

1) Drugs alter neuronal action at synapses by :

- A. Altering neurotransmitter release
- B. Altering neurotransmitter re-uptake and degradation
- C. Competing with neurotransmitters for binding to post-synaptic receptors
- D. Chemically alters neurotransmitters, thus inhibiting or enhancing their impact
- * E. a, b, and c
- F. All of the above

For example, Atropine blocks Ach at the synapse between the postganglionic PNS neuron and the muscarinic effector site (smooth muscle, gland). Agonist drugs enhance impact of a neurotransmitter, while antagonists inhibit.

2) Lidocaine works by

- * A. Blocking voltage-gated Na⁺ channels in peripheral nerves
- B. Blocking Ach at the synapse between the postganglionic PNS neuron and the muscarinic effector site
- C. Inhibiting neurotransmitter release
- D. None of the above

Lidocaine alters depolarization in neurons, by blocking the fast sodium (Na⁺) channels in the cell membrane. With sufficient blockade, the membrane will not depolarise and so not transmit an action potential, leading to its anesthetic effects. The elimination half-life of lidocaine is approximately 1.5-2 hours in most humans

3) Sympathomimetic drugs:

- A. Mimic the action of epinephrine and norepinephrine, neurotransmitters of the PNS system
- B. Have a similar impact as those of Sympatholytic drugs
- C. Interfere with the release of neurotransmitters of the SNS system
- * D. Mimic the action of epinephrine and norepinephrine, neurotransmitters of the SNS system
- E. Interfere with the release of neurotransmitters of the PNS system

Sympathomimetics are a class of drugs whose effects mimic those of a stimulated sympathetic nervous system (SNS). They do not directly impact the PNS. Some act directly by activating adrenergic receptors, e.g. Phenylephrine. Others act indirectly by facilitating release of norepinephrine (e.g. Amphetamine) or by blocking neuronal re-uptake of neurotransmitters.

Parasympathomimetics stimulate the PNS. **Sympatholytic** drugs inhibit all or part of the sympathetic nervous system by interfering with release or activity of norepinephrine and epinephrine.

- A. Stimulate the release of Ach
- B. Inhibit activity of the SNS
- * C. Usually act by competitively blocking muscarinic or nicotinic receptors
- D. Inhibit activity of the PNS through their effect on Epinephrine and Norepinephrine

Parasympatholytic drugs inhibit the activity of the PNS by interfering with the release or activity of Ach. For example, Atropine inhibits salivary, sweat, and mucus glands. By blocking the action of acetylcholine at muscarinic receptors, atropine also serves as an antidote for poisoning by organophosphate insecticides and nerve gases. Troops who are likely to be attacked with chemical weapons often carry autoinjectors with atropine and obidoxime (reverses the binding of organic phosphorus compounds from the enzyme acetylcholinesterase) which can be quickly injected into the thigh. <p>Parasympath drugs, as one would expect, stimulate the release, activity or mimic the effect of ACh, thereby stimulating the PNS. They can act directly on receptors (mimic the action of Ach) or indirectly by blocking the degradation of Ach. Some Chemical weapons such as sarin or VX, non-lethal riot control agents such as tear gas, and insecticides such as Diazinon fall into this category. So does nicotine,

5) Arachnoid granulations (and arachnoid villi) are small protrusions of the arachnoid (the thin second layer covering the brain) through the dura (the thick outer layer). They protrude into the venous sinuses of the brain, and allow cerebrospinal fluid (CSF), produced by the choroid plexus, to exit the brain and enter the blood stream. If arachnoid granulations are blocked for any reason, CSF builds up in the sub-arachnoid space, increasing pressure on the brain. As pressure builds, the most likely component of the brain to be affected is the:

- A. Pressure does not build up as the choroid plexus reduces production of CSF
- B. Pons
- C. Cerebellum
- D. Cerebrum
- * E. Medulla Oblongata

The medulla oblongata is the lower portion of the brainstem. By anatomical terms of location, it is rostral to the spinal cord and caudal to the pons, which is in turn ventral to the cerebellum. When CSF builds, the brain, specifically the medulla oblongata, tends to get "squeezed" out of the foramen magnum. The Nuclei of Cranial Nerves IX (Glossopharyngeal), X (Vagus), XI (Accessory), and XII (Hypoglossal) are located in the Medulla.

6) The Afghan dog's skull shape is best described as

- * A. Dolichocephalic
- B. Brachycephalic
- C. Metacephalic
- D. Oligocephalic
- E. None of the above. It's unique, so is referred to as "Afghan"

Canine skull shapes are usually divided into : Dolichocephalic, or 'long-headed' (e.g. Afghan, Greyhound) Mesocephalic, or 'medium-headed' (e.g. Beagle) Brachycephalic, or 'short-headed' (e.g. Lhasa Apso, Pug, Boxer)

7) The Organ of Corti and the Cristae (Ampullae) are both lined with hair cells that have the following functions:

- A. Hair cells in both Cristae and the Organ of Corti sense sound
- B. The hair cells in Cristae sense sound while the hair cells in the Organ of Corti are responsible for balance
- * C. The hair cells in the Organ of Corti sense sound while the hair cells in Cristae are responsible for balance
- D. Hair cells in both Cristae and the Organ of Corti are responsible for balance while the eardrum transduces sound waves into neural impulses

The **cochlea** is filled with a watery liquid, which moves in response to the vibrations coming from the middle ear via the oval window. As the fluid moves, thousands of "hair cells" are set in motion, and convert that motion to electrical signals that are communicated via neurotransmitters to many thousands of nerve cells. The hair cells in **cristae** of the semicircular canals respond to angular acceleration, not tilt. In fact, the hair cells will not respond to an angular acceleration of less than 2 degrees a second. Consequently, in the absence of visual cues, one could be tilted to an angle of 45 degrees off the vertical and not be aware of it. The **Vestibulocochlear** nerve (**CN VIII**) innervates the cochlear (cochlear nerve) and the semicircular canals (vestibular nerve).

8) The Utricle and Sacculle transduce linear acceleration into neural impulses while Cristae in semicircular canals transduce angular acceleration.

- A. False
- * B. True

Note that neither the Utricle and Sacculle nor the Cristae in semicircular canals can monitor speed. [For example, we are traveling at a speed of about 100,000 km per hour on a spaceship called Earth (going around the Sun) and the Utricle has absolutely no idea about this]. They only respond to changes in speed, or acceleration.

9) Signs of vestibular disease include ataxia, head tilt, loss of balance and abnormal nystagmus. The semicircular canals have hair cells that provide an animal its sense of balance. Consequently, vestibular ataxia could have its roots in the vestibule of the ear, the vestibular nuclei in the brainstem or the vestibulo-cochlear nerve (VIII).

- A. False
- * B. True

The vestibular system senses the position of the head and body in space, in relation to gravity and movement. This helps the animal maintain balance and coordinate eye movements with movement of the head. The receptors for the vestibular system are located in the inner ear from where vestibular information is transferred by the vestibulocochlear nerve (CN VIII) to the brainstem and cerebellum for processing. Any breakdown in the vestibular system - in the ear, CN VIII or the brain - can result in symptoms of vestibular disease.

10) Additional nerves, required for limbs, result in enlarged portions of the spinal cord. These enlargements occur between

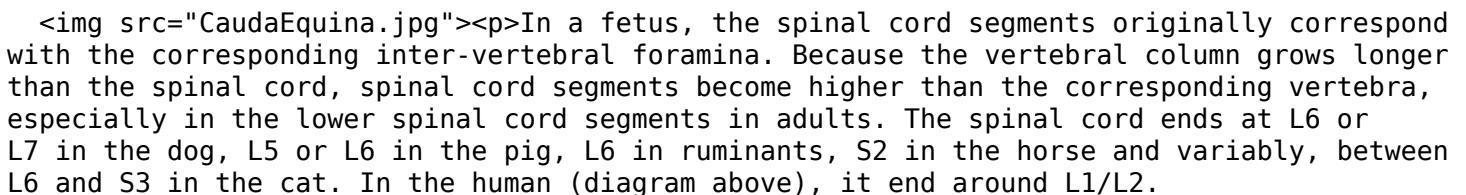
- A. C6-T2 and L2-L5
- B. T3-L3
- * C. C6-T2 and L4-S3
- D. No enlargements occur because the additional nerves come off the brachial and lumbar plexuses

There are two regions where the spinal cord enlarges:

- Cervical enlargement - corresponds roughly to the brachial plexus nerves, which innervate the front limbs.
- Lumbosacral enlargement - corresponds to the lumbosacral plexus nerves, which innervate the hind limbs.

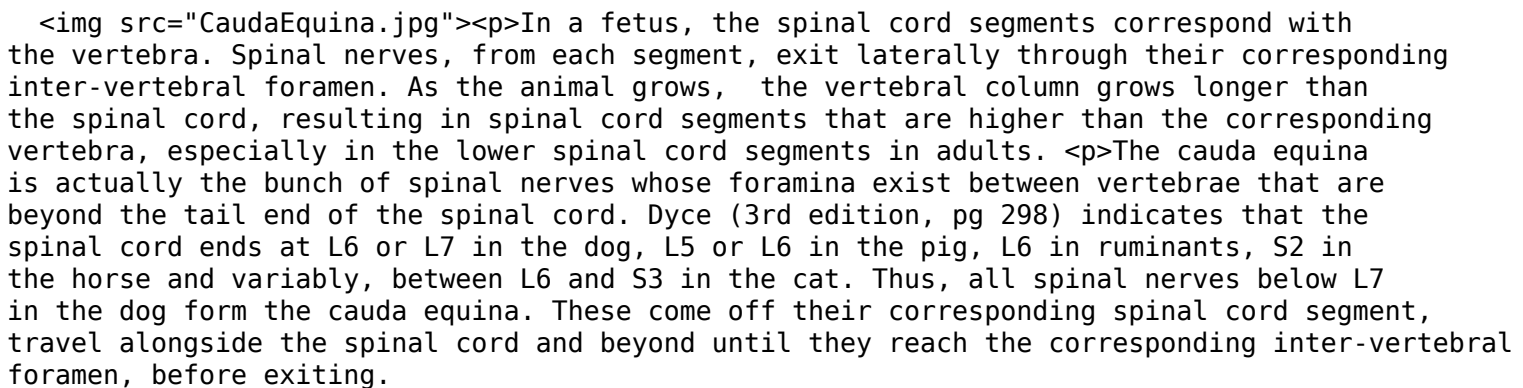
11) The S3 segment of the spinal cord in a dog is located at approximately what position with respect to the vertebrae of the spine?

- A. T12
- B. S2-S3
- C. L2
- * D. L6

 In a fetus, the spinal cord segments originally correspond with the corresponding inter-vertebral foramina. Because the vertebral column grows longer than the spinal cord, spinal cord segments become higher than the corresponding vertebra, especially in the lower spinal cord segments in adults. The spinal cord ends at L6 or L7 in the dog, L5 or L6 in the pig, L6 in ruminants, S2 in the horse and variably, between L6 and S3 in the cat. In the human (diagram above), it ends around L1/L2.

12) The cauda equina is a "horse's tail" of nerves that have their roots at the tip of the spinal cord

- A. True
- * B. False

 In a fetus, the spinal cord segments correspond with the vertebra. Spinal nerves, from each segment, exit laterally through their corresponding inter-vertebral foramen. As the animal grows, the vertebral column grows longer than the spinal cord, resulting in spinal cord segments that are higher than the corresponding vertebra, especially in the lower spinal cord segments in adults. The cauda equina is actually the bunch of spinal nerves whose foramina exist between vertebrae that are beyond the tail end of the spinal cord. Dyce (3rd edition, pg 298) indicates that the spinal cord ends at L6 or L7 in the dog, L5 or L6 in the pig, L6 in ruminants, S2 in the horse and variably, between L6 and S3 in the cat. Thus, all spinal nerves below L7 in the dog form the cauda equina. These come off their corresponding spinal cord segment, travel alongside the spinal cord and beyond until they reach the corresponding inter-vertebral foramen, before exiting.

13) There are 3 types of neurological gaits. These are

- A. Vestibular, cerebellar, proprioceptive
- * B. Ataxia, paresis, paralysis
- C. Cortical, vestibular, spinal
- D. None of the above

Ataxia is gait that shows a lack of coordination, lack of the sense of motion or a lack of the position of the body or limbs in space. Ataxia can be proprioceptive (due to sensory deficits), vestibular (lesion to CN VIII or vestibule), cerebellar or cortical. **Paresis** causes an abnormal gait due to weakness in limbs. **Paralysis** causes an abnormal gait because control over one or more limbs is completely lost.

14) When there is a head tilt associated with ataxia, the type of ataxia is called

- A. Cortical
- B. Proprioceptive
- C. Cerebellar
- * D. Vestibular
- E. None of the above

Vestibular ataxia is characterized by mild depression (mental status), head tilt, pathological nystagmus and instability (even falling) towards the side of the head tilt. **Ataxia** is gait that shows a lack of coordination, lack of the sense of motion or a lack of the position of the body or limbs in space. It can be **proprioceptive** (due to sensory deficits), **vestibular** (lesion to CN VIII or vestibule), **cerebellar** or **cortical**

15) The reticular formation is found in the

- A. Thalamus
- B. Cortex
- * C. Pons
- D. Cerebellum

The reticular formation, centered roughly in the pons, is a part of the brain which is involved in stereotypical actions, such as walking, sleeping, and lying down. It is absolutely essential for the basic functions of life and is phylogenetically (in terms of evolution) one of the oldest portions of the brain. It is a poorly-differentiated area of the brain stem, centered roughly in the pons. Some researchers have speculated that the reticular formation controls approximately 25 specific and mutually-exclusive behaviors, including sleep, walking, eating, urination, defecation, and sexual activity. **General anaesthetics** work through their effect on the reticular formation. [More](http://en.wikipedia.org/wiki/Reticular_formation)

16) The menace response tests the following :

- A. III, IV, VI, VIII, MLF
- B. II, III
- C. II, cortex, V
- * D. II, thalamo-cortex, cerebellum, VII

Carry out the menace response as follows : While covering one eye, touch and then make a threatening gesture at the uncovered eye, looking for a blink in response. This is a learned response, not a reflex. It tests the retina, the optic nerve (II), the thalamo-cortex, the cerebellum and the facial nerve (VII).

17) The pupillary light reflex (PLR) tests the following

- A. II, thalamo-cortex, cerebellum, VII
- B. III, IV, VI, VIII, MLF
- C. II, cortex, V
- * D. II, III

Emergency room physicians often assess the pupillary reflex because it is useful for gauging brain stem function. A PLR is conducted in a darkened room. Shine a light into one eye. The normal reflex will cause pupillary constriction in both eyes. The normal pathway for the AP of the PLR is as follows : II of eye in which light shoneDecussation at chiasmato both Pretectal nucleiEach pretectal nuclei transfers AP to both PNS motor nucleus... which triggers an AP in III to the ciliary ganglion... which transmits AP to ciliary smooth muscle nerve ending, releasing Ach, causing constriction.

18) During a pupillary light reflex (PLR), light shone into the left eye does not cause a constriction of the left eye, but does cause one in the right eye. This indicates that the lesion lies in :

- A. Right II
- * B. Left III
- C. Thalamo-cortex
- D. Right III
- E. Left II

Emergency room physicians often assess the pupillary reflex because it is useful for gauging brain stem function. A PLR is conducted in a darkened room. Shine a light into one eye. The normal reflex will cause pupillary constriction in both eyes. The normal pathway for the AP of the PLR is as follows : II of eye in which light shoneDecussation at chiasmato both Pretectal nucleiEach pretectal nuclei transfers AP to both PNS motor nucleus... which triggers an AP in III to the ciliary ganglion... which transmits AP to ciliary smooth muscle nerve ending, releasing Ach, causing constriction.

19) The palpebral reflex tests the following :

- A. II, III
- B. III, IV, VI, VIII, MLF
- C. II, cortex, V
- * D. V, VII
- E. II, thalamo-cortex, cerebellum, VII

Sensory information that triggers the palpebral reflex is picked up by V (either of ophthalmic - medial canthus, maxillary - lateral canthus or mandibular - ear branches). This triggers a blink reaction via VII through the action of the orbicularis oculi muscle.

20) The nasal septum stimulation test is done with the animal's eyes closed. Using a cotton swab, gently touch the nasal mucosa on either side of the nasal septum. The normal response is withdrawal of the head. This tests

- A. VII-maxillary branch, Cortex
- B. V-mandibular branch, MLF, Cortex
- C. VII-mandibular branch, MLF
- * D. V-maxillary branch, Cortex
- E. VIII, MLF

The nasal septum stimulation test assesses CN V and the thalamo-cortex. CN V (trigeminal) has 3 branches that provide sensory innervation of the face : Ophthalmic, maxillary and mandibular. Ophthalmic innervates the most dorso-medial aspect while the mandibular innervates the most ventro-lateral aspect; the maxillary, in between. In addition, V provides motor innervation to the muscles of mastication (masseter, temporalis, medial & lateral pterygoid, mylohyoid, anterior digastricus). <p>Which nerve causes withdrawal of the head? The Accessory?

21) If a dog has lost tone in its masseter and temporalis muscle, there is likely to be a problem with

- * A. V-motor
- B. V-sensory
- C. VII-motor
- D. VII-sensory
- E. None of the above

CN V (trigeminal) provides motor innervation to the muscles of mastication (masseter, temporalis, medial & lateral pterygoid, mylohyoid, anterior digastricus). It also has 3 branches that provide sensory innervation of the face : Ophthalmic, maxillary and mandibular. <p>CN VII (Facial) has motor branches that innervate the facial muscles (expression) and sensory branches that innervate the palate and rostral 2/3rd of the tongue.

22) If the face of a cat is skewed to one side, there is likely to be a problem with

- A. V-sensory
- B. V-motor
- * C. VII-motor
- D. VII-sensory
- E. None of the above

CN VII (Facial) has motor branches that innervate the facial muscles (expression) and sensory branches that innervate the palate and rostral 2/3rd of the tongue. <p>CN V (trigeminal) provides motor innervation to the muscles of mastication (masseter, temporalis, medial & lateral pterygoid, mylohyoid, anterior digastricus). It also has 3 branches that provide sensory innervation of the face : Ophthalmic, maxillary and mandibular.

23) Physiological nystagmus tests for lesions in

- A. II, cortex, V
- B. II, thalamo-cortex, cerebellum, VII
- * C. III, IV, VI, VIII, MLF
- D. II, III

The pathway that triggers normal physiological nystagmus involve III (oculomotor), IV (trochlear), VI (abducent), VIII (vestibulo-cochlear) and MLF (medial longitudinal fasciculus). <p>A lesion that affects III, IV or VI will also, usually, cause strabismus (misalignment of the eyes). <p>When a lesion affects VIII, there's, almost invariably, a head tilt towards the side affected as well as (vestibular) ataxia. <p>In some Siamese cats, it is normal to have strabismus and resting nystagmus.

24) The Medial longitudinal fasciculus is associated with the following cranial nerves

- A. V, VII
- B. III, V, VIII
- * C. III, IV, VI, VIII
- D. II, III

The medial longitudinal fasciculus (MLF) is a pair of crossed fiber tracts (group of axons), one on each side of the brainstem, that carry information about the direction that the eyes should move. It connects the cranial nerve nuclei III (oculomotor), IV (trochlear) and VI (abducent) together, as well as the gaze centres and information about head movement from cranial nerve VIII (vestibulo-cochlear). The MLF arises from the Vestibular nucleus (VN) and is thought to be involved in the maintenance of gaze. It also descends into the cervical spinal cord, and innervates some muscles of the neck.More

25) If a lesion is affecting the cortex of a dog (and all else is ok), a neurological examination could find

- * A. Depression, problem with gait/posture, proprioceptive deficits, reduced menace response, reduced nasal septum response
- B. Depression, problem with gait/posture, proprioceptive deficits, reduced PLR (pupillary light reflex), abnormal physiological nystagmus
- C. Head tilt, no palpebral reflex, abnormal nystagmus, facial asymmetry
- D. None of the above. The cortex is absent in dogs as they rely on the cerebellum.

Cortical lesions will <u>not affect any reflexes</u>. <p>An abnormal physiological nystagmus is related to lesions in any of III, IV, VI, VIII or MLF. <p>Facial asymmetry occurs when the motor nerves of VII (Facial) are malfunctioning. <p>A head tilt is usually associated with damage to VIII (Vestibular-cochlear) or the MLF. <p>A lesion in the right cortex would cause circling to the right, proprioceptive deficits (knuckling) to both left limbs, reduced menace response on the left and a reduced nasal septum response on the left.

26) A cranial nerve is damaged due to an injury. What could happen to it?

- A. It can regenerate because cranial nerves are part of the PNS
- * B. Some CNs are part of the PNS, other are part of the CNS. If the one damaged is part of the PNS, it could regenerate; otherwise, it's toast
- C. None of the CNs can regenerate
- D. All CNs can regenerate

All cranial nerves except for the olfactory and optic nerves belong to the peripheral nervous system, having axons that are myelinated by Schwann cells (myelinating cells of the PNS) rather than oligodendrocytes (myelinating cells of the CNS). The olfactory and optic nerves are technically not nerves, but continuations of the central nervous system. This is an important issue, as fiber tracts of the mammalian CNS (as opposed to the PNS) are incapable of regeneration. For example, optic nerve damage produces irreversible blindness.

27) An evil madman cuts through one CN V of a stray cat. When you examine it, you would expect to find deficits in/manifested in

- * A. Palpebral reflex, Nasal septum stimulation and degeneration of masticatory muscles
- B. Face drooping, Menace response, Palpebral reflex
- C. Head tilt
- D. Palpebral reflex and physiological nystagmus
- E. Pupillary light reflex, Nasal septum stimulation and degeneration of masticatory muscles

<p>

28) A roving Martian watching a human "stooping to scoop" assumes the dog is in charge and abducts it. At some point in the investigation that ensues, a CN VII of the dog is sliced through. When you examine it (the dog, not the Martian!), you would expect to find deficits in

- A. Palpebral reflex, Nasal septum stimulation and degeneration of masticatory muscles
- B. Palpebral reflex and physiological nystagmus
- C. Pupillary light reflex, Nasal septum stimulation and degeneration of masticatory muscles
- D. Head tilt
- * E. Face tone (resulting in drooping), Menace response, Palpebral reflex

<p>

29) A sign of a lesion in an Upper Motor Neuron would be:

- A. Depression
- B. Lack of corresponding reflex
- * C. An exaggerated reflex
- D. Lack of proprioception

Upper motor neurons are any neurons that carry motor information down to the final common pathway, that is, any neurons that are not directly responsible for stimulating the target muscle. The cell bodies of these neurons are some of the largest in the brain, approaching nearly 100 μ m in diameter. These neurons connect the brain to the spinal cord, from which point nerve signals continue to the muscles by means of the lower motor neurons. Upper motor neuron lesions are indicated by spasticity, exaggerated reflexes (because UMNs are normally inhibitory) and loss of voluntary motor control.

30) A sign of a lesion in a Lower Motor Neuron would be:

- A. An exaggerated reflex
- B. Lack of proprioception
- C. Depression
- * D. Lack of corresponding reflex

Damage to lower motor neurons is indicated by paralysis, weakening of muscles, and neurogenic atrophy of skeletal muscle.

31) The peripheral nerves of the brachial plexus include (multiple answers):

- A. Sciatic
- B. Digital
- * C. Ulnar
- D. Accessory
- * E. Axillary

The nerves that form part of the brachial plexus arise from C5 to T2. They include

- Suprascapular (roots from [c5],6,7)
- Subscapular (C6,7)
- Musculocutaneous (C6,7,8)
- Axillary ([c6],C7,8)
- Radial (C7,8,T1,[t2])
- Median (C8,T1,[t2]), Ulnar (C8,T1,[t2]).

32) Lesions affecting only the lumbosacral plexus occur at:

- A. T2-L4
- B. C5-T2
- C. C1-C4
- * D. L4-S2

The nerves that form the lumbosacral plexus arise from spinal segments L4 to S2. They include

- Femoral (roots from L4,5,6)
- Obturator ([L4],L5,6)
- Cranial gluteal (L6,7,S1)
- Caudal gluteal (L7,[s1,2])
- Sciatic (L6,7,S1,[s2])
- Pudendal (S1,2,3)

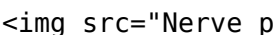
33) The patellar reflex is absent on the right side of the animal only. The lesion is likely to be in:

- A. An interneuron
- B. The brain
- C. The spinal cord
- * D. A lower motor neuron

The patellar reflex or knee jerk is a monosynaptic (no interneuron) reflex that tests the sensory and motor components of the femoral nerve (L4,5,6). Striking the patellar tendon with a tendon hammer just below the patella stretches the quadriceps tendon. This stimulates stretch sensory receptors (most importantly, muscle spindles) that trigger an afferent impulse in a sensory nerve fiber of the femoral nerve leading to the lumbar region of the spinal cord. There, the sensory neuron synapses directly with a motor neuron that conducts an efferent impulse to the quadriceps femoris muscle, triggering contraction. This contraction, coordinated with the relaxation of the antagonistic flexor hamstring muscle causes the leg to kick.

34) The withdrawal reflex of the medial hindlimb tests which nerve for sensory function:

- A. Radial nerve
- B. Caudal gluteal nerve
- * C. Femoral nerve
- D. Sciatic nerve

The withdrawal reflex is a bisynaptic reflex arc (sensory->interneuron->motor) that tests sensory and motor components of relevant nerves. In the medial hindlimb, it can be used to test the **saphenous** (branch of femoral) while the lateral side will test the peroneal (branch of sciatic). In the forelimb, it can be used to test the radial (dorsal surface), ulnar (lateral palmar, digit) and medial (medial palmar) nerves.

35) Which statement is false regarding lesions in the PNS:

- A. Generally unilateral signs
- B. Local proprioceptive deficits without ataxia
- C. Will usually involve sensory and motor deficits
- D. Will not demonstrate changes in mental status
- * E. None of the above

A lesion in the CNS, on the other hand, would typically show

- Bilateral signs (differing severity is possible)
- Ataxia
- Decreased proprioception
- Decreased pain perception

36) In order to distinguish between a lesion in the brain and one in the spinal cord, which two of the following would be the best choices to assess?

- A. Cutaneous trunci stimulation
- * B. Mental status
- C. Pupillary light reflex
- D. Reflexes
- * E. Cranial nerves

Lesions in the brain will usually involve mental depression and behavioural changes. In addition, one or more of the cranial nerves is likely to be affected.

37) Damage to an Upper Motor Neuron (UMN) could result in:

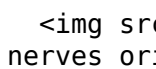
- * A. Spastic paralysis & increased muscle tone
- B. Paralysis & neurogenic muscle atrophy
- C. Areflexia (missing reflex)
- D. Paralysis & flaccid muscle tone

Muscles are innervated by LMNs that are, usually, inhibited by UMNs. UMNs provide voluntary control. If a UMN is damaged, the animal

- loses voluntary control of the muscle, but not reflexes - spastic paralysis.
- Because of the reduced inhibition by UMN, reflexes are normal to enhanced (hyperreflexia)
- Muscle tone is normal to increased (because the LMN controls it)
- Since voluntary control is lost, the muscle will not be used as much, so mild and 'late' atrophy will occur.

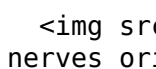
38) A lesion at L7 will, most likely, affect the following nerves:

- A. Caudal gluteal & femoral
- B. Femoral & sciatic
- * C. Sciatic & cranial gluteal
- D. Femoral & pudendal

 Depending on the extent of the lesion, all spinal nerves originating at, or below, L7 could be affected.

39) A lesion at C8 will, most likely, affect the following nerves:

- A. Since C8 is part of the brachial plexus, all nerves that form the brachial plexus will be affected
- B. Suprascapular and Axillary
- * C. Axillary and Radial
- D. Suprascapular and Subscapular

 Depending on the extent of the lesion, all spinal nerves originating at, or below, C8 could be affected.

40) Reflexes :

- A. allow rapid responses to stimuli
- B. involve the thalamus
- C. have afferent & efferent neurons which enter & exit the spinal cord at the same level
- * D. A & C

Simple reflexes (like the patellar reflex) use **sensory** cells (receptors) in the stimulated body part to send signals to the spinal cord. Within the spine a **reflex arc** switches the signals straight back to the muscles of the body (in this case the arm or the leg) (effectors) via a **motor** nerve cell, and the muscle contracts (the arm or leg jerks upwards). In all but the most primitive reflexes, an **interneuron** in the spinal cord communicates signals from the sensory nerve to the motor nerve. Only two or three nerve cells are involved, and the brain is only aware of the initial reflexive response after it has taken place. Such reflex arcs are particularly common in animals, and have a high survival value, enabling organisms to take rapid action to avoid potential danger.

41) If there are Upper Motor Neuron signs in the hindlimbs and Lower Motor Neuron signs in the forelimbs, the lesion is likely to be present at:

- * A. C6-T2
- B. L4-S2
- C. C1-C5
- D. T3-L3

A lesion in C6-T2 will affect forelimb LMNs because that's where they reside. In addition, UMN's to the hind limb passing through that region could be affected. Typical LMN dysfunction signs are

- Reduced or no reflexes (hypo or areflexia)
- Decreased muscle tone
- Early/severe muscle atrophy (neurogenic)
- Flaccid paralysis

42) Upper Motor Neuron signs are present in both forelimbs and hindlimbs. LMN reflexes seem normal. The lesion is likely to be at:

- * A. C1-C5
- B. T3-L3
- C. C6-T2
- D. L4-S2

UMN signs are

- Loses voluntary control of the muscle, but not reflexes - spastic paralysis.
- Because of the reduced inhibition by UMN, reflexes are normal to enhanced (hyperreflexia)
- Muscle tone is normal to increased (because the LMN controls it).
- Since voluntary control is lost, the muscle will not be used as much, so mild and 'late' atrophy will occur.

43) Cranial nerve examination only tests the integrity of the cranial nerve fibres.

- A. True
- * B. False

These tests examine the nerve AND the specific nuclei or brain regions that the cranial nerves are associated with. Cranial nerve tests often test more than one cranial nerve.

44) It is easiest to remember the cranial nerve examination by performing it consistently and working in order through the cranial nerves. Thus, it is always important that you start by testing the olfactory nerve (CN I)

- A. True
- * B. False

Although working from CN I all the way to CN XII may aid you in remembering each nerve, it is not necessary to test olfactory nerve (CN I) function. The OVC does not routinely test this nerve. Absence or decreased sense of smell is difficult to evaluate in animals but there are some tests that you can do (noxious odours) if you really want to.

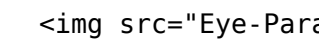
45) An abnormal menace response on its own does not provide a great deal of information to pinpoint the lesion.

- A. False
- * B. True

The pathway necessary for a successful menace response (blink) involves a complex pathway including many structures. Thus, it is difficult to localize the lesion with only the result of this test. The cornea and lens must allow light to reach the retina and the following must also be intact: retina, CN II (optic n), path to/through visual cortex, cerebellum, and CN VII (facial n). The pathway is as follows : Retina -> optic nerve -> optic chiasm -> optic tracts -> synapse in lateral geniculate nucleus -> optic radiation -> visual cortex -> motor cortex -> nucleus of CN VII (modification of impulses via the cerebellum occur here) -> CN VII

46) You shine a penlight in "Rusty" the Golden Retriever's left eye and you observe that neither of his pupils constrict. You then shine your light in his right eye and notice that both the right and the left pupil constrict. Your proficiency in neurology will allow you to localize the lesion to

- A. Left nucleus of CN III
- B. Optic chiasm
- * C. Left optic nerve
- D. Left optic tract
- E. Impossible to say



The left pupil cannot constrict directly in response to light (and the right pupil also cannot display its consensual reflex) because the impulses are not getting past the lesion in the left optic nerve in the first place. "Rusty" is blind in his left eye. The left pupil is still able to show consensual constriction (when light is shined in the right eye) because the rest of the pathway after the optic chiasm is intact. Review the pathway of the PLR:

- Light hits retina
- > optic nerve (CN II)
- > optic chiasm (site of fibre crossover)
- > optic tract
- > pretectal nucleus
- > projections to parasympathetic nuclei of oculomotor nerve (CN III) on BOTH sides of the brain (i.e. fibre crossover)
- > oculomotor nerve (CN III)
- > ciliary ganglion
- > iris.

47) CN III is the:

- * A. Oculomotor nerve
- B. Olfactory nerve
- C. Oculopupillary nerve
- D. Optic nerve
- E. Ocular nerve

The oculomotor nerve arises from the anterior aspect of mesencephalon (midbrain). The muscles it controls are the ciliary muscle (affecting accommodation), and all extraocular muscles except for the superior oblique muscle and the lateral rectus muscle. In addition, it supplies parasympathetic fibres to the eye via the ciliary ganglion, and thus controls pupil constriction.

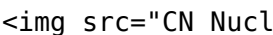
48) Strabismus can indicate a problem with which of the following cranial nerves:

- A. CN V
- B. CN VII
- * C. CN IV
- D. CN VIII
- E. CN II

A problem with CN III, CN IV, CN VI, or their associated nuclei can cause strabismus, which is a fixed deviation of the eye. When strabismus is congenital or develops in infancy, it can cause **amblyopia**, in which the brain ignores input from the deviated eye.

49) The nucleus for the trochlear nerve is in which segment of the brain?

- * A. Midbrain
- B. Cortex
- C. Brainstem
- D. Hypothalamus
- E. Cerebellum

The nucleus of CN IV, the trochlear nerve is located in the **mesencephalon**, also known as the midbrain. The cranial nerves (with the exception of I and II) originate in the **brainstem**, which includes the midbrain, the pons, and the medulla. The 12 cranial nerves can be divided into sensory, motor, or mixed nerves. In general, **sensory** nerve nuclei tend to be located in the **lateral** brainstem, while **motor** nuclei tend to be located **medially**. Nerves with mixed sensory and motor fibers must have more than one nucleus of origin - at least one sensory (afferent) and one motor (efferent).

50) The three branches of the trigeminal nerve (CN V) are:

- A. buccal, facial, mandibular
- B. buccal, maxillary, ophthalmic
- * C. mandibular, maxillary, ophthalmic
- D. facial, nasal, maxillary
- E. facial, mandibular, maxillary

The trigeminal nerve has 3 branches. The ophthalmic branch innervates the ocular region and the medial canthi, the maxillary branch innervates the nasal region and the lateral canthi, and the mandibular branch innervates the buccal area.

51) The trigeminal nerve is solely sensory - it transports sensory info from the face.

- * A. False
- B. True

The trigeminal nerve has both motor and sensory components. The **sensory** portions innervate the face (pinnae, eyelids, cornea, oral cavity, mucosa of the nasal septum). The **motor** component innervates the muscles involved with mastication (masseter and temporalis muscles).

52) The facial nerve (CN VII) is solely motor and it innervates the muscles of facial expression.

- * A. False
- B. True

Along with V (trigeminal) and IX (glossopharyngeal), the facial nerve make up the 3 CNs composed of **both motor and sensory** components.

The motor branches of the facial nerve innervate facial muscles while the sensory branches innervate the palate and the cranial 2/3 of the tongue (taste). There is also some parasympathetic [control](http://e) of salivary glands mediated through this nerve.

53) Pathological nystagmus may occur if there is a lesion in the MLF (medial longitudinal fasciculus).

- A. False
- * B. True

A lesion in the vestibular nerve (part of CN VIII), the vestibular nerve nuclei, or in the MLF will cause pathological (resting) nystagmus.[More](http://en.wikipedia.org/wiki/Med More)

54) You may want to test the glossopharyngeal nerve (CN IX) if you were aware of which of the following signs in one of your patients:

- A. Drooping lips/snout
- B. Impaired tongue movements
- C. Lacerations on the rostral tongue (likely indicative of a sensory deficit to that area)
- * D. History of regurgitation
- E. All of the above

The glossopharyngeal nerve (CN IX) innervates the muscles of the pharynx, larynx, and palatine structures, thus is important in swallowing. An animal with a history of regurgitation could potentially have a problem with CN IX that impairs its ability to swallow food correctly. To test this, you would attempt to elicit the gag reflex (without getting bitten!) though this test is not usually done in a routine neurological exam. The glossopharyngeal nerve also supplies sensory information to the caudal 1/3 of the tongue (taste) and the pharyngeal mucosa.

The rostral tongue gets sensory innervation from the facial nerve (VII).

Parasympathetic [fibers](http://en.wikipedia.org/wiki/Image:Sympathetic_NS.PNG) innervating the parotid salivary gland also travel with CN IX.

55) Which cranial nerve provides motor innervation to the tongue?

- A. XIII
- B. IX
- * C. XII
- D. XI
- E. VIII

The hypoglossal nerve (CN XII) provides all the motor innervation to the internal and external muscles of the tongue.

The glossopharyngeal nerve supplies **sensory** information to the caudal 1/3 of the tongue (taste) and the pharyngeal mucosa while the sensory portion of the facial nerve innervates the palate and the cranial 2/3 of the tongue (taste).

56) The palpebral reflex involves which cranial nerves?

- A. CN II and III
- B. CN VII and VIII
- C. CN V and VI
- D. CN II and VII
- * E. CN V and VII

The palpebral reflex involves CN V (trigeminal) as the sensory component and CN VII (facial) as the motor component. This reflex is observed when you touch the medial canthus (V-ophthalmic), lateral canthus (V-Maxillary), or the skin near the external ear (V-mandibular). The proper end result to this reflex is a blink and possibly a withdrawal response of the head.

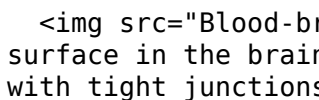
57) The tapetum lucidum is _____ part of the eye.

- A. fibrous tunic
- * B. vascular tunic
- C. liquid component
- D. internal tunic
- E. crocodile-like

The tapetum lucidum (shiny iridescent layer) is part of the vascular tunic of the eye between the sclera and retina. Other vascular components are: choroid, ciliary body, ciliary processes, ciliary muscle, iris, and pupil. The tapetum lucidum serves to reflect light back to the retina, increasing the quantity of light caught by the retina. This improves vision in low light conditions, but can cause the perceived image to be blurry from the interference of the reflected light. It is therefore primarily found in nocturnal animals with good night vision, such as cats.

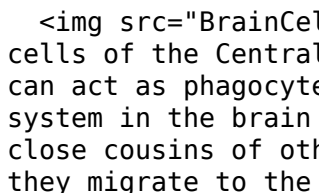
58) Which neuroglial cell helps maintain the blood-brain barrier?

- * A. Astrocyte
- B. Ependymal cells
- C. Astrocyte
- D. Microglia

Astrocytic end-feet cover around 85% of the capillary surface in the brain. The barrier is also maintained by a complete capillary endothelium with tight junctions and no fenestrations.

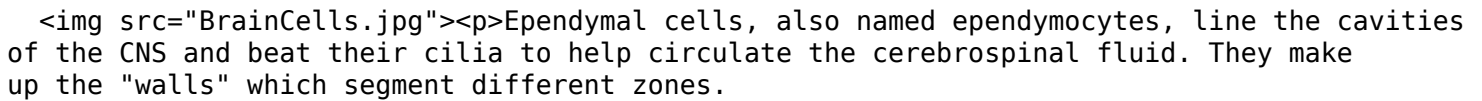
59) Which neuroglial cell phagocytoses pathogens and cellular debris?

- * A. Microglia
- B. Macrophage
- C. Ependymal cells
- D. Astrocyte

Microglia are a type of glial cell that act as the immune cells of the Central nervous system (CNS). Microglia, the smallest of the glial cells, can act as phagocytes, cleaning up CNS debris. Most serve as representatives of the immune system in the brain and spinal cord, inhabiting the cerebrospinal fluid. Microglia are close cousins of other phagocytic cells including macrophages. During embryonic development, they migrate to the CNS to differentiate into microglia.

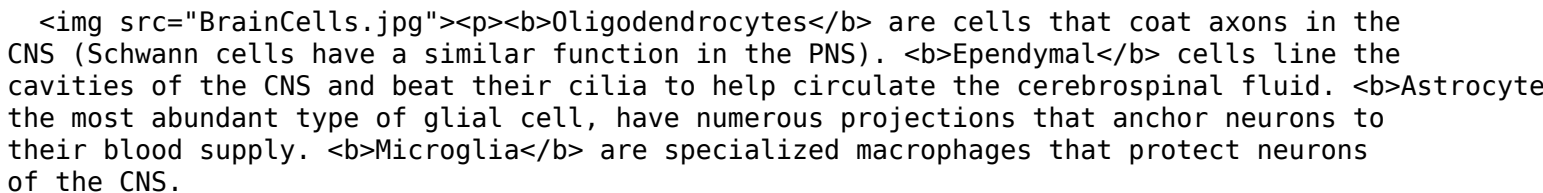
60) Which neuroglial cell is an epithelial cell that lines the brain's ventricles and the central canal of the spinal cord?

- A. Endothelium
- B. Astrocyte
- * C. Ependymal cells
- D. Microglia

 Ependymal cells, also named ependymocytes, line the cavities of the CNS and beat their cilia to help circulate the cerebrospinal fluid. They make up the "walls" which segment different zones.

61) Which of the following is true (multiple answers):

- A. Microglia are synonymous with oligodendrocytes
- * B. Ependymal cells are often ciliated
- C. Oligodendrocytes and Schwann cells myelinate axons in the CNS
- * D. Oligodendrocytes myelinate axons in the CNS
- E. Astrocytes are similar in function to macrophages

 **Oligodendrocytes** are cells that coat axons in the CNS (Schwann cells have a similar function in the PNS). **Ependymal** cells line the cavities of the CNS and beat their cilia to help circulate the cerebrospinal fluid. **Astrocytes** the most abundant type of glial cell, have numerous projections that anchor neurons to their blood supply. **Microglia** are specialized macrophages that protect neurons of the CNS.

62) Sublethal injury of an axon in the PNS leads to this series of events:

- A. Degeneration from the site of injury toward the axon terminal (retrograde), and from the site of injury toward the cell body (anterograde); Development of growth processes; Re-establishment of synapse with target
- B. Degeneration; Mitosis of adjacent neuron to replace degenerated one
- C. Degeneration of axon from synapse to perikaryon; Lengthening of growth processes; Re-establishment with target
- * D. Degeneration from the site of injury toward the axon terminal (anterograde), and from the site of injury toward the cell body (retrograde); Development of growth processes; Re-establishment of synapse with target

All cranial nerves except for the olfactory and optic nerves belong to the peripheral nervous system, having axons that are myelinated by Schwann cells (myelinating cells of the PNS) rather than oligodendrocytes (myelinating cells of the CNS). The olfactory and optic nerves are technically not nerves, but continuations of the central nervous system. This is an important issue, as fiber tracts of the mammalian CNS (as opposed to the PNS) are incapable of regeneration and hence optic nerve damage produces irreversible blindness.

63) Regeneration of a neuron will not occur if:

- A. The proliferating stroma blocks the growth process.
- B. The target neuron is atrophied.
- C. There is an excess of acetylcholinesterase at the synapse between the injured neuron and the target neuron.
- * D. A and B
- E. All of the above

Regeneration of an axon is a 'slow race'. The process must complete before proliferating stroma block the growth process or the target neuron atrophies beyond a certain point. Regeneration involves the following steps : (1) Degeneration from the site of injury toward the axon terminal (anterograde), and from the site of injury toward the cell body (retrograde) (2) Development of growth processes (3) Re-establishment of synapse with target. Hurry, hurry!!!

64) Transneuronal degeneration:

- A. is seen especially in the visual system
- B. is seen especially in the spinal cord
- C. may be anterograde or retrograde
- * D. A and C
- E. B and C

Transneuronal degeneration is the atrophy of certain neurons after interruption of afferent axons or the death of other neurons to which they send their efferent output. Whoa, whoa! Essentially, if a neuron is not serving any purpose (through no fault of its own; either not getting APs or cannot transmit APs), it degenerates. Probably applies to most of us ...

65) Which statement is false regarding ion channels?

- A. There are light-gated and mechanically-gated ion channels.
- B. There are voltage-gated and chemically-gated ion channels
- C. Ion channels are multisubunit proteins that span the cell membrane and allow the selective passage of ions.
- * D. None of the above

Because "voltage-gated" channels underlie the nerve impulse and because "transmitter-gated" channels mediate conduction across the synapses, channels are especially prominent components of the nervous system. Indeed, most of the offensive and defensive toxins that organisms have evolved for shutting down the nervous systems of predators and prey (e.g., the venoms produced by spiders, scorpions, snakes, fish, bees, sea snails and others) work by plugging ion channel pores. In addition, ion channels figure in a wide variety of biological processes that involve rapid changes in cells, such as cardiac, skeletal, and smooth muscle contraction, epithelial transport of nutrients and ions, T-cell activation and pancreatic beta-cell insulin release. In the search for new drugs, ion channels are a favorite target.

66) Resting membrane potential is usually around -70 to -90 mV. It is due to:

- A. Na/K ATPase pump that pumps 2 Na⁺ out for every 3 K⁺ ions it pumps in.
- B. Na/K ATPase pump that pumps 3 Na⁺ out for every 2 K⁺ ions it pumps in.
- C. The cell membrane being relatively impermeable to anions, Na⁺ and Cl⁻, but selectively permeable to K⁺.
- D. A and C
- * E. B and C

For most animal cells potassium ions (K⁺) are the most important for the resting potential. Due to the active transport of potassium ions, the concentration of potassium is higher inside cells than outside. Most cells have potassium-selective ion channel proteins <u>that remain open all the time</u>. There will be net movement of positively-charged potassium ions through these potassium channels with a resulting accumulation of excess positive charge outside of the cell. The net movement of positively-charged potassium ions is due to random molecular motion (diffusion) and continues until enough excess positive charge accumulates outside the cell to form a membrane potential which can balance the difference in concentration of potassium between inside and outside the cell. "Balance" means that the electrical force that acts to move the ions tends to increase until it is equal in magnitude but opposite in direction to the tendency for net movement of potassium due to diffusion. This balance point is an "equi

67) Which is true about neuromuscular junctions?

- * A. The neurotransmitter is acetylcholine
- B. Neurotransmitter release causes relaxation of the muscle
- C. The neurotransmitter is norepinephrine
- D. None of the above

A neuromuscular junction is the synapse or junction of the axon terminal of a motoneuron with the motor end plate. The signal passes through the neuromuscular junction via the neurotransmitter acetylcholine. Acetylcholine then binds to the nicotinic acetylcholine receptors that dot the motor end plate. The receptors are ion channels, and when bound by acetylcholine, they open, triggering the cascade that results in muscle contraction.

68) Neurotransmitter release at a synapse can result in:

- A. Excitation of the postsynaptic neuron by activating ion channels which make the resting membrane potential more negative
- B. Inhibition of the postsynaptic neuron by activating ion channels which make the resting membrane potential less negative
- C. Either of A or B
- * D. Neither of A or B

Excitation would require RMP to be made less negative, and vice-versa. Neurotransmitters may cause either excitatory or inhibitory post-synaptic potentials, the effect being determined by its receptor. That is, they may help the initiation of a nerve impulse in the receiving neuron, or they may discourage such an impulse by modifying the local membrane voltage potential. In the central nervous system, combined input from several synapses is usually required to trigger an action potential.

69) Toxins and drugs may achieve their effects at a synapse by:

- A. Modifying the rate of neurotransmitter release.
- B. Modifying the rate of neurotransmitter breakdown or re-uptake.
- C. Modifying receptor activity on the postsynaptic membrane.
- * D. All of the above
- E. None of the above

For example, **atropine** inhibits salivary, sweat, and mucus glands by blocking the action of acetylcholine at muscarinic receptors. Atropine also serves as an antidote for poisoning by organophosphate insecticides and nerve gases. Parasympathomimetic drugs, on the other hand, stimulate the release, activity or mimic the effect of ACh, thereby stimulating the PNS. They can act directly on receptors (mimic the action of ACh) or indirectly by blocking the degradation of ACh.

70) The class of neurotransmitters that epinephrine falls into is:

- A. Neuropeptides
- B. Amino acids
- C. Acetylcholine
- * D. Amines
- E. None of the above

There are 4 classes of neurotransmitters :

- Amino acids (e.g. Aspartate, GABA, glycine, aspartate)
- Amines (e.g. Serotonin, epinephrine)
- Acetylcholine
- Neuropeptides (e.g. cholecystinin, somatostatin).

[More](http://en.wiki)

71) Which of the following is correct for the condition known as discospondylosis?

- * A. it is a degeneration or proliferation of bony material at the vertebral articulations
- B. it is a herniation or prolapse of disc material into the spinal canal
- C. it is an infection of the vertebral articulations
- D. None of the above

Intervertebral disc disease is a herniation or prolapse of disc material into the spinal canal, while discospondylitis is an infection of the vertebral articulations.

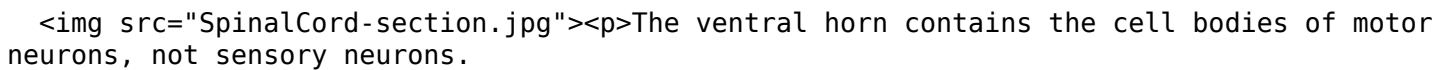
72) Where would one find cerebrospinal fluid?

- A. In the dura mater
- B. In the pia mater
- C. Between the dura mater and the arachnoid
- * D. In the subarachnoid space

Cerebrospinal fluid (CSF) is a clear bodily fluid that occupies the subarachnoid space in the brain (the space between the arachnoid and pia layers of the meninges). It is a very pure saline solution with microglia and acts as a "cushion" or buffer for the cortex. CSF production exceeds volume in the body by a factor of 4; in other words, CSF turnover occurs about 4 times a day. Cerebrospinal fluid can be tested for the diagnosis of a variety of neurological diseases.

73) Which of the following is false about spinal cord grey matter?

- * A. The ventral horn region contains the cell bodies of sensory neurons
- B. The lateral horn region contains the cell bodies of sympathetic neurons
- C. The dorsal horn region contains the cell bodies of interneurons
- D. All of the above are true

The ventral horn contains the cell bodies of motor neurons, not sensory neurons.

74) Which of the following is FALSE about the dorsal root ganglion?

- * A. It contains cell bodies of afferent sensory neurons and efferent motor neurons
- B. It is located at the entry point into the spinal cord of the dorsal root of the spinal nerve
- C. It carries information associated with myotactic (muscle stretch) positioning
- D. It carries information associated with pain
- E. All of the above are true

Dorsal root ganglia do not contain efferent motor neuron cell bodies. They contain cell bodies of afferent somatic sensory neurons, i.e. neurons concerned with sensing touch, pressure, vibrations, temperature, pain, and myotactic positioning (e.g. Golgi Tendon Organ receptors).

75) Which statement concerning cerebrospinal fluid is true?

- A. The CSF carries high amounts of ions due to the high ion turnover of the spinal cord
- B. CSF is produced by the fourth ventricle
- * C. CSF is taken up by the venous system using a passive process at arachnoid granulations
- D. Hydrocephalus (a disease associated with cerebrospinal fluid) is characterized by a drop in CSF pressure and volume
- E. CSF is a cell-rich environment

CSF is indeed taken up at arachnoid granulations, which contain modified microscopic tubules and venules for uptake. CSF is produced by the choroid plexus and is ion-poor and does not have many cells. Hydrocephalus results from an obstruction of flow, increasing pressure.

76) Which of the following increases the susceptibility of a nerve tract (sensory or motor) to injury?

- A. Small size
- * B. High degree of myelination
- C. Close proximity to artery
- D. Central location of tract (i.e away from the periphery)

For some reason, a myelinated axon is more susceptible to damage than an unmyelinated one (maybe it's because it is a larger target). Also, the more peripheral a tract is, the more susceptible it is to injury. So also, are larger tracts. Finally, the further away a tract is from an artery, the more susceptible it is to injury.

77) With respect to nerve damage, what is the order (first to last) in which the following sensations are lost i) Touch and Pressure ii) Proprioception iii) Pain

- A. ii, iii, i
- B. i, iii, ii
- * C. ii, i, iii
- D. i, ii, iii

The dorsal column, located in the dorsal aspect of the spinal cord is responsible for carrying proprioceptive information. Because it is heavily myelinated with large fibers, it is usually the most easily damaged. The spinothalamic tract, which carries pain information, is the last tract to be damaged during injury due to the small size of its fibers and low myelination.

78) Which is true about the dorsal column of the spinal cord?

- A. It carries pain information
- * B. Information in it ascends to the cortex for integration
- C. It decussates substantially
- D. It is the last tract to be damaged during injury due to its small fibers and low myelination
- E. All of the above are true

The dorsal column, located in the dorsal aspect of the spinal cord, does not decussate, is responsible for carrying proprioceptive info and is heavily myelinated with large fibers (therefore the first to be damaged). The spinothalamic tract carries pain information, decussates substantially and is the last tract to be damaged during injury due to the small size of its fibers and low myelination.

79) Which statement is FALSE about the following tracts?

- A. Damage to the dorsal column can result in proprioceptive deficits
- B. The dorsal column includes the fasciculus gracilis (caudal to T6) and the fasciculus cuneatus (cranial to T6)
- * C. The ascending reticular activating system (RAS tract) carries proprioceptive information in multisynaptic pathways
- D. The ventrolateral tract contains fibers of small diameter

The RAS tract does carry information in multisynaptic pathways, but it is **pain** information, not proprioceptive information.

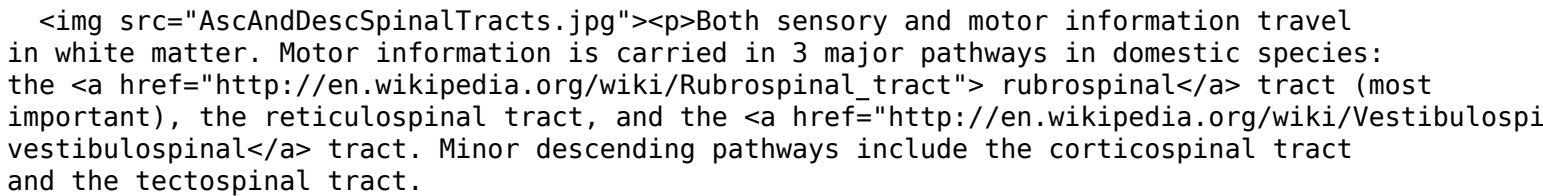
80) What is NOT a general rule with respect to ascending pathways?

- A. The primary neuron always enters the spinal cord via the dorsal root
- B. The primary neuron's cell body is always in the dorsal root ganglion
- C. Conscious sensation always decussates (crosses the midline)
- * D. Unconscious proprioception always decussates (crosses the midline)

Unconscious proprioception involves the position and movement of limbs for balance, tone and smooth/coordinated movements. Information originates in the Golgi Tendon Organs (and other receptors), ascends on the ipsilateral side through spinocerebellar pathways in the lateral margins of the spinal cord, and is carried to the Cerebellum and Reticular formation.

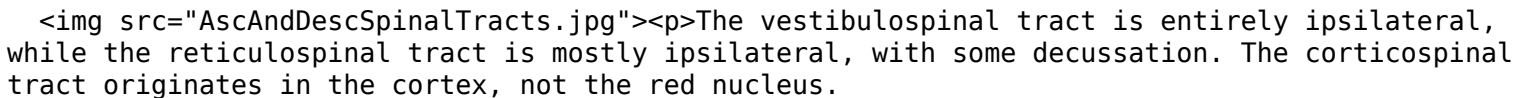
81) What is true about motor information tracts?

- A. Unlike sensory information, they ascend in grey matter
- * B. They often require corresponding sensory pathways to be intact in order to test for normality
- C. There are two major and two minor motor pathways of significance in domestic species
- D. Like sensory information, they ascend in grey matter

Both sensory and motor information travel in white matter. Motor information is carried in 3 major pathways in domestic species: the [rubrospinal](http://en.wikipedia.org/wiki/Rubrospinal_tract) tract (most important), the reticulospinal tract, and the [vestibulospinal](http://en.wikipedia.org/wiki/Vestibulospinal_tract) tract. Minor descending pathways include the corticospinal tract and the tectospinal tract.

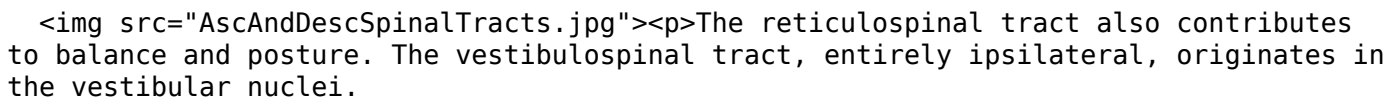
82) Which of the following statements is true about descending tracts of the spinal cord?

- * A. The rubrospinal tract is involved with large muscle movements, like limb movement
- B. The vestibulospinal tract is mostly ipsilateral, with some decussation to the contralateral side
- C. The corticospinal tract originates in the red nucleus, in the region of the thalamus
- D. The reticulospinal tract is entirely ipsilateral

The vestibulospinal tract is entirely ipsilateral, while the reticulospinal tract is mostly ipsilateral, with some decussation. The corticospinal tract originates in the cortex, not the red nucleus.

83) Which of the following is the vestibulospinal tract responsible for?

- A. synergy of muscle movements
- B. balance
- C. equilibrium
- * D. All of the above

The reticulospinal tract also contributes to balance and posture. The vestibulospinal tract, entirely ipsilateral, originates in the vestibular nuclei.

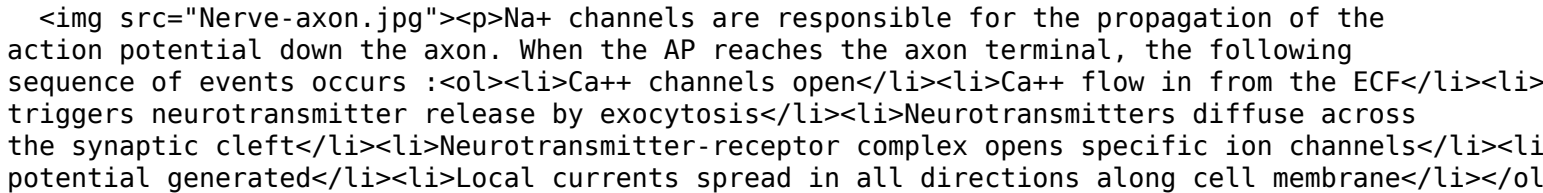
84) Which of the following neurotransmitters is found at the neuromuscular junction?

- A. Norepinephrine
- B. Nitrous Oxide
- * C. Acetylcholine
- D. Muscarine
- E. GABA

Acetylcholine is the neurotransmitter released by the lower motor neuron onto the motor end plate, which acts to depolarize the muscle cells and initiate contraction. As an added note, acetylcholine binds to a nicotinic Ach receptor at the neuromuscular junction.

85) ___ flows into the axon to depolarize it; ___ flows into the axon terminal to cause neurotransmitter release.

- A. Ca⁺⁺ / Na⁺
- * B. Na⁺ / Ca⁺⁺
- C. Na⁺ / Cl⁻
- D. Na⁺ / Na⁺
- E. Ca⁺⁺ / Ca⁺⁺

Na⁺ channels are responsible for the propagation of the action potential down the axon. When the AP reaches the axon terminal, the following sequence of events occurs :

- Ca⁺⁺ channels open
- Ca⁺⁺ flow in from the ECF
- triggers neurotransmitter release by exocytosis
- Neurotransmitters diffuse across the synaptic cleft
- Neurotransmitter-receptor complex opens specific ion channels
- potential generated
- Local currents spread in all directions along cell membrane

86) _____ acts on _____ receptors at the neuroeffector junction between the ciliary ganglion and the iris muscles of the eye to constrict the pupil.

- A. epinephrine; beta
- B. acetylcholine; atriatric
- * C. acetylcholine; muscarinic
- D. acetylcholine; nicotinic
- E. epinephrine; alpha

Constriction of the pupil is a parasympathetic action of smooth muscle, so epinephrine can be eliminated as an option. Atriatric receptors don't exist. Muscarinic receptors are commonly found at neuroeffector junctions, particularly with respect to the parasympathetic nervous system, and cause a 'rest and digest' response (i.e. pupil constriction)

87) These sympathetic ganglia exist as a pair of chains that parallel the vertebral column throughout the thoracic region.

- * A. paravertebral ganglia
- B. prevertebral ganglia
- C. vertebral ganglia
- D. terminal ganglia
- E. splanchnic ganglia

Only prevertebral, paravertebral, and terminal pertain to the thoracic region and/or the sympathetic nervous system. **Prevertebral** ganglia are located in the abdomen and pelvis on the ventral surface of the vertebral columns and are few in number. **Terminal** ganglia lie near the organs which they innervate. **Paravertebral** ganglia, as the name suggests, are found along sympathetic trunks that run on either side of the vertebral column. They are the first potential synapse for sympathetic information coming from the spinal cord.

88) All of the following will be observed upon activation of the sympathetic nervous system except:

- A. reduced gut motility
- B. increased glucose release into the blood
- C. bronchodilation
- D. pupillary dilation
- * E. elevated saliva production

Saliva production is decreased in a 'fight or flight' response, to focus energy on more important tasks at hand (think of the dry mouth you get when you're nervous).

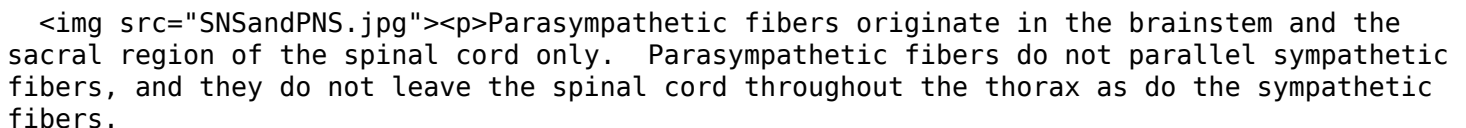
89) The motor activities of our visceral organs are controlled by the autonomic nervous system. What is responsible for the sensory component of our viscera?

- A. the autonomic nervous system controls sensory too
- * B. the general visceral afferent system
- C. Nothing. We can't consciously feel what's going on inside our gut
- D. the somatic nervous system
- E. the hypothalamo-pituitary-gonadal axis

Although we can't consciously perceive any sensations regarding visceral function, that doesn't mean sensory information isn't being collected subconsciously.

90) All of the following are true about the parasympathetic nervous system except:

- A. the vagus nerve is the most important parasympathetic nerve because it controls the viscera
- * B. parasympathetic fibers exit the spinal cord with the sympathetic fibers, however, they synapse on different ganglia
- C. the pupillary light reflex elicits a parasympathetic response
- D. acetylcholine acts on nicotinic receptors in PSNS autonomic ganglia
- E. preganglionic fibers are much longer than postganglionic fibers



<p>Parasympathetic fibers originate in the brainstem and the sacral region of the spinal cord only. Parasympathetic fibers do not parallel sympathetic fibers, and they do not leave the spinal cord throughout the thorax as do the sympathetic fibers.

91) If an animal has a flaccid urethral sphincter but a normal detrusor reflex, this would indicate damage to:

- A. the spinal cord below L1
- B. the pelvic nerve
- * C. the pudendal nerve
- D. the spinal cord above L1
- E. both the pelvic and pudendal nerve

A damaged spinal cord can be ruled out as the detrusor reflex is normal. Additionally, the detrusor reflex is maintained by the pelvic nerve. The pudendal nerve is responsible for maintaining tone at the urethral sphincter via a monosynaptic reflex. Inhibitory neurons which override the contraction of the sphincter during urination, descend from the cortex or arise from the detrusor muscle via the pelvic nerve.

92) Transection of the spinal cord at T4 will not have an effect of the detrusor reflex.

- A. True
- * B. False

The detrusor reflex has the following pathway :

- Sensory fibres from stretch receptors in detrusor muscle enter the sacral spinal cord via the pelvic nerve, ascending in white matter tracts
- In the pons, the sensory fibres synapse on interneurons
- Integration occurs at this point with input from the detrusor muscle, the cortex and the cerebellum
- If conditions are 'good', a motor AP is triggered, descending in parasympathetic [UMNs](http://en.wikipedia.org/wiki/Image:Sympathetic_NS.PNG)
- The UMNs synapse with a PNS preganglionic neuron in grey matter of the sacral spinal cord.
- The next neuron, via the pelvic nerve, synapses with the postganglionic neuron within the pelvic ganglia
- An AP leads to smooth muscle contraction (detrusor muscle). At this point, the sphincter muscle, through a coordinated by separate pathway, is allowed to relax to allow urine to flow out.

93) The urethral sphincter reflex, like the patellar reflex, is a monosynaptic somatic reflex

- * A. True
- B. False

Stretch receptors within the urethralis muscle (the muscle that controls the sphincter) send APs into the spinal cord via the PUDENDAL nerve. These neurons synapse directly into LMNs which return via the same pudendal nerve to innervate the urethralis muscle, tightening it. To allow urination, inhibitory neurons synapse with the same LMNs to override the contraction of the sphincter muscle. These inhibitory neurons arise from

- the cortex through UMNs
- the detrusor muscle via the pelvic nerve

94) The detrusor reflex sensory neurons synapse in the sacral spinal cord before ascending to the pons

- * A. False
- B. True

The detrusor reflex has the following pathway :

- Sensory fibres from stretch receptors in detrusor muscle enter the sacral spinal cord via the pelvic nerve, ascending in white matter tracts
- In the pons, the sensory fibres synapse on interneurons
- Integration occurs at this point with input from the detrusor muscle, the cortex and the cerebellum
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- An AP leads to smooth muscle contraction (detrusor muscle). At this point, the sphincter muscle, through a coordinated by separate pathway, is allowed to relax to allow urine to flow out.

95) If an animal with spinal cord damage has lost control over micturition, it will probably lack voluntary motor movement.

- A. False
- * B. True

Increasing levels of spinal cord damage will progressively cause loss of proprioception, then motor function, micturition and, finally, deep pain at the most severe insult.

96) An animal, that has just been hit by a car, has a confirmed spinal cord lesion. Why is it advisable to place a urinary catheter in such a situation?

- A. because the shock response of the animal will prevent the urethral sphincter from opening
- B. to collect a urine sample as quickly as possible
- C. because the animal hasn't suffered enough yet
- D. the use of a catheter would not be useful
- * E. because damage to the spinal cord has potential to damage the detrusor reflex

As the detrusor reflex travels all the way up and down the spinal cord between the bladder and the pons, any spinal cord lesion could damage this reflex. Damage to this reflex would prevent the animal from evacuating his/her bladder voluntarily. The spinal cord injury has also damaged inhibitory (relax) signals from the cortex to the urethral sphincter. However, bladder stretch also send "relax" signals to the urethral sphincter, so that urine will be released. However, this flow will involuntary. A catheter will, thus, prevent 'accidents'.

97) A lesion in a sacral segment has disabled APs through the pudendal nerve. Which of the following scenarios is likely?

- A. The detrusor reflex will be disrupted
- B. No change in the micturition reflex
- * C. Constant urine leakage due to loss of urethral sphincter tone
- D. Possibility of urinary bladder rupture due to urethral sphincter tetany

The urethral sphincter is innervated by an LMN via the pudendal nerve. Disruption of the pudendal nerve will, therefore, cause rapid loss of tone of the sphincter leaving it open.

98) A lesion in a sacral segment has disabled UMNs passing through as well as APs through the pelvic nerve. Which of the following scenarios is likely?

- A. The detrusor reflex will be unaffected
- B. Constant urine leakage due to loss of urethral sphincter tone
- * C. Possibility of urinary bladder rupture due to urethral sphincter tetany
- D. No change in the micturition reflex

The urethral sphincter is innervated by an LMN via the pudendal nerve. Under normal conditions, this results in tetany that keeps the sphincter closed. Sphincter tetany can be overridden (inhibited) by signals from either (1) Cortex (which normally reacts to APs from stretch receptors in the urinary bladder or (2) ???

99) The nerve cell bodies of the myenteric plexus is/are:

- A. Contained in the Dorsal Root of the spinal cord
- B. A combination of spinal nerves emanating from the spinal cord between L6-S3
- C. Exit the Red Nucleus via the Rubrospinal tract
- D. All of the above
- * E. None of the above

The myenteric plexus resides within the tunica muscularis of the GI tract, between the circular and longitudinal muscles. Meissner's plexus : this lies in the submucosa. More

100) Which of the following statements is TRUE?

- A. The Myenteric Plexus spans the Small Intestine while the Submucosal Plexus spans the Large Intestine.
- B. The Submucosal Plexus spans the Small Intestine while the Myenteric Plexus spans the Large Intestine.
- C. The Myenteric Plexus is Parasympathetic and the Submucosal Plexus is Sympathetic.
- D. Both A and C
- * E. None of the above

The myenteric plexus lies between the 2 layers of tunica muscularis while the submucosal plexus, as the name suggests, resides in the submucosa. Both plexuses extend the length of the G.I. tract, containing both myelinated and non-myelinated nerve fibres.

101) Which of the following is FALSE?

- * A. The ENS receives no input from the CNS.
- B. Action potentials within the ENS arise spontaneously (similar to pacemaker activity in the heart)
- C. Action potentials within the ENS may arise due to mechanical stimuli such as stretch.
- D. ENS is responsible for changes in secretion and smooth muscle contraction.
- E. None of the above.

The ENS does receive extensive input from the CNS (both Para. Symp. and Symp.). The ENS, however, does seem to be able to function (in the short term) in the absence of external influence of the ANS.

102) Gastrointestinal neuro-physiology is important because

- * A. GI disturbances are a major medical problem and may have roles in several clinical diseases.
- B. It helps explain why cats eat string.
- C. G.I. disturbances are actually quite insignificant
- D. It is the key to understanding the balance between Parasympathetic and Sympathetic interaction.
- E. All of the above.

103) Which of the center(s) of physiologic function does the Pons contain?

- A. Respiratory centers
- B. Cardiac centers
- C. Vasomotor centers
- * D. None of the above
- E. All of the above

The Medulla contains the respiratory, cardiac and vasomotor centers. Note that the Pons is involved in regulation of breathing via the Apneustic and Pneumotaxic centers (respiratory nuclei)

104) The Pons is responsible for integration of the Micturition response.

- * A. True
- B. False

Integration of the micturition response does occur in the pons as input from the stretch receptors of the detrusor muscle, the cerebral cortex and the cerebellum combine to generate a motor discharge under the appropriate circumstances.

105) Which of the components of the Midbrain is involved in visual reflexes?

- A. Tegmentum
- B. Caudal Colliculi
- C. Red Nucleus
- D. Tectum
- * E. Rostral Colliculi

The Rostral Colliculi (a part of the Tectum of the midbrain) is involved in the movement of the eye in response to visual stimuli.

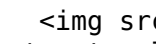
106) The Reticular formation is:

- * A. Located between the medulla and thalamus and is responsible for arousal and consciousness
- B. Dorsal to the cerebellum and is responsible for regulating motor activity through the reticulospinal tract.
- C. Within the Red Nucleus and regulates respiratory activity via connections with the respiratory nuclei (centers) in the medulla.
- D. None of the above.
- E. All of the above.

The reticular formation is a part of the brain which is involved in stereotypical actions, such as walking, sleeping, and lying down. It is absolutely essential for the basic functions of life and is, phylogenetically, one of the oldest portions of the brain. It is a poorly-differentiated area of the brain stem extending from the medulla to the thalamus, centered roughly in the pons. [More](http://en.wikipedia.org/wiki/Reticular_formation)

107) The Vermis, Hemispheres and Peduncles are features of which portion of the brain?

- A. Cerebral Cortex
- B. Midbrain
- C. Pituitary
- D. Pons
- * E. Cerebellum

 Along with the cerebellar nuclei, these are structural features of the cerebellum. Most input and output is via peduncles. The cerebellum (Latin: "little brain") is a region of the brain that plays an important role in the integration of sensory perception and motor output. Many neural pathways link the cerebellum with the motor cortex (which sends information to the muscles causing them to move) and the spinocerebellar tract (proprioception). The cerebellum integrates these pathways, using the constant feedback on body position to fine-tune motor movements. [More](http://en.wikipedia.org/wiki/Cerebellum#Vermis)

108) The Thalamus is intimately linked to the pituitary and is responsible for controlling homeostasis via secretion of hormones such as ACTH, etc.

- * A. False
- B. True

It is the hypothalamus, not the thalamus that is responsible for maintaining homeostasis along with the Pituitary.

109) Which of the following components does the Cerebrum contain?

- A. Limbic System.
- B. Caudal Colliculi.
- C. Basal Nuclei.
- D. Both A and B
- * E. Both A and C

Along with the limbic system and basal nuclei, the third component of the Cerebrum is the cerebral cortex (which is divided into sensory areas, motor areas and association areas)

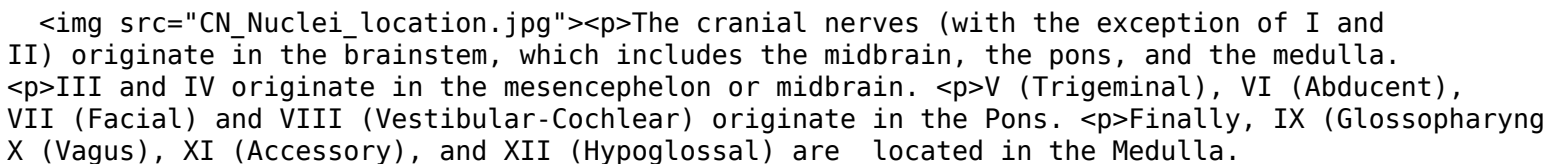
110) Which of the following is/are not a part of the Limbic system of the Cerebrum?

- A. Hippocampus
- * B. Tectum
- C. Amygdala
- D. Both A and B
- E. Both B and C

Only the Hippocampus and the Amygdala are part of the Limbic system. The Tectum is a region of the Midbrain.

111) The Pons contains the nuclei of which cranial nerves?

- A. II, III, IV
- * B. V, VI, VII, VIII
- C. The pons contains nuclei for no cranial nerves
- D. I, II, III
- E. The Pons contains nuclei for all cranial nerves.

The cranial nerves (with the exception of I and II) originate in the brainstem, which includes the midbrain, the pons, and the medulla. III and IV originate in the mesencephalon or midbrain. V (Trigeminal), VI (Abducent), VII (Facial) and VIII (Vestibular-Cochlear) originate in the Pons. Finally, IX (Glossopharyngeal), X (Vagus), XI (Accessory), and XII (Hypoglossal) are located in the Medulla.

112) The thalamus is a relay site for both sensory and motor information.

- * A. True
- B. False

The thalamus also has roles in short term memory and behaviour and seems to be responsible for the initial perception of pain.

113) Which if the following is not a part of the Cerebellar nuclei of the Cerebellum?

- A. Fastigil
- B. Emboliform
- C. Dentate
- * D. Tectoform
- E. Globose

All are part of the Cerebellar nuclei of the Cerebellum except the Tectoform, which does not exist! The cerebellum (Latin: "little brain") is a region of the brain that plays an important role in the integration of sensory perception and motor output. Many neural pathways link the cerebellum with the motor cortex - which sends information to the muscles causing them to move - and the spinocerebellar tract - which provides feedback on the position of the body in space (proprioception). The cerebellum integrates these pathways, using the constant feedback on body position to fine-tune motor movements.

114) "Doc", a 5 yr old DSH, is very weak and staggering. The physical exam suggests only neurological problems. Neurological exam : Severe weakness in the hind limbs with increased tone; however, normal patellar/withdrawal reflex. Also, decreased proprioception in the hind limbs. All else is normal. Doc's lesion is

- A. In the spinal cord between L4 and S2 because there are UMN signs to the hindlimbs.
- B. In the spinal cord between C6 and T2 because there are UMN signs to the fore limbs and LMN signs to the hind limbs
- * C. In the spinal cord between T3 and L3 because there are UMN signs to the hind limbs only
- D. In the spinal cord between C6 and T2 because there are UMN signs to the hind limbs only
- E. In the spinal cord between C1 and C5 because all four limbs are affected

Forelimbs are normal, so the lesion is T3 or below. Patellar/Withdrawal reflexes are normal, so LMN is ok; therefore lesion is above L4. Lesion is localized between T3 and L3. Weakness and increased tone confirm UMN signs.

115) "Doc", a 5 yr old DSH, is very weak and staggering. The physical exam suggests only neurological problems. Neurological exam : Severe weakness in the hind limbs. Normal patellar reflex in both hind limbs. Normal withdrawal reflex in both hind limbs. Increased tone in muscles of hind limbs. Decreased proprioception in the hind limbs. Normal pain sensation. Doc retains pain sensation because

- A. The vestibulospinal pathway is ipsilateral and may not be affected by a lesion on the opposite side
- B. The dorsal column system has heavily myelinated fibres which are relatively resistant to injury
- C. The injury in the spinal cord is confined to gray matter and does not affect the ascending tracts
- * D. The ascending RAS has small fibres which are present in several different regions of the spinal cord and are not as susceptible to injury
- E. The spinothalamic (ventrolateral) tract synapses and decussates after fibres enter the spinal cord which decreases the chances of injury

Small fibres are less susceptible to damage.

116) "Doc", a 5 yr old DSH, is very weak and staggering. The physical exam suggests only neurological problems. Neurological exam : Severe weakness in the hind limbs. Normal patellar reflex in both hind limbs. Normal withdrawal reflex in both hind limbs. Increased tone in muscles of hind limbs. Decreased proprioception in the hind limbs. Normal pain sensation. Doc's patellar reflex is normal because ...

- A. The multisynaptic reflex enters and exits the spinal cord at spinal levels L2 and L4 and does not require input from UMNs which are damaged by the lesion
- B. The golgi tendon organs in the patellar tendon continue to respond to motor impulses in the lower motor neuron
- C. Sensory impulses in the afferent component of the reflex arc continue to ascend past the site of the lesion because the fibres are resistant to injury
- * D. It is a monosynaptic reflex arc which is decreased or absent only when the lesion is at the site of entry/exit from the spinal cord
- E. The reflex arc enters and leaves the spinal cord at the brachial enlargement and does not require input from UMNs which are affected by the lesion

The patellar reflex tests sensory and motor components of the femoral nerve (SC segments L4 - L6). It is a monosynaptic reflex, i.e. does not involve interneurons or UMN integration, and enters and exits at the same level in the spinal cord.

117) "Doc", a 5 yr old DSH, is very weak and staggering. The physical exam suggests only neurological problems. Neurological exam : Severe weakness in the hind limbs. Normal patellar reflex in both hind limbs. Normal withdrawal reflex in both hind limbs. Increased tone in muscles of hind limbs. Decreased proprioception in the hind limbs. Normal pain sensation. Proprioception is decreased in Doc's hindlimbs because ...

- A. The spinothalamic tract is affected as it passes by the lesion
- B. The axons in the dorsal column and spinocerebellar tracts which carry motor impulses are the most susceptible to injury and have been damaged by the lesion
- C. The grey matter between T3 and L3 has been damaged by the lesion and is a site of synapses for the ascending proprioceptive fibres
- * D. Nerve fibres which carry proprioceptive impulses have been damaged
- E. None of the above explains it.

Conscious proprioceptive sensation is relayed to the the brain via large myelinated fibres within the dorsal column in the spinal cord. The dorsal location, myelination and size of the fibres make them very susceptible to injury.

118) "Doc", a 5 yr old DSH, is very weak and staggering. The physical exam suggests only neurological problems. Neurological exam : Severe weakness in the hind limbs. Normal patellar reflex in both hind limbs. Normal withdrawal reflex in both hind limbs. Increased tone in muscles of hind limbs. Decreased proprioception in the hind limbs. Normal pain sensation. Muscle tone in Doc's hind limbs is increased because ...

- * A. Some inhibitory upper motor neurons to the hindlimbs have been damaged as they pass the lesion
- B. Excitatory motor neurons in the descending pathways have an increased rate of firing due to the injury, which increases muscular tone
- C. Spastic paralysis is a typical sign of injury to grey matter at the site of the lesion
- D. Reciprocal inhibitory reflexes from the opposing muscle groups have been damaged at the same spinal level

Consider spastic paralysis and that LMNs are still intact / undamaged, therefore hind limb extensor and flexor muscles maintain tone. All the more, there is no longer inhibitory feedback from the efferent UMN to control muscle movement / reflex.

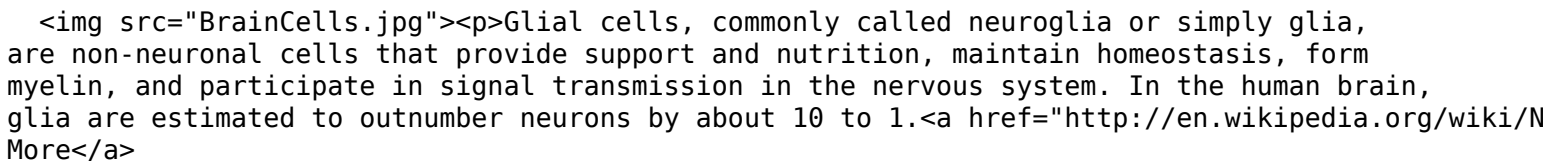
119) "Doc", a 5 yr old DSH, is very weak and staggering. The physical exam suggests only neurological problems. Neurological exam : Severe weakness in the hind limbs. Normal patellar reflex in both hind limbs. Normal withdrawal reflex in both hind limbs. Increased tone in muscles of hind limbs. Decreased proprioception in the hind limbs. Normal pain sensation. If the spinal cord lesion is severe in the present location, it will cause which of the following :

- A. Micturition will be affected leading to spastic paralysis of the bladder and flaccid paralysis of the urethral sphincter.
- B. Disruption of the sphincter reflex will result in frequent urination of small volumes of urine
- C. Loss of inhibitory components of the detrusor reflex will lead to increased tone in the muscle of the bladder wall
- * D. Loss of inhibitory UMNs to the urethral sphincter reflex will lead to increased tone in the urethral sphincter

The urethralis muscle (which controls the sphincter) is constantly firing. Tone inhibition, enabling micturition, is accomplished by inhibition from cortical UMNs as well as direct inhibition from the detrusor via the pelvic n. A lesion at the level of the hind limbs will not affect the sphincter reflex. Nor will it affect detrusor inhibition of the sphincter. However, it could disrupt UMN inhibition, thus leading to increased tone in the sphincter.

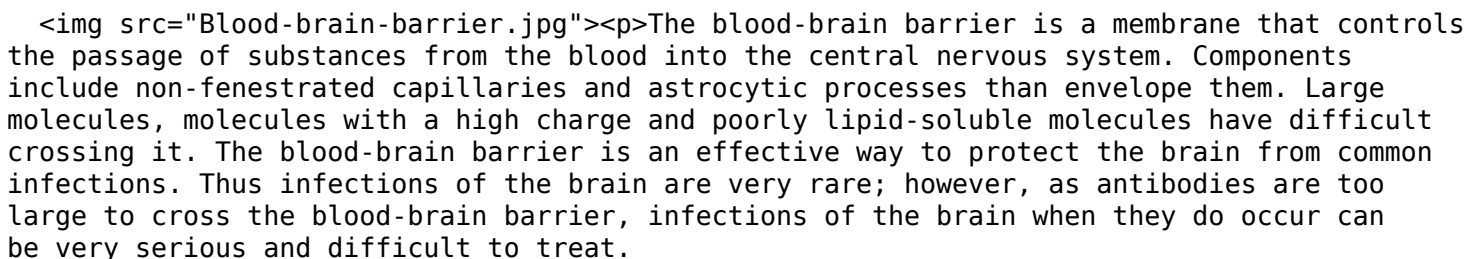
120) Which of the following is NOT considered a neuroglial cell?

- A. Microglia
- B. Astrocytes
- C. Oligodendroglia
- * D. Endothelia
- E. Schwann cells

 Glial cells, commonly called neuroglia or simply glia, are non-neuronal cells that provide support and nutrition, maintain homeostasis, form myelin, and participate in signal transmission in the nervous system. In the human brain, glia are estimated to outnumber neurons by about 10 to 1. <http://en.wikipedia.org/wiki/More>

121) The blood-brain barrier

- A. Restricts the passage of nutrients from the bloodstream to neurons
- B. Limits the delivery of certain therapeutic agents in the brain
- C. Cannot prevent toxin uptake from the bloodstream by neurons
- D. Is maintained by fenestrated capillary endothelium and astrocytic processes
- * E. a and b are correct

 The blood-brain barrier is a membrane that controls the passage of substances from the blood into the central nervous system. Components include non-fenestrated capillaries and astrocytic processes that envelope them. Large molecules, molecules with a high charge and poorly lipid-soluble molecules have difficulty crossing it. The blood-brain barrier is an effective way to protect the brain from common infections. Thus infections of the brain are very rare; however, as antibodies are too large to cross the blood-brain barrier, infections of the brain when they do occur can be very serious and difficult to treat.

122) Myelinated axons

- A. Conduct action potentials more rapidly than non-myelinated axons
- B. Have Nodes of Ranvier which occur along their length
- C. Are surrounded by Schwann cells in the PNS
- * D. a, b and c are correct
- E. Only a and b are correct

Myelination, which allows saltatory conduction (AP appears to jump between nodes of Ranvier) greatly speed conduction of APs. In the autonomic nervous system in mammals, postganglionic neurons are unmyelinated. The small diameter of these axons (about 2 μ) results in a propagatory speed of approximately 1 m/s, as opposed to approximately 18 m/s in myelinated nerve fibers of comparable diameter.

123) Which of the following is true of ion channels?

- A. They maintain the resting membrane potential.
- B. They are highly responsive to further stimuli during the period when the inactivation gate is closed
- C. They open exclusively in response to changes in voltage across the cell membrane
- * D. Each channel conducts a single type of ion
- E. They have resident enzymatic activity which pumps ions into or out of the cell

Ion channels can be chemically, mechanically, light or voltage gated. Ion channels figure in a wide variety of biological processes that involve rapid changes in cells, such as cardiac, skeletal, and smooth muscle contraction, epithelial transport of nutrients and ions, T-cell activation and pancreatic beta-cell insulin release. Most of the offensive and defensive toxins that organisms have evolved for shutting down the nervous systems of predators and prey (e.g., the venoms produced by spiders, scorpions, snakes, fish, bees, sea snails and others) work by plugging ion channel pores. In the search for new drugs, ion channels are a favorite target.

124) Which of the following is NOT true with respect to action potentials?

- A. They require a rapid influx of Na⁺ from the extracellular fluid
- B. They are the primary mechanism for the transmission of information within the nervous system
- C. Peak depolarization occurs at approximately +30 mV
- * D. They are propagated along an axon primarily by voltage gated calcium channels
- E. They are stimulated within a neuron when the sum of graded potentials decreases the resting membrane potential to a threshold value of approximately -55 mV

APs travel down axons due to the action of voltage-gated Na⁺ channels. The speed of AP conduction is directly proportional to axon diameter. Myelination, which allows saltatory conduction (AP appears to jump between nodes of Ranvier) greatly speed conduction. In the autonomic nervous system in mammals, postganglionic neurons are unmyelinated. The small diameter of these axons (about 2 μ) results in a propagatory speed of approximately 1 m/s, as opposed to approximately 18 m/s in myelinated nerve fibers of comparable diameter.

125) Neurotransmitters released at a synapse:

- A. Can interact with receptors on the post-synaptic membrane
- B. Can be metabolized by enzymes which are present in the synaptic cleft
- C. Can be taken up by endocytosis in the presynaptic membrane
- * D. All of the above

126) Which of the following statements is incorrect?

- A. Cerebrospinal fluid (CSF) can be found immediately outside the pia layer
- B. CSF enters the subarachnoid space via the lateral foramina
- * C. CSF is reabsorbed into the bloodstream by the choroid plexus in the subarachnoid space
- D. The dura is the toughest and outermost meninx
- E. The pia is the innermost meninx and contains many blood vessels

The choroid plexus creates CSF. CSF is reabsorbed into venous circulation via arachnoid granulations. Uptake occurs in the dural venous sinuses: dorsal sagittal and transverse. CSF turns over about 4-5 times daily (so don't worry too much about depleting CSF through a spinal tap).

127) The spinal cord:

- A. Contains white matter tracts which are sites of entry/exit of individual neurons
- B. Contains cell bodies of sympathetic neurons in the lateral gray matter horns of the cervical region
- C. Contains cell bodies of sensory neurons in the dorsal gray matter horns
- * D. Contains cell bodies of motor neurons in the ventral gray matter horns

Sensory neurons reside in the dorsal root ganglion, outside the spinal cord. **Sympathetic neurons** do exist in lateral gray matter, but only in the thoracolumbar region. **White matter tracts** contain axons (myelinated and unmyelinated) that carry impulses to and from the brain. Neurons do not exit individually; all motor neurons of a segment exit through a single spinal nerve.

128) Fibres carrying action potentials relaying conscious sensory information

- A. Enter via the dorsal root
- B. Often decussate somewhere en route to the brain
- C. Ascend in the spinocerebellar tracts when the information relayed is proprioceptive
- D. Pass through a synapse in the ventral grey matter horn before ascending
- * E. a and b are correct

129) Which of the following pathways does NOT carry afferent (sensory) information?

- A. Dorsal Column
- B. Dorsal Spinocerebellar tract
- C. Spinothalamic tract
- D. Ascending RAS
- * E. Rubrospinal tract

The major ascending (sensory) pathways are :

- Dorsal column (conscious proprioception)
- RAS (pain)
- Spinocerebellar (unconscious proprioception)

The major descending (motor) pathways are :

- Rubrospinal (voluntary muscle movement)
- Reticulospinal (balance & posture)
- Vestibulospinal (synergy of muscle movement, equilibrium, balance)

130) In the sympathetic nervous system:

- * A. The neurotransmitter between the pre and post-ganglionic fibre is acetylcholine
- B. Neurons of the sympathetic nervous system leave the spinal cord in the thoracolumbar region and synapse on striated muscle throughout the viscera and vasculature
- C. The neurons primarily control homeostatic functions
- D. Neurons synapse primarily in the prevertebral ganglia
- E. a and d are correct

The SNS activates the fight-or-flight response. Neurons leave the spinal cord in the thoraco-lumbar region to connect to paravertebral ganglia in the two sympathetic trunks on either side of the spinal cord. The first synapse (in the sympathetic chain) is mediated by nicotinic receptors (PNS - normally muscarinic) physiologically activated by acetylcholine, while the target synapse is mediated by adrenergic receptors physiologically activated by either noradrenaline or adrenaline.

131) With reference to the parasympathetic nervous system:

- * A. Preganglionic neurons leave the CNS via cranial nerves III, VII, IX, X and sacral spinal nerves
- B. Norepinephrine is the neurotransmitter utilized by both pre and post ganglionic neurons
- C. Neurons synapse primarily in the paravertebral ganglia
- D. Control of urethral sphincter tone is an important function of parasympathetic neurons in the sacral spinal cord
- E. a and d are correct

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132) Which of the following is INCORRECT?

- A. The myenteric plexus is found between muscle layers in the gut
- * B. Acetylcholine is a neurotransmitter of the enteric nervous system which inhibits gut motility
- C. Opioids are neurotransmitters within the ENS which markedly decrease secretion and increase segmental motility
- D. Although it can function autonomously, the enteric nervous system has extensive efferent input from the autonomic nervous system
- E. Action potentials within the enteric nervous system often arise spontaneously

Ach is a neurotransmitter of the ENS; however, it <u>stimulates</u> gut motility and glandular secretion.

133) Which of the following is NOT considered true of neurons?

- A. They normally have a resting membrane potential between -70mV and -90mV
- * B. They conduct impulses in at least two directions
- C. They conduct action potentials along their axons
- D. They may be unipolar, bipolar or multipolar
- E. They are the basic functional unit of the nervous system

134) A 3 yr old gelding is noticed to have a wide stance, a head tilt and to stumble when forced to walk. The horse is slightly depressed, has a head tilt to the left and rapid, horizontal back-and-forth eye movements when in the normal resting position. There is a palpable decrease in tone and mass in the muscles on the left side of the head and the palpebral reflex is completely absent in all sites. The horse is ataxic and slightly weak, particularly on the left side. The remainder of the examination is normal. Rapid eye movement of this type is called :

- * A. Nystagmus and is probably due to a lesion involving CN VIII or its nucleus
- B. Nystagmus and is probably due to a lesion involving CN III or its nucleus
- C. Strabismus and is probably due to a lesion involving CN III, IV or VI
- D. Nystagmus and is probably due to a lesion somewhere in the cortex
- E. c and d are correct

Rapid back and forth eye movement is nystagmus. Pathological nystagmus can occur due to malfunctions in any of III, IV, VI, VIII and the MLF (in the brainstem). A head tilt occurs due to a malfunction in VIII, the vestibule of the ear or the MLF.

135) A 3 yr old gelding is noticed to have a wide stance, a head tilt and to stumble when forced to walk. The horse is slightly depressed, has a head tilt to the left and rapid, horizontal back-and-forth eye movements when in the normal resting position. There is a palpable decrease in tone and mass in the muscles on the left side of the head and the palpebral reflex is completely absent in all sites. The horse is ataxic and slightly weak, particularly on the left side. The remainder of the examination is normal. The loss of mass and tone in the muscles of the head in the horse are

- A. Caused by a loss of motor neurons in CN VII which innervates the face
- B. Related to strabismus and suggest a lesion involving CN V
- C. Related to strabismus and suggest a lesion involving CN VII
- D. Related to the loss of the palpebral reflex and suggest a lesion involving CN VII
- * E. Related to the loss of the palpebral reflex and suggest a lesion involving CN V

The palpebral reflex involves sensory CN V and motor CN VII. CN V (trigeminal) has 3 branches that provide sensory innervation of the face : Ophthalmic, maxillary and mandibular. Ophthalmic innervates the most dorso-medial aspect while the mandibular innervates the most ventro-lateral aspect; the maxillary, in between. In addition, V provides motor innervation to the muscles of mastication (masseter, temporalis, medial & lateral pterygoid, mylohyoid, anterior digastricus)

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- A. cerebral cortex on the right side
- B. peripheral vestibular nerve on the left side
- C. semicircular canals on the left side
- D. b and c are correct
- * E. None of the above are correct

Depression points to a lesion in the brain, so the peripheral nerve and semicircular canals are ruled out. The head tilt suggests vestibular disease; in the brain, that would point to the vestibular nuclei in the brain stem, rather than the cortex.

137) A 3 yr old gelding is noticed to have a wide stance, a head tilt and to stumble when forced to walk. The horse is slightly depressed, has a head tilt to the left and rapid, horizontal back-and-forth eye movements when in the normal resting position. There is a palpable decrease in tone and mass in the muscles on the left side of the head and the palpebral reflex is completely absent in all sites. The horse is ataxic and slightly weak, particularly on the left side. The remainder of the examination is normal. The problem in the horse is a :

- A. Central lesion involving the nucleus of CN VII on the left side
- B. Lesion in the vestibular nerve and the facial nerve where they run together on the left side
- C. Lesion involving CN V and VIII near the point where they enter the brain on the left side
- * D. Lesion in the brainstem on the left side
- E. Lesion in the cerebral cortex on the right side

Depression points to a lesion in the brain. The head tilt suggests vestibular disease; in the brain, that would point to the vestibular nuclei in the brain stem, rather than the cortex. Rapid back and forth eye movement is nystagmus. Pathological nystagmus can occur due to malfunction in the MLF, part of the brainstem. Since the head tilt is to towards the left, one can conclude that the left side of the brain stem has the lesion.