

Neurological System

General Survey

- ✚ Have the patient seated, chat with the patient, and observe the following general characteristics:
 - Dress
 - Grooming
 - Hygiene
 - Facial expression
 - Manner of speech

Assess Mental Status

- ✚ Person
- ✚ Place
- ✚ Time
- ✚ Perform a more detailed exam if responses to the above are inappropriate
 - Mini-Cog Assessment Instrument for Dementia
 - The Mini-Mental Status Examination (MMSE)
 - *These are just some examples and some are also copyrighted*
 - Mental status is assessed throughout the entire visit

Cranial Nerves

- ✚ Cranial Nerve I (Olfactory)
 - Ask patient if they can breathe through both nostrils
 - Determine nasal patency
 - Assess smell in one nostril at a time
 - Close both eyes and one nostril
 - Ask the patient to identify familiar odors (i.e. coffee, soap, perfume, etc.)
 - Video Link:
 - <https://www.youtube.com/watch?v=HH7a-B7c0cM>
 - Testing the sense of smell *rarely* identifies significant pathology. An abnormal bilateral decrease in smell might be confusing as it may result from a nasal airway obstruction, smoking, cocaine abuse, congenital, or from a normal decline of olfaction with age. A unilateral loss of smell without nasal disease suggests a frontal lobe lesion. Also, a frontal lobe lesion is suspected in cases of personality change, hemiparesis, or unexplained visual loss as the olfactory pathways run under the frontal lobe near the optic chiasm. Harsh odors (such as ammonia) are not to be used as they will stimulate pain receptors of CN V and will cause damage to intranasal mucosa.
- ✚ Cranial Nerve II (Optic) [consult the Eye System for more details]
 - Central vision
 - Test visual acuity far and near
 - Video Link:
 - <https://www.youtube.com/watch?v=ueuGxjckrtM>
 - <https://www.youtube.com/watch?v=w1hWJAnaYc>
 - OS (left eye), OD (right eye), OU (both eyes)
 - Snellen (far vision)
 - Rosenbaum (near vision)
 - Peripheral vision
 - Ask the patient to cover one eye and look at your nose. Wiggle simultaneously the index fingers of both your hands in the superior fields. Ask the patient to point to or tell you the side they see movement. The correct response is "both sides." Repeat for the lower fields in the same eye. Cover the other eye, but only wiggle one of your index fingers in the superior field. With the same eye, wiggle both fingers in the superior field. Repeat in

the lower fields, asking each time which fingers the patient sees. There are also alternative methods listed in the **Eye System**.

- Video Link:
 - <https://www.youtube.com/watch?v=kqPVVsVN4b8>
- Ophthalmoscopic exam
- + Cranial Nerves III (Oculomotor), IV (Trochlear), VI (Abducens)
 - These nerves are tested as a unit, since all supply muscles for eye movement
 - CN III also supplies the muscles which constrict the pupils and elevate the lids
 - Assess and compare the pupils for the following:
 - Size, shape, and symmetry
 - Accommodation
 - Video Link:
 - <https://www.youtube.com/watch?v=cV8ZDaRi3VA>
 - Light Reflexes (include direct and consensual)
 - Video Link:
 - <https://www.youtube.com/watch?v=E0BAqYKiYlw>
 - Extraocular Movements
 - Video Link
 - https://www.youtube.com/watch?v=_gpKwikoZv4
 - <https://www.youtube.com/watch?v=WWig0j8oNFY>
- + Cranial Nerve V (Trigeminal)
 - Divisions include ophthalmic (V₁), maxillary (V₂), and mandibular (V₃)
 - Motor function
 - Observe the face for muscle atrophy, deviation of the jaw, and fasciculations
 - Ask patient to clench teeth
 - Palpate bilaterally for the temporalis muscles and masseter muscles
 - Sensory function
 - Ask patient to close eyes
 - Assess pain and/or light touch bilaterally on the forehead, cheeks, and jaw
 - Video Link:
 - <https://www.youtube.com/watch?v=kOwJNTAZy5o>
- + Cranial Nerve VII (Facial)
 - Motor function
 - Ask the patient to raise eyebrows, close eyes tightly as you try to open them, smile and show teeth (critically important test), frown, and puff out cheeks as you then tap on them
 - Sensory function
 - Usually do not test unless complaint of smell or taste concern. To test make a salt and sugar solution and use cotton tip applicators to apply to anterior tongue. Be sure to rinse mouth with plain water before testing.
 - Video Link:
 - https://www.youtube.com/watch?v=eD46Mrk_9So
 - Testing this nerve is an important part of the neurological exam. In smiling, the doctor notes whether there is weakness or drooping of one side and elevation of the other side of the mouth. Look for flattening of the nasolabial fold. Lesions of the cerebral cortex or its pathway to the motor nucleus of VII in the pons cause contralateral weakness of the mouth and not the forehead. So, in a stroke there will be weakness in elevating the corner of the mouth and no significant weakness in wrinkling the brow. In Bell's palsy and other forms of peripheral nerve damage to VII (damage between the pons and face), there is weakness of one side of the **entire** face.

- ✚ Cranial Nerve VII (Vestibulocochlear)
 - Assess patient's hearing by holding your fingers next to a patient's ears, rubbing one, then the other, and/or both and ask the patient to point to the ear in which they hear sound
 - Video Link:
 - <https://www.youtube.com/watch?v=SUEZtGbxxXg>
- ✚ Cranial Nerve IX (Glossopharyngeal) and X (Vagus)
 - Ask patient to say "ahh" and note the position of uvula, the soft palate should rise symmetrically, and the posterior pharynx moves in
 - *If abnormal*, do gag reflex by stroking the soft palate or pharynx with a tongue depressor
 - Video Link:
 - <https://www.youtube.com/watch?v=IdRuasfki6U>
- ✚ Cranial Nerve XI (Spinal Accessory)
 - Inspect shoulders and neck for equal development, atrophy, and fasciculations
 - Shrug shoulders against resistance to test trapezius and turn head left and right against resistance to test sternocleidomastoid muscles
 - Video Link:
 - <https://www.youtube.com/watch?v=aRMBGPjtNLo>
- ✚ Cranial Nerve XII (Hypoglossal)
 - Examine tongue at rest for asymmetry, atrophy, and tremor
 - Ask the patient to stick out their tongue and assess for asymmetry and midline deviation
 - Video Link:
 - <https://www.youtube.com/watch?v=u4Pd2IMFDfg>

Motor

- ✚ Muscle strength testing
 - See **Musculoskeletal System** for more specific details
- ✚ Examine gait and muscle motion (this is also part of the cerebellar exam)
 - Smoothness, arm swing, leg movement, smoothness of turns, rigidity (i.e. lead pipe and cogwheel), weakness, and muscle atrophy
- ✚ Postural drift (if a stroke or TIA is suspected)
 - Ask patient to close their eyes. Hold arms horizontally, forward, and palm up for 15-30 seconds. Watch for drift, slow drop, and pronation.
- ✚ Grip
 - Have the patient squeeze your fingers
- ✚ Examine resistance to passive stretch
 - Upper extremities
 - Fingers
 - Wrists
 - Elbows
 - Shoulders
 - Lower extremities
 - Knees
 - Ankles
- ✚ Palpate groups of muscles
 - Shoulders
 - Extension (Trapezius)
 - Abduction (Deltoid)
 - Arms
 - Flexion (Biceps)
 - Extension (Triceps)

- Wrists
 - Flexion
 - Extension
- Fingers
 - Extension
 - Flexion
 - Adduction (Interosseous)
 - Opposition
- Hips
 - Flexion (Iliopsoas)
 - Abduction
 - Adduction
- Knees
 - Flexion (Hamstrings)
 - Extension (Quadriceps)
- Feet
 - Plantarflexion (Gastrocnemius)
 - Dorsiflexion (Anterior Tibial)

Cerebellum

✚ Cerebellum controls balance and coordination

✚ Finger-Nose-Finger

- Patient has eyes open, touches index finger to their nose, repeat with other index finger, and then repeat with eyes closed. An alternative method is to have the patient keep their eyes open, touch their index finger to the doctor's index finger, touch their nose, continue while the doctor's index finger is moved with increasing speed, and repeat with the other index finger.
 - Video Link:
 - <https://www.youtube.com/watch?v=2Buhkr5akMs>

✚ Heel-to-Shin

- With the patient supine or sitting, have them touch their heel to the opposite knee, run the heel down that shin, and repeat on the opposite side.
 - Video Link:
 - <https://www.youtube.com/watch?v=uEaTMysjSDA>

✚ Rapid Alternating Movements

- For a minimum of 20 seconds have the patient pat their knees with back and palms of hands on knees, perform rapid pronation and supination, rapidly touch fingers to thumb, or have the patient place their heel on the floor and rapidly tap their foot.
 - Video Link:
 - <https://www.youtube.com/watch?v=AA4E0nRik6M>

✚ Gait

- Assess balance, arm swing, leg movement, and smoothness
 - Walk normally
 - Walk on toes (tests for plantarflexion)
 - Walk on heels (tests for dorsiflexion)
 - Tandem gait (patient walks heel-to-toe)
 - Ensure to remain near patient to prevent injury in case the patient falls or stumbles

✚ Romberg test

- Have the patient standing, feet together, and arms at sides. Reassure the patient you will not let them fall and remain close to catch the patient if needed. Repeat this with both eyes open and then eyes closed. Loss of balance is a positive Romberg. Vision, vestibular sense, and

proprioception are three senses that directly or indirectly connected to the cerebellum. Two of these three senses must be intact to maintain balance; thus **a positive Romberg implies a proprioceptive or vestibular defect.**

- Technically, a positive Romberg is swaying (near falling, but you will catch the patient) with eyes closed, no sway with eyes open; however, you need to correlate your other findings and observations. A vestibular lesion is suspected by the history of vertigo while standing. A proprioception defect is detected by performing proprioception testing (covered later in this system). Difficulty in balance is also associated with orthostatic hypotension, thus check blood pressure in supine and standing positions. Lastly, weakness or rigidity may also be present with imbalance.

- Video Link:
 - <https://www.youtube.com/watch?v=suxuiAcBEp4>

Sensory Exam

- ✚ Considerations for sensory testing include the following:

- Fatigue may occur that could cause inconsistent results
- Compare testing bilaterally
- Start testing at gross sensations and work to finer discriminatory senses
- It is rarely useful to test *all* of the dermatomes
- Usually the patient will outline the distribution of pain, burning, tingling, or loss of sensation
- Confirmation can be performed at the specific areas
- Ask the patient to close their eyes during portions of the sensory exam and advise ahead of time what you are doing
 - Show the patient the sterile needle, cotton wisp, etc. and demonstrate what you will do

- ✚ Pain

- Lateral spinothalamic tracts
- Patient closes eyes. Alternating with the hub and point of a sterile needle or a broken shaft and cotton tip of a cotton tip applicator, touch the skin. Allow 2-3 seconds between testing and identify as sharp or dull.
 - Video Link:
 - <https://www.youtube.com/watch?v=AR6Mg1qDCAs>
- Temperature sensation could also be tested using warm and cold test tubes or water

- ✚ Light touch

- Anterior spinothalamic tracts
- Stroke the patient with a wisp of cotton or gently with your finger and have the patient report what is felt and where they felt it.
 - Video Link:
 - <https://www.youtube.com/watch?v=g6AYM6Hyaxg>

- ✚ Crude touch

- Anterior spinothalamic tracts
- Squeeze a muscle (i.e. trapezius or biceps).

- ✚ Proprioception

- Posterior columns
- Ask patient to close eyes. Move the great toe up and ask the position, then move the great toe down and ask the position. In order to properly perform this test, ensure that you hold the sides of the toe and do not simply bend it up and down. Repeat the same test with the index finger or thumb.
 - Diseases that may cause proprioceptive difficulty (i.e. multiple sclerosis, neurosyphilis, and pernicious anemia) may affect the lower extremities before the upper extremities
 - Video Link:
 - https://www.youtube.com/watch?v=0krCEry9_w8

✚ Vibration

- Posterior columns
- Use low pitched tuning fork (128 hz) and place it on **bony prominences**. Begin distally and work proximally if sensation is impaired.
 - Vibration testing is another way, in addition, to testing for posterior column disease and elderly people may have a diminished vibratory sense and this should not be mistaken for a neurologic deficit

✚ Two point discrimination

- Posterior columns
- Use the ends of a paper clip or two sterile needles
- Useful in a skin laceration where peripheral nerve damage could have occurred (this is used instead of checking for pain, because after an acute injury pain fibers are blunted)
- Have the patient close their eyes and let you know when they are able to accurately discriminate between the feeling of one point and two separate points.
 - Check the distance of discrimination with the following chart:
 - Tongue: 1 mm
 - Fingertips: 2-8 mm
 - Toes: 3-8 mm
 - Palms: 8-12 mm
 - Chest, forearms: 40 mm
 - Back: 40-70 mm
 - Upper arms and thighs: 75 mm

✚ Ascending spinal tracts, spinothalamic, and spinocerebellar provide cortical and discriminatory sensation with complex somatic sensations interpreted by the cerebral cortex

- The following tests are usually only performed when previous testing shows impairment or injuries to determine the extent of nerve damage:
 - Point localization
 - Patient's eyes are closed and they locate where they were touched at.
 - Texture discrimination
 - Patient's eyes are closed and they identify cotton, wool, or silk by feeling with their hands.
 - Stereognosis
 - Patient's eyes are closed and they identify familiar objects in their hand (i.e. coin, key, etc.). Sides are compared.
 - Graphesthesia
 - Patient's eyes are closed and a number or letter is drawn in the palm of their hand or other areas with a blunt point. Sides are compared.

Deep Tendon Reflexes

✚ The following are some basic notes on testing deep tendon reflexes (DTRs):

- Support the joint, so that the muscles are relaxed
- Reflex hammer is held between the thumb and index finger and is swung **at the wrist**
- Ensure to *gently* tap the DTR to be tested
- The actual response might only be palpated
- Test each reflex and compare it **bilaterally** and reflexes should be *symmetrically* equal
- Grading is based upon the following chart:

+0/4	<i>No response</i>
+1/4	<i>Diminished</i>
+2/4	<i>Normal</i>
+3/4	<i>Increased</i>
+4/4	<i>Hyperactive</i>

- ✚ Hyperactive reflexes are seen in pyramidal tract disease, hyperthyroidism, pre-eclampsia, and other metabolic disorders and in contrast diminished or absent reflexes are seen in anterior horn cell pathology, herniated discs, myopathies, hypothyroidism, and other pathologies
- ✚ *Always consider the grade of the reflex to the bulk and strength of the muscle!*
- ✚ **Diminished reflexes can be augmented by reinforcement** (i.e. clench teeth or clasp hands and pull apart [Jendrassik maneuver or augmentation])

DTRs	Spinal Levels
<i>Biceps</i>	C5-6
<i>Brachioradialis</i>	C5-6
<i>Triceps</i>	C6-7-8
<i>Patellar</i>	L2-3-4
<i>Achilles</i>	S1-2

- ✚ The following memory tool might aid in learning the DTRs and spinal levels:
 - C6-7-8 – “Don’t be late.”
 - C5 & 6 – “Pick up sticks.”
 - L2-3-4 – “Kick the door.”
 - S1 & 2 – “Look at my shoe.”
- ✚ Testing DTRs:
 - Biceps – biceps contraction and elbow flexion
 - Triceps – triceps contraction and elbow extension
 - Brachioradialis – supination and flexion
 - Patellar – quadriceps contraction and knee extends
 - Achilles – plantarflexion

Plantar (Toe) Signs

- ✚ Can be initiated with a finger, tip of a reflex hammer, etc. (**do not gouge or dig**)
- ✚ “Normal” is flexion (“toes are down”) and “abnormal” is extension (“toes are up”)
- ✚ Various methods to perform and “toes being up” is normal up to age 16-24 months

Description	Eponym	Technique	Video Link
<i>Plantar toe reflex</i>	Babinski	Stroke the lateral sole of the foot and move in a “J” fashion to the sole of the forefoot	https://www.youtube.com/watch?v=VwpLUUq2L8U
<i>N/A</i>	Chaddock	Stroke the lateral foot	https://www.youtube.com/watch?v=wdoVBmG9Iz4
<i>Achilles toe reflex</i>	Schaeffer	Squeeze the Achilles tendon	N/A
<i>Shin-toe reflex</i>	Oppenheim	Press knuckles on shin and move distally	https://www.youtube.com/watch?v=5CpQq2hfzkU

<i>Calf-toe reflex</i>	Gordon	Squeeze calf briefly	https://www.youtube.com/watch?v=lehrTYq0Mnw
<i>Pinprick-toe reflex</i>	Bing	Multiple, light pinpricks on the dorsolateral foot surface	N/A
<i>Toe pull reflex</i>	Gonda or Stransky	Pull the 4 th toe outward and downward briefly and quickly release	https://www.youtube.com/watch?v=vktHpdMy54M

Pathological Reflexes

- ✚ Extensor toe signs
 - Upper motor neuron (UMN) and pyramidal tract lesions
 - Normally toes will plantarflex, but abnormally there will be great toe extension with fanning of the other toes
 - See **Plantar (Toe) Signs** for more details
- ✚ Ankle clonus
 - UMN lesion and should test for when reflexes are hyperactive
 - Support patient's partially flexed foot. Briskly dorsiflex foot and observe if clonus occurs (clonus refers to rhythmic oscillating movements [extension and flexion]).
- ✚ Meningeal irritation
 - Kernig and Brudzinski signs are done in suspected cases of meningitis and subarachnoid hemorrhage. Do these tests in patients with unexplained nuchal rigidity, cephalgia, fever, or altered mental state. A stiff neck or nuchal rigidity is a sign associated with meningitis and intracranial hemorrhage.
 - Brudzinski
 - Doctor forward bends the patient's head and neck. Patient reports marked nuchal pain and hips and lower extremities flex.
 - Video Link:
 - <https://www.youtube.com/watch?v=Pxo02mAgIvg>
 - Kernig
 - Hip and knee are flexed and extension of the knee occurs. Low back pain and/or neck flexion occurs.
 - Video Link:
 - <https://www.youtube.com/watch?v=EV1HOuxJUjQ>