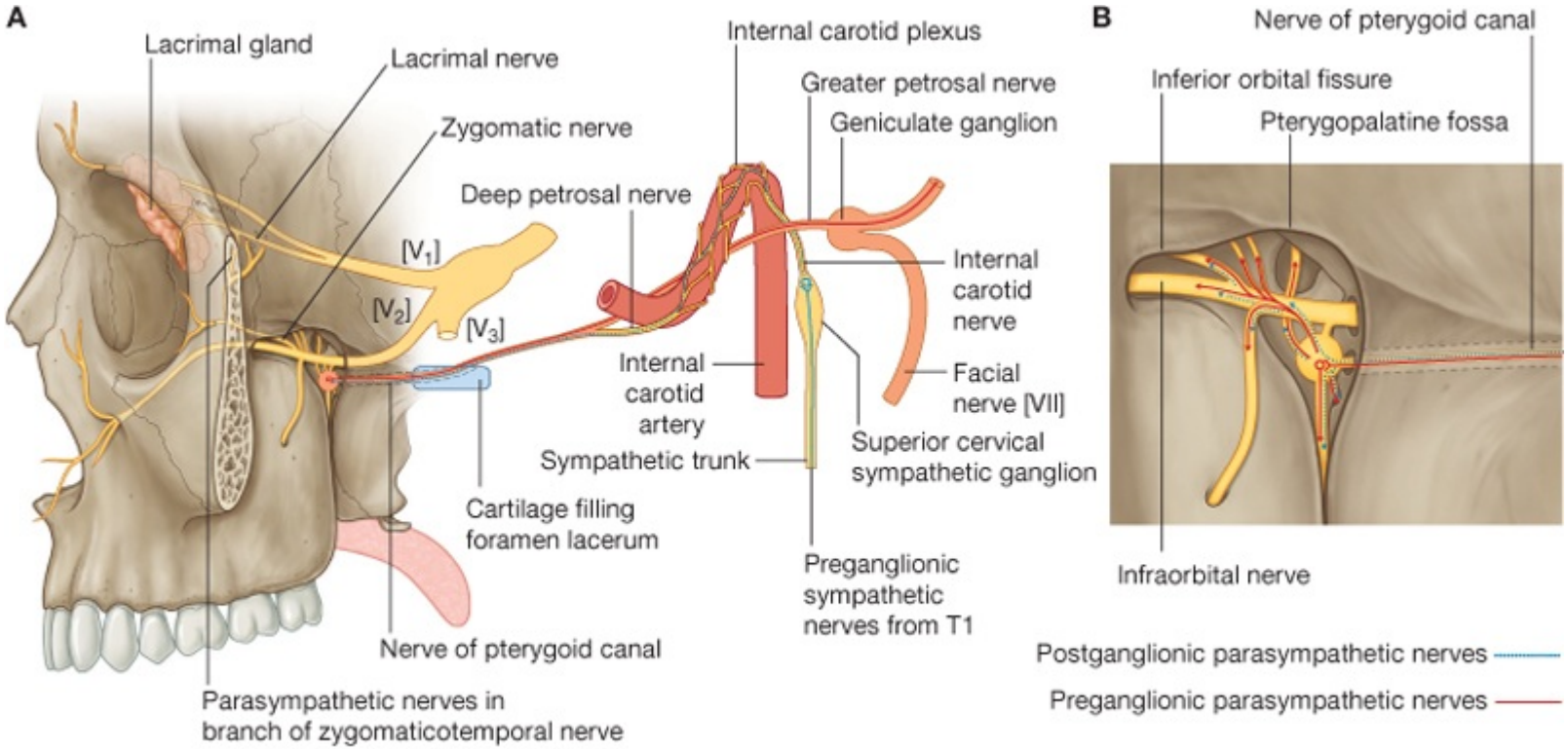
PARASYMPATHETIC PATHWAY FOR PUPILLARY CONSTRICTION AND ACCOMMODATION

Final pathway




Sensory root
Nasociliary nerve
Long ciliary nerve
Sympathetic root
Parasympathetic (motor) root
Ciliary ganglion
Oculomotor nerve [III]
Short ciliary nerve
Sensory fibers
Sympathetic fibers
Parasympathetic preganglionic fibers
Parasympathetic postganglionic fibers


B
Tympanic plexus
Greater petrosal nerve
Facial nerve [VII]
Lesser petrosal nerve
Trigeminal nerve [V]
Chorda tympani
Ophthalmic nerve [V1]
Maxillary nerve [V2]
Glossopharyngeal nerve [IX]
Mandibular nerve [V3]
Otic ganglion
Tympanic nerve
Auriculotemporal nerve
Lingual nerve
Inferior ganglion
Chorda tympani (carries taste from the anterior 2/3 of the tongue)
Tympanic membrane
Parotid gland
Chorda tympani carries parasympathetic innervation to all glands below the oral fissure
Submandibular ganglion
Submandibular gland
Sublingual gland



Drake: Gray's Anatomy for Students, 2nd Edition.