- **Additional information (for problem 1-6 review):**

**PROBLEM 1 (Peripheral Neuropathy):**

- Why does someone feel burning sensation?
  - ✓ Sensation of cold is transmitted by delta fibers while sensation of warmth is transmitted by C-fibers. Therefore, when there is damage to delta fibers heat will be felt.
- Sensation of pain and temperature will be lost ipsilaterally when there is a lesion to the spinal nucleus in medulla oblongata.

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**PROBLEM 2 (Spinal Cord Injury):**

- When there is voluntary movement → both α and γ motor neurons are stimulated.
- Mention one example on static reflex and another one on dynamic reflex.
  - ✓ Static reflex: posture of the body.
  - ✓ Dynamic reflex: load reflex (knee jerk).

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**PROBLEM 3 (Unconsciousness):**

- Reticulospinal tract is involved in anticipated disturbed movement correction.
- Motor mirror neurons are present in the ventrolateral part of premotor area and it is involved in imitation of movement and empathy.
- Wakefulness and alertness is maintained by: ascending reticular activating system going to intralaminar nuclei of the thalamus and then to the cortex.
- Circadian rhythm is controlled by: suprachiasmatic nucleus.
- Pineal gland is the one which is secreting melatonin that is chemically inducing sleep.
- Slow-wave sleep is seen more in the beginning of sleep while REM-sleep is seen more late in sleep (toward the morning). Notice that all muscles are paralyzed in REM-sleep except eye muscles and respiratory muscles. In addition, eye movement which is occurring during REM-sleep is caused by ponto-geniculo-occipital complex and superior colliculus.
- Narcolepsy: it is associated with decreased levels of orexin.
- Hypothalamus induces sleep through ventolateral preoptic nucleus (VLPO) which is GABAergic.
- Caffeine will enhance alertness through inhibition of adenosine.

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**PROBLEM 4 (Stroke):**

- In facial palsy (paralysis of the facial nerve): the angle of the mouth will be deviated toward the normal side.
- What is the difference between bulbar palsy and pseudobulbar palsy?
  - ✓ Bulbar palsy: when the lesion is in the cranial nerve nucleus itself.
  - ✓ Pseudobulbar palsy: when the lesion is in the corticobulbar tract (above the level of the cranial nerve nucleus).
- What is the difference between decorticate and decerebrate postures?
  - ✓ Decorticate: when the lesion is above the red nucleus: there will be flexion of the arm and extension of the leg.
  - ✓ Decerebrate: when the lesion is below the red nucleus: there will be extension of both the arm and the leg.
- The most important factor which is affecting cerebral blood flow is: $PCO_2$
- What is the blood supply to the lateral and medial parts of the medulla?
  - ✓ Lateral part of the medulla: it is supplied by vertebral artery and sometimes by PICA.
  - ✓ Medial part of the medulla: it is supplied by vertebral artery and anterior spinal artery.
- What is the difference between phonation and articulation?

- ✓ Phonation is the ability to produce sounds and this is mediated by the 9th and 10th cranial nerves which are supplying pharyngeal and laryngeal muscles.
- ✓ Articulation: is producing letters and words from the generated sound by lips, tongue and soft palate. The following cranial nerves are involved: 7th, 9th, 10th, 11th (cranial part) and 12th.

- What are the 3 main types of aphasia and the differences between them?
  - ✓ Borca's aphasia: non-fluent, good comprehension, poor repetition.
  - ✓ Wernicke's aphasia: fluent, poor comprehension, poor repetition.
  - ✓ Conductive aphasia: fluent, good comprehension, poor repetition.
- Who can learn sign language and who cannot?
  - ✓ Aphasia with lesion to the left hemisphere: cannot.
  - ✓ Aphasia because of deafness: can.
  - ✓ Aphasia because of deafness later developing lesion in Broca's area: losing his sign language.
  - ✓ Aphasia because of deafness and lesion in the right hemisphere: loss of emotional component in the sign language.
- When there is lesion in corpus callosum: words or images seen in the left visual field will be transmitted to the right hemisphere but then will not be transmitted to the left hemisphere which is containing angular gyrus (for naming) and Wernicke's area for interpretation. Therefore, a person cannot describe what he sees.

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**PROBLEM 5 (Parkinson's Disease):**

- Globus pallidus internus (GPi): is an inhibitory output to the thalamus because it is GABAergic.
- Movement occurs when medium spiny neurons (MSNs) are stimulated.
- Basal ganglia is controlling body movement through globus pallidus internus (GBi) and eye movement through substantia nigra pars reticulata (SNr).
- Dopamine receptors (D1 and D2) are present in the putamen (D1 for stimulation of direct pathway and D2 for inhibition of indirect pathway).
- In Parkinson's disease: there is deficiency of dopaminergic neurons in substantia nigra pars compacta (SNc).
- There are 2 pathways in cerebellar units:
  - ✓ One which is responsible for correction of movement: climbing fiber which are originating from inferior olivary nucleus in medulla oblongata.
  - ✓ Another one which is responsible for learning and initiation+termination of movement: Mossy fibers coming from the cortex.
- Alcohol causes damage in the anterosuperior part of the vermis. Therefore, it is resulting in ataxia in the lower limbs.

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**PROBLEM 6 (Meningitis):**

- Superior sagittal sinus is containing a one-way valve which is allowing the entrance of CSF to venous blood (when CSF has more pressure than venous blood) but it will not allow venous blood to enter subarachenoid space (even when pressure of venous blood is higher than that of the CSF).
- What is the difference between communicating and non-communicating hydrocephalus?
  - ✓ Non-communicating: it is caused by obstruction of CSF flow in the ventricles especially in narrow places such as the cerebral aqueduct.
  - ✓ Communicating: it is caused by impaired reabsorption of CSF or obstruction of CSF flow in subarachenoid space.

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**Problems: 7-12 review:**

**PROBLEM 7 (Epilepsy):**

- What is the source of brain waves detected by EEG?
  - ✓ Pyramidal cells in the 5th layer of the cortex.
- What is the difference between simple partial epilepsy and complex partial epilepsy?
  - ✓ Simple partial epilepsy: there is no loss of consciousness.

- ✓ Complex partial epilepsy: there is loss of consciousness because the abnormal electrical activity is reaching the diencephalon.

- What are the causes of seizure?
  - ✓ Hyperexcitability: which is caused by changes in ion channels or receptors or neurotransmitters.
  - ✓ Hypersynchrony: many neurons are firing at the same time.
  - ✓ Propagation: spread of the electrical activity throughout the brain.
- What are the excitatory and inhibitory neurotransmitters:
  - ✓ Excitatory: glutamate which can be ionotropic (fast transmission) or metabotropic (slow transmission) and it is acting through binding to 2 receptors: AMPA and NMDA.
  - ✓ Inhibitory: GABA which is present in 2 forms:
    - ❖ GABA-A: presynaptic and associated with chloride channels.
    - ❖ GABA-B: postsynaptic and associated with potassium current.
- What are the causes of absence seizure?
  - ✓ It is caused by over-expression of T-type calcium channels in thalamocortical neurons.
  - ✓ Or spontaneous firing of reticulothalamic neurons.
    Note: absence seizure is treated by ethosuximide.
- How to localize a focus?
  - ✓ This can be done by MRI or EEG or aura.

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**PROBLEM 8 (Vision):**

- What are the muscles of the iris which are responsible for miosis and mydriasis?
  - ✓ Miosis: by constrictor papillae which are having M3-receptor and innervated by parasympathetic nervous system.
  - ✓ Mydriasis: by radial muscles which are having α1-receptors and are innervated by sympathetic nervous system.
- Accommodation reflex: it is characterized by 3 things:
  - ✓ Medial convergence of both eyes.
  - ✓ Miosis: notice that when there is a lesion to Edenger-Westphal nucleus in the midbrain, there will be loss of papillary constriction of light reflex but it will not be lost in accommodation reflex (this condition is know Argyll-Robertson pupil).
  - ✓ Contraction of ciliary muscle → resulting in relaxation of suspensory ligament → and the lens will become more convex.
- In glaucoma (increased aqueous humor in the eye): peripheral vision is the one which will be affected.
- There are 2 different types of pigments in photoreceptos:
  - ✓ Rods: retinal + scotopsin. Notice that rods are stimulated in darkness, they have a lot of pigment and they are present in the periphery of the retina (detecting motion).
  - ✓ Cons: retinal + photopsin. Notice that cons are stimulated in day-time (with intense light), they have little amount of pigment and they are present in macula lutea (for accurate colored vision).
    Note: these pigments are engulfed by the pigment epithelium (after their life span which is equal to 12 days. If they are not engulfed, this will result in a condition known as retinitis pigmentosa which will lead to tunnel vision).
- What are the 2 pathways formed by the 6 layers of lateral geniculate body?
  - ✓ Parvocellular pathway (formed by 4 layers): it is the (what) system projecting to the parietal lobe – detecting shape – receiving information from X-ganglion cells.
  - ✓ Magnocellular pathway (formed by 2 layers): it is the (where) system projecting to superior colliculus for orientation – detecting motion – receiving information from Y-ganglion cells.
- How are rods stimulated in darkness?
  - ✓ In darkness there will be increased cGMP in rods leading to influx of sodium and calcium → therefore, they will be depolarized (the opposite occurs in day-time).

- There are 2 types of cons responsible for colored vision (red, blue and green). Each one of them is detecting waves with different lengths.
- What are the properties of ganglion cells?
  - ✓ They have circular receptive field which is small and detecting spots of light. There are also on and off centers.
- You must study lesions of vision. Notice that bitemporal hemianopia is important. It occurs when there is a lesion in optic chiasma (which is probably due to tumor in the pituitary gland compressing on the chiasma).
- Cortical simple cells are sensitive to lines and their orientation. They have receptive fields bigger than those of ganglion cells.
- Complex cells: they have huge receptive fields and they are detecting (bars and edges, orientation and direction of movement).
- What is the difference between voluntary and involuntary eye movements?
  - ✓ Voluntary eye movement is mediated by the frontal eye field.
  - ✓ Involuntary eye movement is mediated by the occipital cortex.

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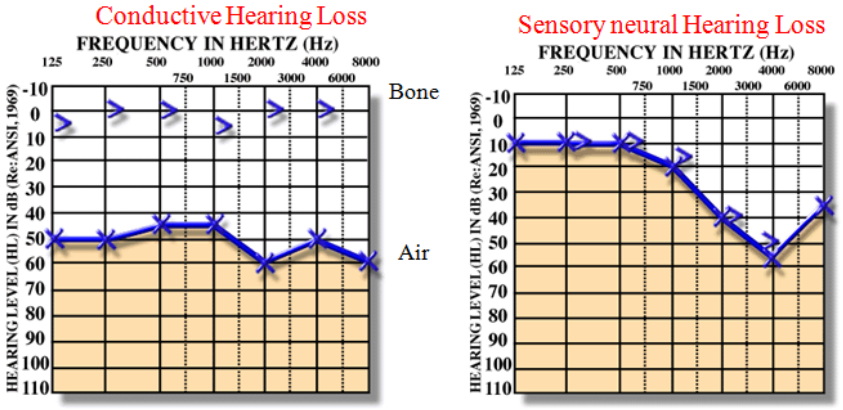
**PROBLEM 9 (Hearing):**

- What is hyperaccusis and why does it happen?
  - ✓ It is increased sensitivity to certain frequency and volume ranges of sound resulting from paralysis of stapedius muscle (when there is Bell's palsy: because this muscle is innervated by the facial nerve).
- The cochlear duct is composed of:
  - ✓ Scala vestibuli: containing perilymph (Na).
  - ✓ Scala media: containing endolymph (K) and organ or Corti.
  - ✓ Scala tympani: containing perilymph (Na).
- What are the differences between inner and outer hair cells?
  - ✓ Inner hair cells: 3500 in each ear (arranged in a single row) – responsible for hearing – not piercing the tectorial membrane – containing most of afferent fibers.
  - ✓ Outer hair cells: 11500 in each ear (arranged in 3 rows) – responsible for sharpness of sound – piercing the tectorial membrane – containing more efferent fibers.
- How does depolarization occur in hair cells?
  - ✓ When the endolymph causing stereocilia to move toward the taller. Therefore, there will be influx of potassium ions and depolarization of these cells.
- High frequency sound will be heard in the base of basilar membrane while low frequency sounds will be heard in the apex.
- When there is unilateral hearing loss, this means that the defect can be in:
  - ✓ Cochlea.
  - ✓ Cochlear nerve.
  - ✓ Or cochlear nucleus.

    But note beyond this level because there will be bilateral supply and interconnections.
- The pathway which is responsible for sound localization and reflex movement:
  - ✓ From cochlear nerve → to cochlear nucleus → fibers forming trapezoid body and ascending to → superior olivary nucleus in pons → then to inferior colliculus in midbrain → to medial geniculate body in thalamus → to primary auditory cortex (which is present in the upper part of superior tymporal gyrus).
- What is the difference between conductive deafness and sensory neural deafness (according to Weber's and Rinne tests)?
  - ✓ Weber's test: sound will be lateralized to the ear which has conductive deafness while it will not be lateralized to the ear which is having sensory neural deafness.
  - ✓ Rinne test: if there is conductive deafness bone transmission will be longer that air transmission while both bone and air transmissions will be decreased in case of sensory neural deafness.

- How to differentiate between audiographs of conductive deafness and sensory neural deafness?




- High frequency sound are detected by lateral part of superior olivary nucleus through intensity difference.
- Low frequency sounds are detected by medial part of superior olivary nucleus through timing difference.
- Angular movement of the head (such as rotation of the head to the right and left) is detected by semicircular canals.
- Linear horizontal movement is detected by macula of utricle.
- Linear vertical movement and head-tilt are detected by macula of saccule.
- What is striola?
  - ✓ It is the line which is separating hair cells in maculae of utricle and saccule into 2 populations.
- When the head is turned to the left side:
  - ✓ Left horizontal semicircular canal will be activated.
  - ✓ There will be movement of both eyes to the right side and this is achieved through:
    - ❖ Stimulation of the right nucleus of abducens nerve.
    - ❖ Stimulation of the left nucleus of oculomotor nerve.

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**PROBLEM 10 (Dementia)**

- What are the differences between explicit and implicit memories?

| Explicit | Implicit memories |
|---|---|
| • *Late* developed memory | • *Early* memory. |
| • For facts and events. | • Perceptual and motor skills |
| • Related to conscious thoughts and language | • Acquired through practice or reflexes |
| • Stored with the context in which it was learned. | • Do not retain the context in which they were learned |
| • Four stages | • Not |
| • Retrieved deliberately | • Automatic |
| • Easy to store and easy to forget | • Require much repetition but not easy to forget |
| • A function of the Temporal lobe structures | • Differs according to the type (fear conditioning in Amygdala/ Operant conditioning in Striatum & Cerebellum. |

- Mention the 2 types of amnesia and the difference between them.
  - ✓ Retrograde amnesia: in which the person cannot retrieve memory from the past.
  - ✓ Anterograde amnesia: in which the person is unable to form new long-term explicit memories.
- Habituation: means that with constant tactile stimulation there will be depression of withdrawal reflex (in this case, calcium channels will be closed).

- In the formation of long-term memories: there is long-term potentiation through NMDA receptors.
- What is the difference between memory of places and faces?
  - ✓ Memory of places: it is in the medial parts of the temporal lobe.
  - ✓ Memory of faces: it is in the lateral parts of the temporal lobe (fusiform face area).
- What is the difference between electrical and chemical synapses?
  - ✓ Electrical synapse: gap junctions – electrotonically coupled – diameter of 2nm – highly synchronized.
  - ✓ Chemical synapse: wide synaptic cleft with a diameter of 20-50 nm – presynaptic element – postsynaptic element.
- In inhibitory postsynaptic potential (IPSP): negativity inside the cell will be increased through the opening of Cl-channels or K-channels.
- In excitatory postsynaptic potential (EPSP): positivity inside the cell will be increased through the opening of Na-channels or Ca-channels.
- What is the difference between ligand-gated ion channel and voltage-gated ion channel?
  - ✓ Ligand-gated ion channel: requires the binding of a neurotransmitter so the channel can be opened.
  - ✓ Voltage-gated ion channel: is stimulated by the difference in voltage.
- What are the characteristics of a neuropeptide and when is it released?
  - ✓ It is synthesized in the cell body.
  - ✓ No uptake mechanism.
  - ✓ Stored in large dense-core vesicles which are only used once.
  - ✓ Released when there is high frequency stimulation resulting in general elevation of intracellular calcium.
- Where is acetylcholine released from?
  - ✓ Basal forebrain complex.
  - ✓ Peduculopontine tegmental nucleus.
  - ✓ Laterodorsal tegmental nucleus.

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**PROBLEM 11 (Depression):**

- What are the 2 important nuclei in hypothalamus which are regulating food intake?
  - ✓ Lateral hypothalamus: it is the feeding center. A lesion in this nucleus will result in weight loss.
  - ✓ Ventromedial hypothalamus: it is the satiety center. A lesion in this nucleus will result in obesity.
- Grehlin is the only GI hormone which is secreted from the stomach and inducing hunger. Notice that all other GI hormones will induce satiety.
- Where does expression of emotions happen?
  - ✓ In the hypothalamus.
- Amygdala is the one which is responsible for reading emotional facial expressions and formation of emotional memory.
- There are 2 pathways which will be emerging from amygdala:
  - ✓ One going to the pre-frontal cortex: creating emotional awareness.
  - ✓ Another one is going to the hypothalamus: for physical expression of emotions (represented by heart beat, ventilation, sweating… etc).
- The ventral (what) system in the temporal lobe will have 2 components:
  - ✓ Fusiform face area: for conscious identification. A lesion in this pathway will result in a condition known as (prosopagnosia) in which the person has a sense of familiarity but cannot identify faces.
  - ✓ Limbic amygdala: unconscious autonomic responses (familiarity). A person with a lesion in this pathway will be able to identify his parents (for example) but without sense of familiarity (feeling that they were replaced by aliens!!).
- What are the characteristics of Kluver-Bucy syndrome (in which there will be a bilateral lesion involving temporal lobes and amygdala):
  - ✓ Loss of memory.

- ✓ Learning difficulty.
- ✓ Loss of fear.
- ✓ Increased curiosity.
- ✓ Increased sexual drive.
- ✓ Being hyperactive.
- ✓ Oral tendency.

- Explain the pathway of reward/addiction.
  - ✓ Dopamine is secreted from dopaminergic neurons in VTA (ventral tegmental area) → going to nucleus accumbens → and then to prefrontal cortex.
- Difference between drugs in producing addiction (according to mechanism of action):
  - ✓ Cocaine: it is blocking the normal reabsorption of dopamine from the synaptic cleft (therefore it will accumulate).
  - ✓ Amphetamine: enhancing the release of more amount of dopamine.
  - ✓ Cigarettes: nicotine will stimulate the release of more dopamine and another component in cigarettes will block the action of the enzyme monoamine oxidase (MAO: which is responsible for enzymatic degradation of dopamine).
- What are the 3 neurotransmitters which are responsible for regulation of mood?
  - ✓ Norepinephrine (NE).
  - ✓ Serotonine.
  - ✓ Dopamine.

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**PROBLEM 12 (Schizophrenia):**

- What happens when a patient undergoes frontal lobotomy?
  - ✓ If someone undergoes frontal lobotomy, anything which is related to thinking, remembering, solving problems, reasoning or judgment will be affected (the person might also become selfish or rude with many other behavioral changes). In addition, he becomes less aggressive.
- What are the association areas?
  - ✓ Association areas are those which are responsible for interpretation of information more than the primary areas. there are 3 important association areas:
    - ❖ Limbic association area: it is further composed of 2 parts:
      - ➢ Orbito-frontal: for emotions.
      - ➢ Inferior temporal: for memories.
    - ❖ Prefrontal association area: for cognitive behavior and motor planning.
    - ❖ Parietal-temporal-occipital association area: involved in language comprehension (Wernicke's area) and attention.
- All sensory inputs will arrive to layer 4 of cerebral cortex (it is the thickest layer in the primary sensory cortex and primary visual cortex).
- What are the positive and negative symptoms of schizophrenia. Mention their causes.

| Positive symptoms (they are caused by overactivity of mesolimbic system in which there will be excess of dopamine) | Negative symptoms (they are caused by dopamine deficiency in mesocortical system) |
|---|---|
| Delusion (false belief) | Catatonic behavior |
| Hallucination (perception of non-existing stimuli) | Blunted effect: reduced or no emotions |
| Disorganized thinking or speech (the person becomes talkative) | Alogia: reduced speech |
| Disorganized behavior | Avolition (lacking motivation) and anhedonia (loss of interest and pleasure in life ☹) |

- Mention the different neurotransmitters and their origin.
  - ✓ Dopamine: VTA (Ventral Tegmental Area).
  - ✓ Serotonin: Raphe nucleus.
  - ✓ Norepinephrine (NE): locus ceruleus.
  - ✓ Histamine: tuberomamillary nucleus.

- ✓ Acetylcholine (Ach): pedunculopontine tegmental nucleus – laterodorsal nucleus – basal forebrain complex.

- What neurotransmitters are increased in schizophrenia?
  - ✓ ↑ dopamine
  - ✓ ↑serotonin.

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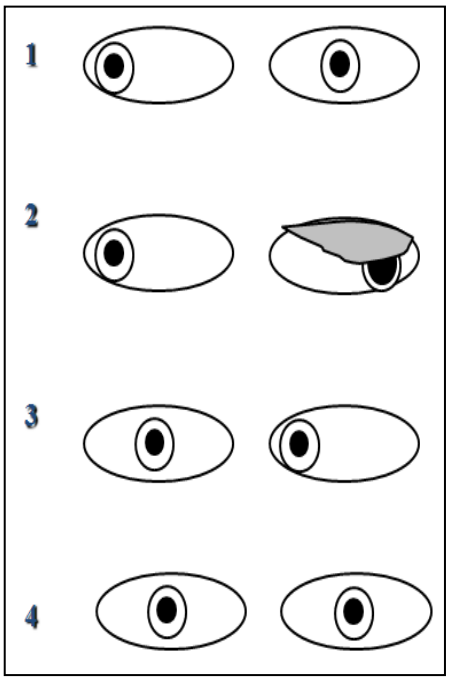
## LABS

- Lesions causing abnormal movement of the eye:
  - ✓ If you ask the patient to look to the right side → and you notice that his **right eye is moving but the left eye does not** → this indicates that the lesion is in the medial longitudinal fasciculus (fibers coming from nucleus of 6th cranial nerve at the right side are not reaching the nucleus of the 3rd cranial nerve at the left side).
  - ✓ If you ask the patient to look to the right side → and you notice that the **right eye is moving but the left eye does not**, **has ptosis and dilation of the pupil** → this indicates that the lesion is in the nucleus of the 3rd cranial nerve at the left side.
  - ✓ If you ask the patient to look to the right side → and you notice that his **right eye does not move while the left eye is moving** → this indicates that the lesion is in the abducens nerve fiber going to lateral rectus muscle of the right eye (not in the nucleus of the 6th cranial nerve).
  - ✓ If you ask the patient to look to the right side → and you notice that **both eyes are not moving** → this indicates that there is a lesion in the right paramedian pontine reticular formation.




- Contralateral and ipsilateral sensory loss:
  - ✓ If the lesion is above the medulla: sensation of dorsal column and spinothalamic tract will be lost contralaterally.
  - ✓ If the lesion is below the level of medulla: dorsal column sensations will be lost ipisilaterally while sensations of spinothalamic tract will be lost contralaterally.
- Notice that in lateral medullary syndrome, the lesion will involve the inferior cerebellar peduncle → resulting in loss of unconscious proprioception.
- What are the reflexes which will be lost or exaggerated when there is a medial medullary syndrome (hint: there is a lesion in corticospinal tract)?
  - ✓ Lost reflexes: abdominal and cremasteric reflexes.
  - ✓ Exaggerated: muscle stretch reflexes.
- Explain papillary light reflex and its abnormalities.
  - ✓ Papillary light reflex:
    - ❖ Afferent: optic nerve (2nd cranial nerve).
    - ❖ Efferent: oculomotor nerve (3rd cranial nerve).
  - ✓ When you shine a light (for example: right eye), there will be direct papillary constriction (of the right eye) and consensual/indirect papillary constriction (of the left eye):
    - ❖ If there is a lesion of the right optic nerve: there will be no direct or consensual papillary constriction.
    - ❖ If there is a lesion in the right oculomotor nerve: there will be no direct papillary constriction of the right eye but there will be consensual papillary constriction of the left eye.

- Explain corneal reflex and its abnormalities.
  - ✓ Corneal reflex.
    - ❖ Afferent: ophthalmic division of trigeminal nerve.
    - ❖ Efferent: facial nerve ($7^{th}$ cranial nerve).
  - ✓ When you touch the cornea (for example: right eye), the normal response would be blinking of both eye (direct and consensual).
    - ❖ If there is a lesion in the right ophthalmic nerve: there will be no blinking in both eye (neither direct or consensual).
    - ❖ If there is a lesion in the right facial nerve: there will be no direct blinking of the right eye but there will be consensual blinking of the left eye.
- Explain gag reflex and its abnormalities.
  - ✓ Gag reflex:
    - ❖ Afferent: glossopharyngeal nerve ($9^{th}$ cranial nerve).
    - ❖ Efferent: vagus nerve ($10^{th}$ cranial nerve).
  - ✓ Abnormalities: same concept as papillary light reflex and corneal reflex (but notice that uvula is always deviated toward the normal side).
- Brainstem lesions (cases): review the following cases only: 12, 18, 19 and 25
- What are the EEG activation procedures?
  - ✓ These are the procedure which are used when there is a patient who is known to be epileptic but the EEG is not showing the abnormal waves.
  - ✓ Routine:
    - ❖ Eye opening and closure.
    - ❖ Hyperventilation.
    - ❖ Intermittent photic stimulation.
  - ✓ Optional:
    - ❖ Sleep deprivation.
    - ❖ Sedated sleep.
    - ❖ Video games and visual patterns.
    - ❖ Anti-epileptic drugs withdrawal.
- What are the normal brain waves?
  - ✓ **Beta waves (13-30 Hz):** they are normally seen in an awake person. Sometimes they might refer to anxiety and psychological issues.
  - ✓ **Alpha waves (8-12 Hz)**: these are seen in adults who are in an awake state with occipital dominancy (if you ask the person to close his eyes → the occipital lobe will not be functioning → therefore, alpha waves will appear).
  - ✓ **Theta waves (3.5-7.5 Hz)**: some can be detected normally in the temporal lobe → but excessive theta waves detected in an awake state is abnormal (because normally it should be detected during sleep-stage I).
  - ✓ **Delta waves (1-4 Hz)**: these must not be detected/recorded in an awake person! Because normally it is seen during deep sleep (notice that diffuse delta waves are detected in encephalitis because the brain is not functioning properly and has less activity).
- What are the abnormal waves seen in:
  - ✓ Absence seizure: spike and dome (frequency: 3 Hz).
  - ✓ Focal epilepsy: interictal spikes (caused by paroxysmal depolarization shift).
- How do you calculate nerve conduction velocity?
  - ✓ Nerve conduction velocity: $\frac{Distance\ between\ distal\ and\ proximal\ electrodes\ (mm)}{Proximal\ latency - distal\ latency\ (msec)}$
  - ✓ Normal conduction velocity ranges between 50-60 m/s. a neuropathy is considered when the conduction velocity is less than 25 m/s.

- What are these used for:
  - ✓ Snellen chart: visual acuity.
  - ✓ Perimetry: visual field.
  - ✓ Ishihara cards: color vision.
- You must memorize the following table:

| LESION / EMG Steps | NORMAL | NEUROGENIC LESION | MYOGENIC LESION | |
|---|---|---|---|---|
| | | Lower Motor | Myopathy | Polymyositis |
| Insertional Activity | Normal | Increased | Normal | Increased |
| Spontaneous Activity | — | Fibrillation, Positive Wave | — | Fibrillation, Positive Wave |
| Motor Unit Potential | 0.5-1.0 mv, 5-10 msec | Large Unit, Limited Recruitment | Small Unit, Early Recruitment | Small Unit, Early Recruitment |
| Interference Pattern | Full | Reduced, Fast Firing Rate | Full, Low Amplitude | Full, Low Amplitude |