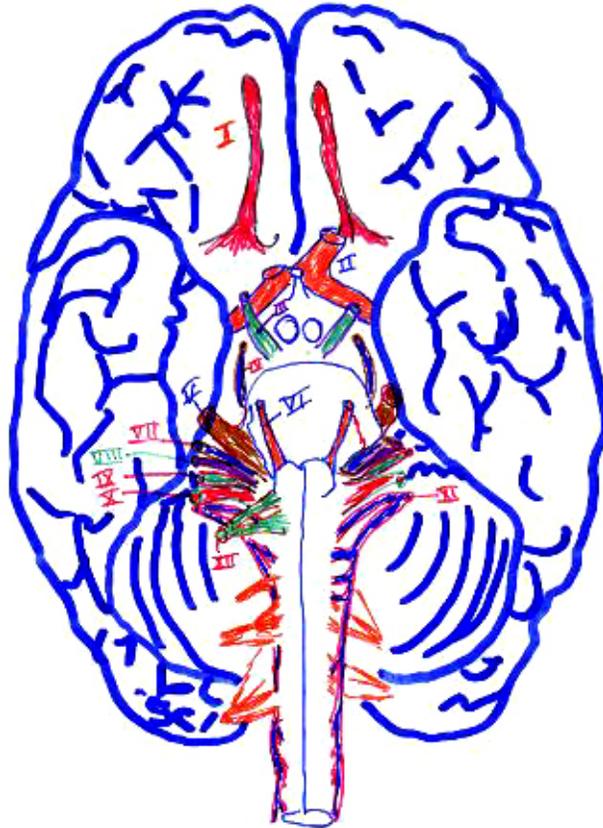


Cranial Nerve Testing

Introductory Background

There are twelve pairs of cranial nerves:



Each nerve root is labeled in the matching color. The following table summarizes the names of these nerves, the numbers of these nerves, the mnemonic (nee MAWN ick) to remember the nerves in order and the mnemonic to remember if the nerves are sensory (S), motor (M) or both (B).

Number	Name	Mnemonic for order	Mnemonic for M, S, or B	Tests/Defects/Results
I	Olfactory	On	Silly	Test with tobacco, coffee, cloves, peppermint, etc.
II	Optic	Old	Sally's	Appropriate test for vision.
III	Oculomotor	Olympus'	Mother	With complete paralysis, eyes deviate inferiorly oblique to the lateral.
IV	Trochlear	Tiny	Makes	Eye deviates superiorly

V	Trigeminal	Tops	Big	<p><u>Motor</u>: bilateral paralysis, mouth will not close tightly; unilateral paralysis: mandible deviates TOWARDS the weak side when the mouth opens.</p> <p><u>Sensory</u>: test touch, pain, temperature.</p>
VI	Abducens	A	Maroon	Eye[s] may converge -- no lateral movement.
VII	Facial	Finn	Balls	<p><u>Motor</u>: flaccid paralysis = Bell's Palsy, unable to whistle or puff out cheek;</p> <p><u>Sensory</u>: test taste (anterior 2/3 of tongue)</p>
VIII	Acoustic	And	Sail	<p><u>Cochlear</u>: test for hearing: Weber's test: vibrating tuning fork on skull midline. Lateralization of sound to one side means BONE CONDUCTION loss on THAT side; Rinne's test: vibrating tuning fork on mastoid process. After sound isn't heard, place fork by ear and listen. Tones are heard here normally 2 times as long as on the mastoid (test for AIR CONDUCTION).</p> <p><u>Vestibular</u>: balance tests (spin on stool).</p>
IX	Glossopharyngeal	German	By	Tested with X
X	Vagus	Viewed	Bob's	Open mouth and say "Ah" -- if uvula (little hangy downy thingy at the back of the throat) doesn't elevate, is bilateral paralysis; with unilateral elevation, uvula deviates to strong side (away from site of lesion); gag reflex: present or absent.

XI	Spinal Accessory	Some	Blue	Raise shoulders against resistance -- check for tense trapezius; turn head back to midline against resistance: check for tense sternocleidomastoideus.
XII	Hypoglossal	Hops	Mercedes	Stick out tongue: if paralyzed, tongue deviates to the weak side; test lingual speech: "round the rugged rock the ragged rascal ran."

The Olfactory nerve exits the skull via the cribriform plate. It terminates in the temporal lobe. About 20 fibers spread out over the nose: an inner group of fibers over the upper third of the septum and an outer group of fibers over the superior turbinate and surface of the ethmoid. The anomaly of this nerve is the loss of smell with a secondary loss of taste.

The Optic nerve exits the skull via the optic foramen and terminates in the occipital lobe. The optic tract exits the brain in two bands: an external band and an internal band. The external band is partly continuous with the superior colliculi and coordinates movements of the eyeball and head, regulates focusing and adjusts the size of the pupils. The internal band is partly continuous with the inferior colliculi and coordinates movement of the head and trunk following audio stimulus. The optic tract crosses at the optic chiasm with 2 sets of fibers: crossed and uncrossed. Crossed fibers are present in greater numbers: left stay on the left sides of both eyes and right stay on the right sides of both eyes. Uncrossed fibers stay on the same sides of the eyes from which they leave the brain, i.e., right fibers stay on the right half of the right eye and left fibers stay on the left half of the left eye. The anomaly of this nerve is blindness.

The Oculomotor nerve exits the skull via the superior orbital fissure. This nerve regulates accommodation, raises the upper eyelid, dilates and constricts the pupil and eyeball movements in all directions except inferiorly lateral and laterally. Anomalies include ptosis (TOE siss; paralysis of the upper eyelid muscle [levator palpebrae]), external strabismus (struh BISS muss; eyes diverge) due to a lack of innervation of the lateral eyeball muscles, pupillary dilation due to paralysis of the iris (colored part of the eye) and loss of accommodation.

The Trochlear nerve exits the skull via the sphenoidal fissure. It supplies and enters the orbital surface of one of the extraocular (outside the eyeball) muscles. The anomaly of this nerve is that one is unable to turn the eye down and out due to muscle paralysis and leads to diplopia (dih PLOE pee uh; double vision).

The Trigeminal nerve exits in three branches: the ophthalmic via the sphenoidal fissure; the maxillary via the foramen rotundum; the mandibular via the foramen ovale. The ophthalmic branch supplies the eyeball, lachrymal gland (tear gland), conjunctiva (mucous lining of the eye and lid), nasal mucosa and skin of eyebrow and the forehead

and nose. The maxillary branch enters the orbit and traverses the sub-orbital canal, exiting at the infraorbital foramen. It supplies the temple, side of the forehead, skin on the malar prominence on the cheek, all maxillary teeth (via individual branches which is why your dentist has to anesthetize each tooth on your upper jaw that s/he works on), skin and conjunctiva of the lower eyelid with sensation, skin of the side of the nose, the upper lip and the mucous membranes of the mouth. The mandibular branch supplies the teeth and gums of the mandible (by one branch that "nets out" which is why it usually only takes on injection to anesthetize half of your lower jaw so your dentist can work on them), skin of the temple and external ear, lower face and lower lip, muscles of mastication (chewing), the two salivary glands beneath the tongue and the anterior 2/3 of the tongue. illustrates these branches of V. Anomalies of V include anesthesia to half of the face (except over the parotid gland, the gland over the masseter), destructive inflammation of the cornea and/or paralysis of muscles of mastication (chewing).

The Abducens nerve exits the skull via the superior orbital fissure. It passes into the 3d cranial nerve. This nerve regulates lateral movement of the eyeball. This nerve is involved in the greatest frequency in basilar fractures than any other cranial nerve. Paralysis of this nerve results in convergent squint (strabismus; cross-eyed); it also leads to secondary pupil contraction because fibers of III pass with this nerve.

The Facial nerve exits the skull via the internal auditory meatus through the petrous portion of the temporal bone to the stylo-mastoid foramen (between the mastoid and styloid processes). It supplies the muscles of facial expression, the platysma and buccinator, the external ear, the anterior 2/3 of the tongue and the salivary glands beneath the tongue. There are five branches: the temporal, zygomatic (or malar), buccal, mandibular and cervical, from top to bottom.

VII is more frequently paralyzed than any of the other cranial nerves. Paralysis depends on 1) central causes, i.e., clot, tumor, which increases pressure on the nerve before it enters the internal auditory meatus, 2) in the petrous bone following middle ear disease or fracture (this can lead to loss of taste where the patient is unable to differentiate between bitters and sweets, acid and saline, and a dry mouth secondary to lack of salivary flow) or 3) at or after exit from the stylomastoid foramen. After exit from the stylomastoid foramen, all muscles of expression are paralyzed. This leads to a smooth forehead, the patient is unable to frown, ptosis, tears run down the cheeks constantly, and the nostril can not be dilated. The mouth is drawn to the healthy side; the effected corner of the mouth sags and you are unable to whistle. The patient develops a partial loss of taste. All of these signs indicate Bells' Palsy. Bell's Palsy may be idiopathic (means that the cause is unknown) -- it may clear up spontaneously.

The Acoustic nerve is also called the auditory or vestibulocochlear nerve. It is exclusive to the internal ear and is for balance and hearing. A few fibers blend with the inferior colliculi. If this nerve is torn due to fracture, the deafness is permanent. If the nerve is bruised or pressed on due to blood, the deafness will be temporary. If loud explosions (e.g., shooting a .44 magnum without hearing protection) occur, the deafness results because of pressure compression of VIII -- this is an incredibly soft nerve.

The Glossopharyngeal nerve provides innervation for taste and pressure receptors. It exits the skull via the jugular foramen. It is distributed to the posterior 1/3 of the tongue (taste for here). It's one of the nerves for sensation to the mucous membrane of the pharynx, fauces, tonsils and uvula. It is motor to the parotid gland (salivary gland over the masseter) and sensory to the pressure receptors in the carotid artery. Injury and inflammation cause impairment of swallowing and taste: specifically sour and bitter.

The Vagus nerve is also known as the pneumogastric nerve. There is a possibility that IX and X are actually parts (branches) of the same nerve and not separate nerves. This nerve exits the skull at the jugular foramen accompanying IX. If the superior laryngeal trunk is pressed upon by a goiter (enlarged thyroid gland) or aneurysm causes a particularly dry, brassy cough; when paralyzed, the patient has a deep hoarse voice. If the inferior laryngeal trunk is paralyzed, the voice is altered and weak due to same side paralysis and strong side vocal cord compensating by crossing the mid-line. Organs that are innervated by X include the lungs, heart and GI system.

The Spinal Accessory nerve is accessory to the vagus nerve. It innervates the sternocleidomastoideus and trapezius muscles. It ENTERS the skull via the foramen magnum then EXITS the skull via the jugular foramen. This nerve has roots from both the medulla and the cervical spine. The brain-originating root is distributed to the pharyngeal and superior laryngeal branches of X; the cord roots pierce the sternocleidomastoideus and deep surface of the trapezius. A hyperactive XI causes spasmodic torticollis (wryneck). To treat this may require excision or division of a portion of the nerve.

The Hypoglossal nerve exits the skull via the anterior condyloid canal (hypoglossal canal). It passes into the tongue all the way to the tip. When this nerve is paralyzed unilaterally, the tongue is twisted to the weak side.

With the exception of the first two cranial nerves (I and II), the remaining cranial nerves have as their origin portions of the mid- and hind-brain, i.e., ten of the cranial nerve pairs are from the brain stem (review your text for locations of cranial nerves and their nuclei). To study the cranial nerves, then, it would seem prudent to provide a series of tests which would localize various problems to regions in the brainstem -- assuming the tests were abnormal. This is the whole basis for this experiment.

Experimental – Supplies and Methods

Obtain a partner for this experiment – test each others' cranial nerves as a team.

Testing I

The olfactory nerve is easily tested using common items around the house. For this experiment, have the subject/patient/client/partner close his/her eyes and occlude one nostril. Ask him or her to sniff through the open nostril while you hold extracts of orange, mint or peppermint or cinnamon beneath his/her nose. Ask your subject if s/he

can identify the odor. Repeat on the other nostril. I is the first cranial nerve to “go” as we age. It is also easily damaged, irreparably, if we receive blunt, forceful trauma to the nose, breaking the nose, as this will destroy the fibers from I in the nose. Loss of smell on one side is of significance, whereas bilateral loss of olfaction is normal with aging.

NOTE: Avoid perfumes as they will stimulate V instead of I and confuse your results, i.e., a portion of the nose is innervated by V, as well.

Record your results below:

I smelled:

on the RIGHT: ___ Orange ___ Mint ___ Peppermint ___ Cinnamon ___ Nothing

on the LEFT: ___ Orange ___ Mint ___ Peppermint ___ Cinnamon ___ Nothing

Testing II

The optic nerve is really fairly easy to test. All one needs to test this nerve is a disposable cotton swab packet. If the patient can read “Made in USA” clearly while holding the packet about 15” away, the patient can see. If the patient wears glasses, let the patient leave them on while reading. The only drawback to this is that when testing visual acuity, it is necessary to test one eye at a time. Hence, it seems carefully placing one hand over the eye (glasses) not being tested is prudent.

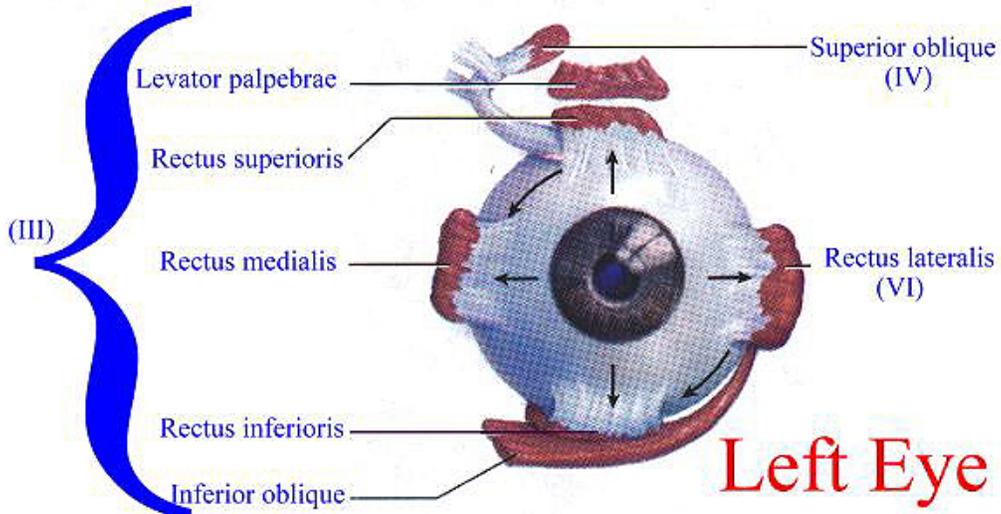
Distance vision is checked by standing 20 feet away from a standard Snellen eye chart and reading the clearest line one eye at a time. The right eye is indicated by “OD” and the left eye by “OS”. Record, below, your results for each eye (read the level of vision from the clearest line on the eye chart) without your glasses:

	OD	OS
Without Glasses		
With Glasses		

BTW: If you wear contacts in the lab, do NOT remove them. Just record your data as if you were wearing glasses.

Testing III, IV and VI

These cranial nerves are generally tested together as it is convenient to do so. Abnormal results for the oculomotor nerve are that the eye deviates inferiorly oblique to the lateral; for the trochlear nerve, the eye deviates superiorly; for the abducens nerve, the eye[s] may converge, i.e., there is no lateral movement. This graphic illustrates the relationship between the extra-ocular muscles and these three cranial nerves:



When testing for the patency of these three cranial nerves, all one has to do is guide the patient to move their eye[s] in the six cardinal directions:

Eye movement (cranial nerve tested)	Eye movement (cranial nerve tested)
To 1:30 (III)	To 7:30 (IV)
To 3:00 (III)	To 9:00 (VI)
To 4:30 (III)	To 10:30 (III)

Record (circle yes or no) your results, below:

EYE	Eye Moved in All Directions	
OD	YES	NO
OS	YES	NO

If your eye[s] did not move in one or more directions, record your observations, below:

EYE	Direction[s] Eye Did Not Move (Clock Time)	
OD		
OS		

Testing V

Like the other cranial nerves, this nerve is not difficult to test. Unlike the other 5 cranial nerves, thus far tested, the trigeminal nerve has both motor and sensory functions. This means, then, that we will be testing for two different kinds of function.

Motor Testing the Trigeminal Nerve

For this portion of the experiment, we will assess the function of two muscle groups: the masseter and the temporalis. Both are involved in mastication and both are innervated by V. Have your subject sit quietly while you place your fingers on that person's temporal fossa, bilaterally. You will be palpating for a flexion of the temporalis muscle when you ask your patient to clench his or her jaws. The ability to clench is a positive result; the lack of clenching is a negative result. Likewise, place your fingers over the masseter and have the patient repeat his or her clenching. Results are the same as with the temporalis if V is working or not. Record your results, below:

	Left side	Right side
Temporalis clenched	YES	NO
Masseter clenched	YES	NO

Sensory Testing the Trigeminal Nerve

The sensory function of V will be determined by testing for light touch – the corneal reflex is too dangerous to be done in a basic science class. You can mimic it by “flicking” your fingers in your partner's eyes and watching them blink.

To test for light touch, obtain a cotton ball and gently touch/rub/drag the cotton over the frontal area, the maxillary regions at about the level of the infraorbital foramen and the mandibular region at the level of the anterior mental protuberances. Positive results are that touch is felt – negative, is that it's not.

NOTE: on a male, drag the cotton WITH the beard direction – to go against it may give a false positive as the cotton will catch and tug on the beard stubble and THAT will be detected instead.

Testing VII

The facial nerve is another nerve that has dual activities, i.e., motor and sensory activities.

Motor Testing the Facial Nerve

To test the motor activity of the facial nerve, you need to observe your subject smile, raise his or her forehead, frown, grimace, whistle (or at least try to) and puff up his or her cheeks. All of these are positive results for the motor portion of the facial nerve. The lack thereof, of course, is negative and indicates dysfunction of VII. Record your results, below:

	Positive Results	Negative Results
Left Side of Face	YES	YES
Right Side of Face	YES	YES

Sensory Testing the Facial Nerve

Since the facial nerve provides taste to the anterior two-thirds of the tongue, it seems reasonable to test for taste to determine if the sensory portion of this nerve is functioning normally. Obtain three solutions of sugar (sweet), salt (salty) and dilute vinegar (sour) and three cotton swabs. Place the cotton swabs in the solutions so that you do not confuse them. Ask the subject to close his or her eyes and stick out his or her tongue. Using one of the swabs, streak the lateral portion of the tongue on one side and ask your subject to identify the taste. Repeat in random order for each side of the tongue on one side and ask your subject to identify the taste.

Do NOT replace a used swab in the solutions under ANY circumstances!!!

Record your results, below:

I tasted				
Right side	Sweet	Sour	Salt	Nothing
Left side	Sweet	Sour	Salt	Nothing

Testing VIII

You will be testing only the acoustic portion of the acoustic, auditory, vestibulocochlear nerve – I want no one puking in lab were we to test for the vestibular portion.

The first test is the Weber test for bone conduction. Obtain a tuning fork preferably of high frequency. Record the frequency below:

Tuning Fork Frequency: _____

Have the subject sit in a quiet room. Gently strike the tuning fork ***with the heel of your hand*** to set it off. Hold the handle of the vibrating tuning fork to the frontal bone in the midline of the skull – just anterior to the triple junction of the frontal and parietal bones. If your hearing is normal, you should hear the sound equally in both ears. If you have abnormal bone conduction, then the side on which you hear the tuning form the loudest is the side of the damage, i.e., lateralization of the sound to that side. Record your results below:

Sound Equal in Both Ears	Sound Loudest in Right Ear	Sound Loudest in Left Ear
YES	YES	YES

The second test is the Rinne test for air conduction. This uses the same tuning fork as before. In a quiet room, strike the tuning fork ***with the heel of your hand*** and place the handle of the vibrating tuning fork against the mastoid process of your subject. Time this. When your subject no longer hears the sound, mentally record the time, and, then, hold the tuning fork about an inch from the same ear and have the subject listen, again. Time this, too. Record the results, below, repeating for the other ear, as well:

	Right Ear	Left Ear
Mastoid time (seconds)		
In front of ear time (seconds)		

Tones are normally heard twice as long in front of the ear as on the mastoid process.

Testing IX and X

These nerves are tested together – indeed, there is a strong possibility that these two nerves are actually branches of the same nerve – that’ll throw a kink in the old mnemonic if it turns out to be correct!

Have your subject open his or her mouth and say “Ah!”. If the uvula elevates, this is a normal response. If the uvula does not elevate, there is bilateral paralysis. If the uvula deviates unilaterally, it is leaning towards the strong side, i.e., away from the side of the lesion (if it leans left, the lesion is on the right). Test the gag reflex: if present, this is normal. To test the gag reflex, all you have to do is touch the peri-tonsillar area, NOT THE UVULA, and see if it elicits the gag reflex. Gagging is normal. Record your results below:

My uvula deviated: ___Right ___Left ___Up ___None

I gagged ___Yes ___No

Testing XI

The spinal accessory nerve is tested by determining the activity of the sternocleidomastoideus (SCM) and trapezius muscles. Place your hands on your subject’s shoulders and ask him or her to shrug. If he or she can, it’s a positive test; otherwise, it’s a negative test. Record your results below:

I shrugged ___Yes ___No

Now place your hand on one side of your subject’s face after he or she has turned his or her head to one side. See if your subject can turn his/her head back to the midline pushing against your resistance. Do this for both sides and record your results below:

I turned my head left Yes No
I turned my head right Yes No

Head turning is positive; the converse is negative.

Testing XII

To test the function of the hypoglossal nerve, there are two basic tests: stick out your tongue and test lingual speech.

When your subject sticks out his/her tongue, does it stay midline or deviate? If it remains in the midline, this is a positive result. If it deviates to one side, it is deviating to the weak side, i.e., to the side of the lesion (this is OPPOSITE what happens with the uvula and IX). Record the results, below:

My tongue deviated Left Right No Deviation

Ask your subject to repeat the following tongue twister: “Round the ragged rock the ragged rascal ran.” If your subject can repeat it without problems, XII is intact. If there are problems, there may be some abnormality with XII – or your subject just isn’t good with tongue twisters. Record your results, below:

I said the tongue twister: Yes No

References

- 1) Bates: **A Guide to Physical Examination and History Taking, Fourth Edition.** (Lippincott: London) ©1987.
- 2) Carman: **Doc Carman’s Necessities of Human Anatomy and Physiology, Volume II.** (WC Brown: Dubuque) ©1996.
- 3) Novey: **Rapid Access Guide to The Physical Examination.** (Year Book Medical Publisher’s, Inc.: Chicago) ©1988.