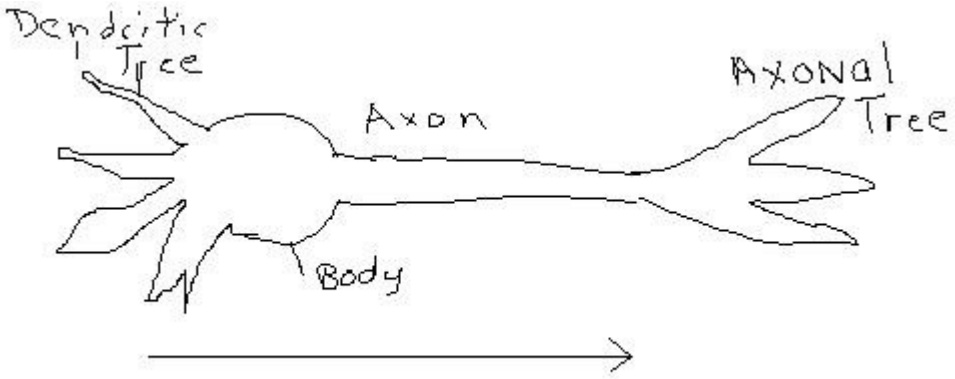
A&P Exam 4 Study Guide

GUARANTEED QUESTIONS:

1. Mix and match about thirty.

2. Draw a neuron, label the dendritic end, axonal tree, and axon; and show with an arrow which direction nerve signals travel. (119)



3. How could you identify the following types of neuroglia cells of central nervous system and what are their functions; astrocytes, oligodendrocytes, microglial cells, and ependymal cells? (120-122)

- Astrocytes –
  - **involved in the metabolism of neurotransmitters**
  - **help maintain the proper potassium balance in nerve cells**
  - **form the blood brain barrier around capillaries in the brain**
- Oligodendrocytes –
  - **Produce myelin sheath in CNS**
- Mycroglial cells –
  - **Phagocytic – They engulf bacteria, dead cells and other undesireable materials.**
- Ependymal cells –
  - **Produce the cerebrospinal fluid.**

4. How could you identify the following types of neuroglia cells of the peripheral nervous system and what are their functions: schwann cells and satellite cells? (121&122)

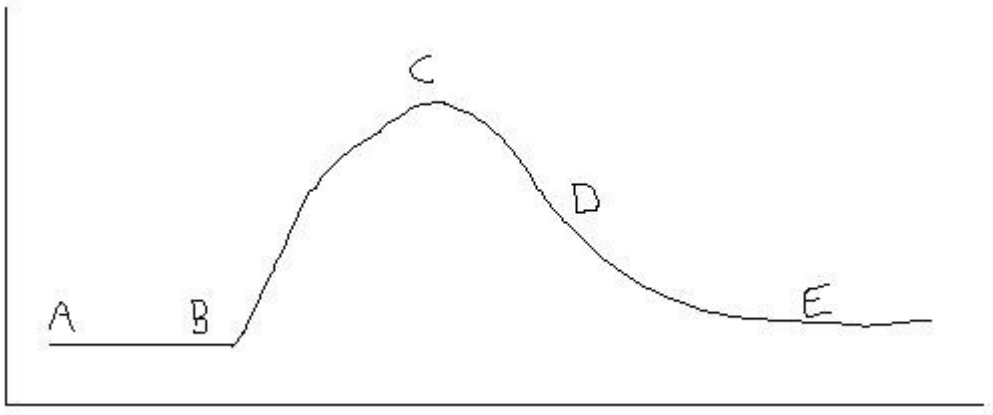
- Schwann cells – **produce the myelin sheath around peripheral nerves.**
- Satellite cells – **Wrap around the neurons and help support them.**

5. Explain the function of schwann cells, which surround neurons? What are the nodes of Ranvier and what is their significance? How does greater neuron diameter affect the speed of nerve transmissions? (124-125)

1. Function of Schwann cells: **The cells which make up the myelin sheath in the peripheral nervous system.**

2. Node of Ranvier: **The unmyelin-ated sections of the neuron. Have ion gates (Na+, K+, etc.).**
3. How does the greater diameter affect the speed of nerve transmission? **The larger the diameter the faster the signal can travel (more surface area, more ion gates).**

6. Explain what is happening at different points on an action potential diagram for nerves. How and where are ions moving? How does the action potential move down the cell? (122-124)



A. **Resting potential (-70mv). K+ is inside the cell, Na+ is outside the cell.**
B. **Neurotransmitter received at the dedritic end. Na+ gates open by the neurotransmitter receptor site. The membrane potential at that area goes up as Na+ rushes in (diffusion).**
C. **Action potential (+40mv) achieved at site. Na+ gates close, K+ gates open K+ rushes out of cell (diffusion). Membrane potential declines.**
D. **K+ gates close. Na+/K+ pump moves 3 Na+ out of cell for two K+ into cell, per ATP using active transport.**
E. **Resting potential achieved.**

As the membrane potential at the dendritic end which received the neurotransmitter goes up, it causes the membrane potential of the cell membrane around it to go up a little as well. This causes the Na+ gates next to it to open up, and the Na+ in that area will rush into the cell too. This process continues until for the length of the dendrite, then the cell body, and finally the axonal tree (assuming no myelin sheath are present. Where myelin sheath are present the membrane potential jumps from one end of the myelin sheath to the other end causing the gates to open up over there.

7. If all action potentials are the same, how is different information carried by nerve signals?
Frequency Encoded. More frequent signals are interpreted as a stronger signal. I.e. warm may be 10 signals per, where hot is 100 and burning is 1000.

8. What is an electric synapse and how does it work? (126-127)

In electronic synapses the two neurons are connected via a connexon which allows them to send the action potential from the sending neuron to the receiving neuron. The synaptic cleft between the two neurons is very narrow and is referred to as a gap junction. No chemical neurotransmitter is required.

9. Be able to explain in detail how acetylcholine and monoamine neurotransmitters carry the nerve signal across the synapse. (127-130)

Acetylcholine:

- **Neurotransmitter is bound in a synaptic vesicle inside the presynaptic neuron.**
- **Action potential arrives at the axonal end of the presynaptic neuron causing Ca+ gates to open up (diffusion of Ca+ into the cell).**
- **The Ca+ causes exocytosis of the neurotransmitter.**
- **The neurotransmitter travels across the synaptic cleft to the receiving neuron where it binds to and opens a Na+ gate.**
- **Na+ diffuses into the receiving neuron via diffusion.**
- **The acetylcholine is then broken down into acetate and choline by the enzyme acetylcholinesterase. The acetate and choline are reabsorbed by the presynaptic neuron and used to make more acetylcholine.**

Monoamine:

- **Single amine group (dopamine, epinephrine, norepinephrine**
- **Neurotransmitter are stored in synaptic vesicles**
- **Action potential arrives at the axonal end of the presynaptic neuron causing Ca+ gates to open and Ca+ to diffuse into the cell.**
- **The Ca+ causes exocytosis of the neurotransmitter.**
- **The neurotransmitter travels across the synaptic cleft to the receiving neuron where it binds to a G-protein receptor site on the postsynaptic neuron.**
- **The neurotransmitter binding to the G-protein receptor site activates the enzyme adenylate cyclase inside the cell.**
- **The adenylate cyclase converts ATP to cyclic AMP (C-AMP). The C-AMP acts as a secondary messenger carrying the nerve signal into the cell.**
- **C-AMP activates the enzyme that opens the sodium gates on the postsynaptic neuron. Na+ then diffuses into the cell.**
- **Both the enzyme that opens the sodium gates and the neurotransmitter must be broken down to stop the nerve signal.**
- **Catecholamine-O-Methyltransferace (COMT) breaks down the enzyme that opens the sodium gates.**
- **Monoamine oxidase (MAO) is released from the presynaptic neuron to break down the neurotransmitter.**

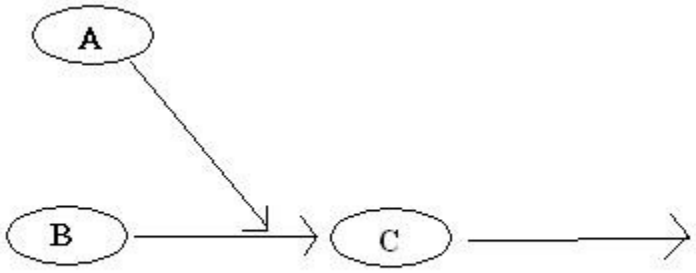
10. Contrast excitatory and inhibitory post synaptic potentials. (131)

Excitatory post synaptic potentials cause an action potential in the cell, i.e. they cause Na+ gates to be opened and if sufficient will cause the cell membrane to rise to action potential (+40mv).

Inhibitory post synaptic potentials reduces the likelihood that the cell will reach action potential. They bring the neuron's membrane potential down from -70mv to -85mv. This can be done either by making the cell membrane more permeable to K+ allowing it to leak out of the cell or by opening Cl- gates which allow Cl- to diffuse into the cell. Both will reduce the cells membrane potential.

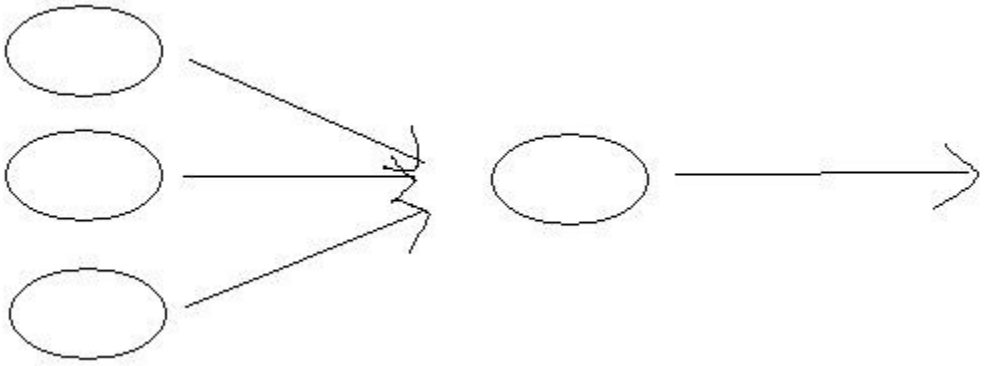
11. What are graded potentials? (131-132)
Typically found on special 'sensory' cells. These cells have no refractory period so they can receive many signals very rapidly and can sum or add them up. Weak signals can be added up over time to cause the cell to reach action potential.

12. What is presynaptic facilitation and what is presynaptic inhibition? (132)

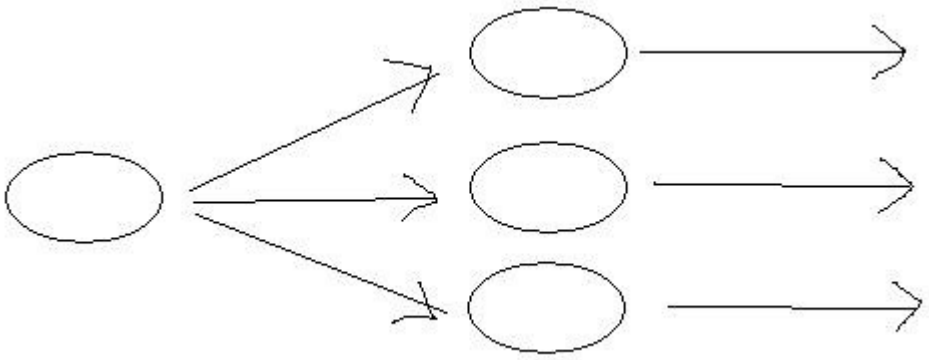


Presynaptic facilitation: When neuron-A releases an excitatory neurotransmitter that is received by neuron-B and this causes neuron-B to release a stronger neurotransmitter to neuron-C.
Presynaptic inhibition: When neuron-A releases an inhibitory neurotransmitter which causes neuron-B to decrease the release of it's neurotransmitter to neuron-C.

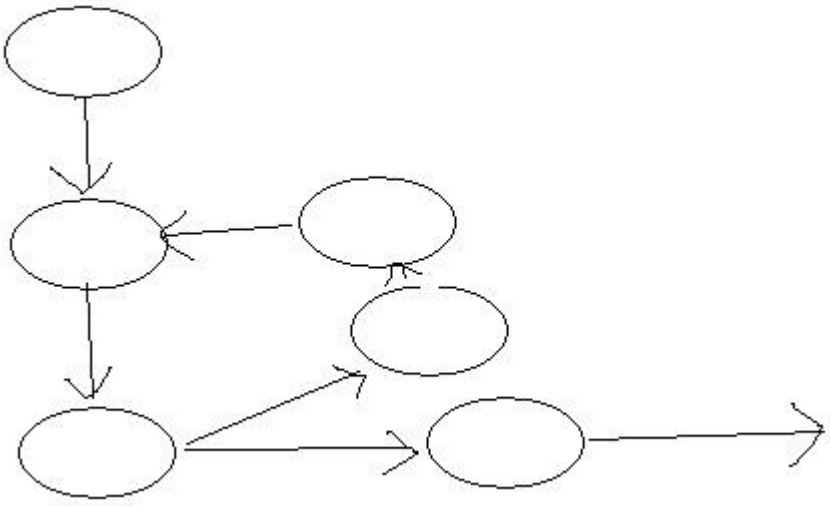
13. Be able to diagram and explain the following types of neural circuits and how they function: convergent, divergent, reverberating, and parallel after discharge. (132-133)
Convergent:
Multiple neurons release neurotransmitters to a single receiving neuron. The more neurotransmitters received, the more excited the receiving neuron will be.



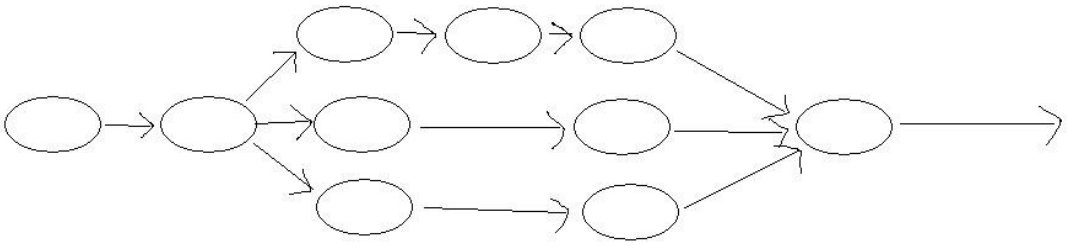
Divergent:
One neuron releases neurotransmitters to multiple receiving neurons. Each will get excited by the neurotransmitter.



Reverberating:
One neuron (neuron-A) releases a neurotransmitter, which is received by multiple neurons (neuron-B and neuron-C). One path continues on to wherever (brain, muscle, etc.) the other path ends up back at the receiving (dendritic) end of the original neuron (neuron-A) causing it to start all over again.



Parallel after discharge:
One neuron releases a neurotransmitter to multiple neurons which each distribute the signal on down the line through multiple paths which may later convege.



14. Explain temporal summation and spacial summation. (133)
Temporal summation: (summation over time) where multiple action potentials reach a neuron in rapid succession and their effects are graded together.
Spacial summation: (summation of multiple signals received at the same time) a number of neurons converge on a single dendrite, combining their effects to get a neuron to fire.

15. What effect does alkalosis or acidosis have on the nervous system? (133)
Alkalosis (pH above 7.45) causes the activity inside the synaptic cleft to increase which increases the nerve signals.
Acidosis (pH below 7.35) decreases the activity inside the synaptic cleft, reducing nerve signals. Very low pH will cause a person to pass out due to lack of neural signals. I.e carbon monoxide poisoning.

16. Define the four basic types of neurotransmitters and their basic mode of action (i.e., do they work like acetylcholine or monoamine neurotransmitters). (133-135)
Acetylcholine
- **Works like Acetylcholine ☺**

Amino Acid neurotransmitters
- **Modified single amino acids**
- **Works like Acetylcholine**

Monoamines
- **Molecules with a single amine group, but they do not have the basic form of amino acids**
- **Works like monoamines ☺**

Neuropeptides
- **Chain of amino acids**
- **Works like Acetylcholine**

17. In general what affect do drugs have on the nervous system? (136)
In general drugs either excite or inhibit neurotransmission by effecting the secretion and/or reception of neurotransmitter or by effecting the chemicals which breakdown the neurotransmitters.

18. Define and contrast the parts of the central and peripheral nervous system. (137-138)
Central nervous system – brain and spinal cord
Peripheral nervous system – All of the nerves in the body except for those in the CNS. Comprised of both the somatic nervous system and the visceral (autonomic) nervous system:

- **Somatic – nerves you can control**
  - **Afferent – Receives sensory information**
  - **Efferent – Controls the muscles of the body**
- **Visceral –**
  - **Afferent – Sensory information from organs**
  - **Efferent – Controls organ functioning. Consists of two subsystems:**
    - **Sympathetic – Flight or Fight**
      - **Increases:**
        - **Heart rate**
        - **Vasoconstriction**
        - **Breathing rate**
        - **Blood flow**
        - **Blood glucose**
      - **Decreases:**
        - **Gut contraction and digestion**
    - **Para-sympathetic**
      - **Decreases:**
        - **Heart rate**
        - **Vasoconstriction**
        - **Breathing rate**
        - **Blood flow**
        - **Blood glucose**
      - **Increases:**
        - **Gut contraction and digestion**

19. Contrast short term and long term memory. What changes occur in the brain when a memory trace is created? (141-142)
Short term memory:

- **Memories that are stored for seconds to minutes**
- **Not associated with any structural or chemical changes in the brain**
- **Removed by electro-shock treatment**
- **Stored in hippocampus**

Long term memory:

- **Memories that are stored for longer periods of time (i.e. years)**
- **Associated with chemical and structural changes in brain including memory traces.**

Changes that occur when a memory trace is created:

- **A large flow of norepinephrine and glutamate between neurons in certain parts of the brain.**
- **An increase in the dendritic connections in the brain**
- **An increase in glial cells in association with neurons occurs**
- **Protein synthesis occurs as long-term memories are created.**

20. Be able to explain how the layers of the meninges are arranged and what the spaces between layers and within layers are called (i.e., dura mater, superior sagittal sinus, subdural space, arachnoid mater, subarachnoid space, and the pia mater). (146&148)

Dura mater
- **Just below the cranial bones**
- **Above the brain is split into two layers with the superior sagittal sinus between them.**

Superior sagittal sinus
- **The space between the dural layers superior to the brain.**
- **Filled with venous blood and carries this blood back to the heart via veins.**
- **CSF is moved back into the blood by moving through the arachnoid villi into the superior sagittal sinus.**

Subdural space
- **Very narrow space between the dura mater and the arachnoid mater.**

Arachnoid mater
- **Layer below dura mater**
- **Has arachnoid villi**

Arachnoid villi
- **Lobe like extension of the arachnoid matter that extend into the superior sagittal sinus.**
- **Allow the CSF to be reabsorbed by the blood in the superior sagittal sinus where it is then transported back to the heart.**

Subarachnoid space
- **The space between the arachnoid mater and the pia mater**
- **CSF is found in this space**

Pia mater
- **Inner most layer of meninges that covers the brain and spinal cord.**

21. What are two functions of cerebrospinal fluid? (148)
- **Protects the brain and spinal cord from physical shock**
- **Provides the proper chemical composition for brain function**
- **Helps with circulation; provides nutrients and removes waste**

22. Explain where cerebrospinal fluid is produced, how it circulates around the brain and spinal cord, and where it is reabsorbed into the brain. (148-149)

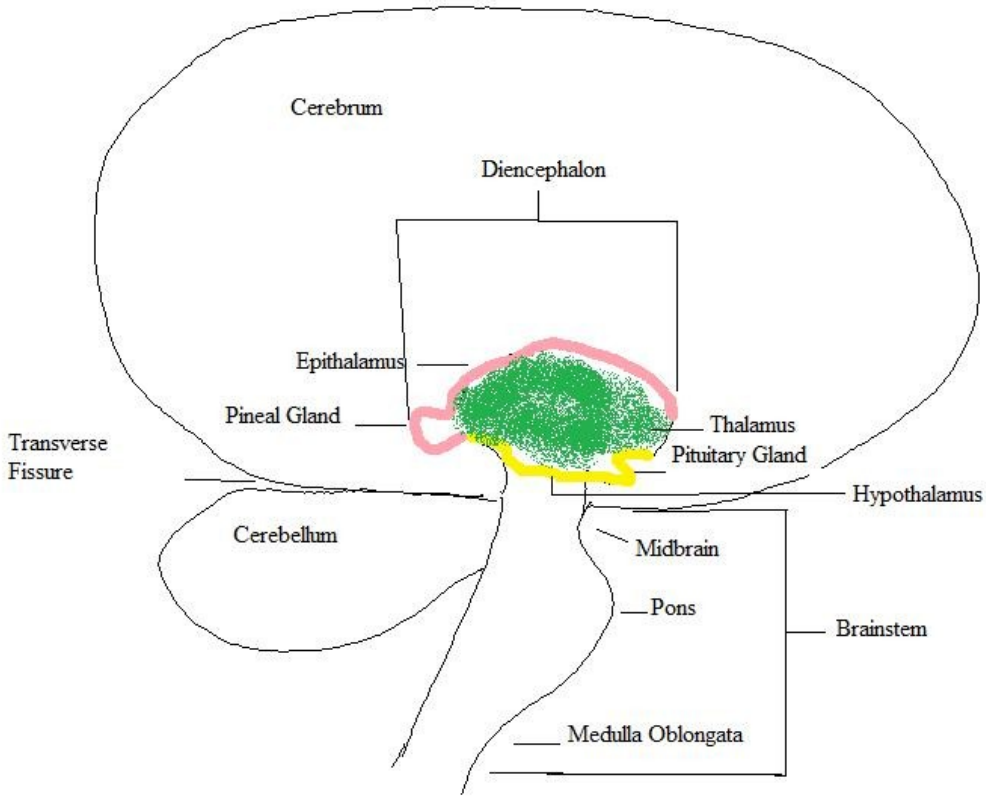
CSF is made from blood plasma by ependymal cells that line the choroids plexuses of the ventricles of the brain.

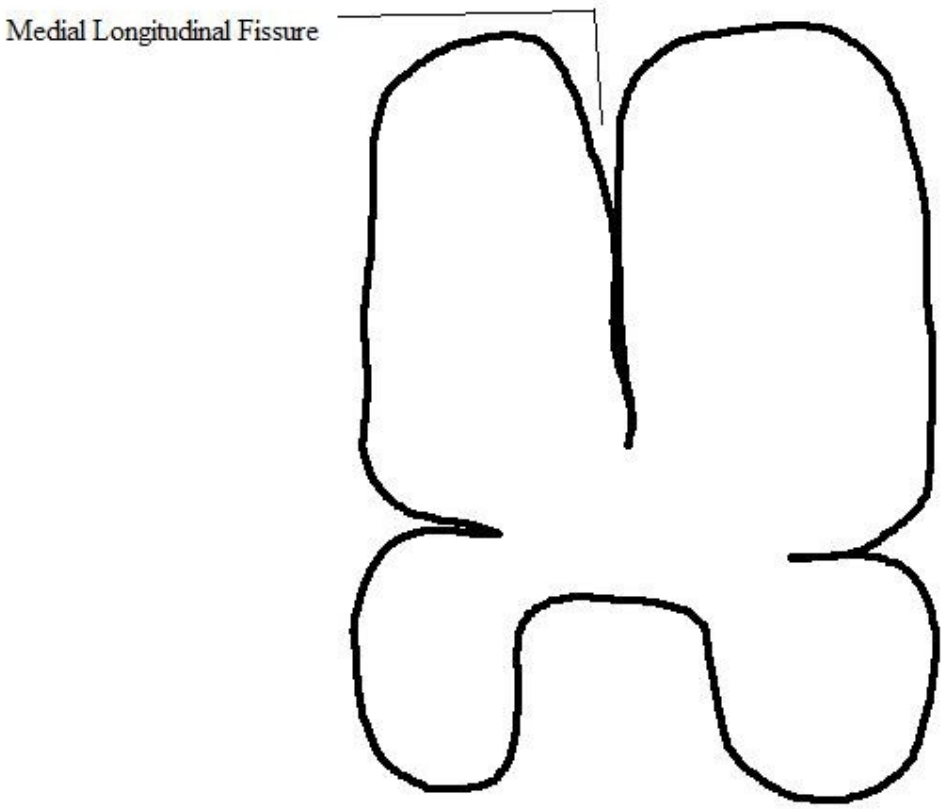
The brain has four ventricles or cavities that are filled with CSF. The ventricles have capillary beds in them called Choroid plexuses. These choroids plexuses are lined with ependymal cells which manufacture the CSF.
The path that the CSF travels is:

- **Lateral Ventricles (two)**
- **Third ventricle**
- **Forth ventricle**
- **Through the central canal of the spinal cord to the bottom of the spinal cord**
- **Around the spinal cord in the subarachnoid space**
- **Around the brain in the subarachnoid space**
- **Arachnoid villi**
- **Superior sagittal sinus where the CSF is reabsorbed into the blood stream and returns to the heart.**

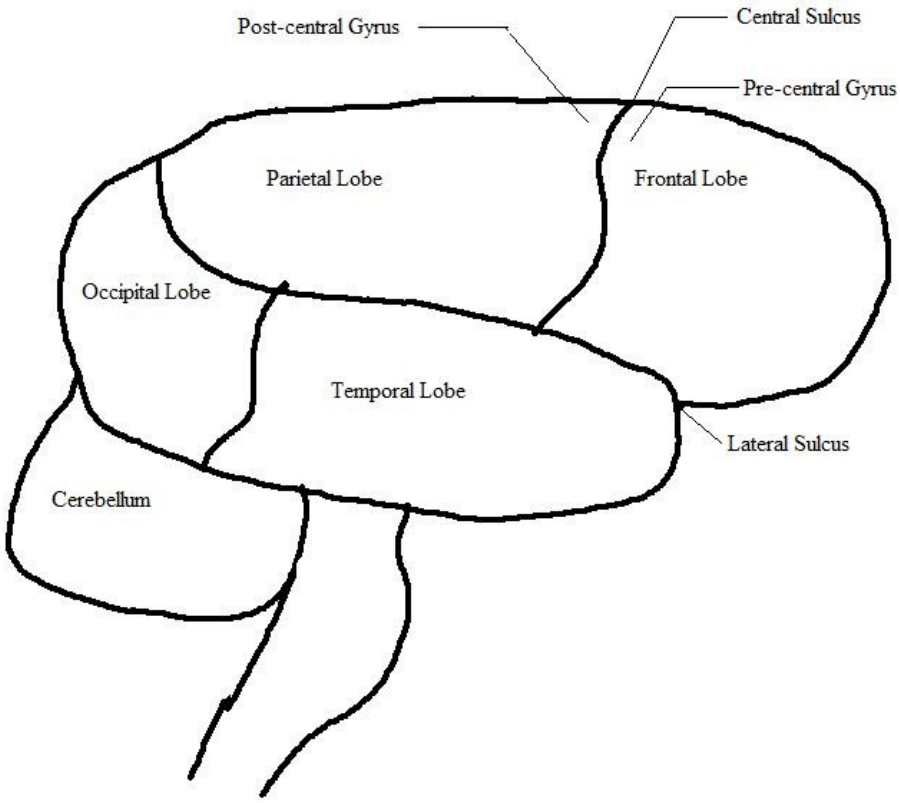
23. What is blood brain barrier? What type of nerve cells form the blood brain barrier? (149-151)
The capillaries in the brain are surrounded by astrocytes (a type of glial cell). The astrocytes act as filters allowing the blood to move from the capillaries into the brain tissue. Generally fat soluble material is allowed through where as water soluble materials are not.

24. Draw a diagram of the brain showing the location of the following: cerebrum, cerebellum, diencephalons, and brainstem. Also be able to show the following parts: epithalamus, thalamus, hypothalamus, midbrain, pons, and medulla oblongata. Be able to show the following fissures: medial longitudinal fissure and transverse fissure. What are the major functions of the different parts of the brain listed above.


Cerebrum
Diencephalon
Epithalamus
Pineal Gland
Thalamus
Pituitary Gland
Transverse
Fissure
Hypothalamus
Cerebellum
Midbrain
Pons
Brainstem
Medulla Oblongata



25. Be able to draw and identify the major lobes of the cerebral cortex (i.e., frontal, parietal, temporal, occipital, and insula). Be able to identify the central sulcus, lateral sulcus, precentral gyrus, and postcentral gyrus.



26. What are the major functions of the precentral gyrus and the postcentral gyrus (154)?
Pre-central gyrus – The gyrus located just in front of the central sulcus on the posterior of the frontal lobe. Has the primary somatic motor area which controls skeletal muscle. (aka motor cortex)

Post-central gyrus – The gyrus locateion just behind the central sulcus on the anterior of the parietal lobe. Has the primary somatosensory area which receives and interprets sensory information. (aka sensory cortex)

27. Explain the differences between sensory areas, motor areas, and association areas. (155)
Sensory areas – receive and interpret sensory information
Motor areas – Control contractions of muscles
Association areas – Deals with integration of functions such as evaluation of sensory information, memory, emotions, reasoning, and judgment.

28. Explain the functions of the commissural fibers, association fibers, and projection fibers. (157)
Commissural fibers - Myelinated fibers in the corpus callosum that connect the two hemispheres.
Association fibers – Myelinated fibers that carry signals anteriorly and posteriorly in the cerebrum and vertically in the frontal lobes.

Projection fibers – Mylinated fibers that carry signals to and from the spinal cord to the cerebral hemispheres. These fibers cross in the brain stem which is why the left side of your brain controls the right side of your body and vice versa.

29A. What are nuclei? (158)
A cluster of unmyelinated nerves

29B. What are basal nuclei? What are the functions of the corpus striatum (i.e., caudate nucleus, putamen, and globus pallidus)? (158)
Basal nuclei – Masses of unmyelinated nerves found in the medulla of the cerebrum.
Corpus striatum – The main nuclei in the cerebrum which has two parts the caudate nucleus and the lenticular nucleus. The lenticular nucleus has two parts the putamen and globus pallidus.
Caudate nucleus and putamen – control autonomic movements of skeletal muscles that help you maintain balance like swinging your arms while you walk.
Globus pallidus – regulates muscle tone.

30. What is the limbic system and what are three of its functions? Where is the limbic system found? (159)
What is the limbic system – A number of nuclei that encircle the diencephalons and form a ring at the inner border of the cerebrum mainly in the temporal lobes.
Functions:

- **Governs emotional aspects of behavior**
- **Controls sensation of pain and pleasure**
- **Involved in memory formation and retrieval**
- **Controls most involuntary aspects of behavior, by linking the cerebral cortex which controls voluntary aspects of behavior with the brain stem which controls involuntary aspects of behavior.**

31a. The pineal gland is associated with what part of the brain and what is its function? (160)
The pineal gland is part of the epithalamus (roof of the third ventricle). It produces melatonin. Melatonin is a hormone that promotes sleep and is involved in setting your daily biological clock.

31b. What is the function of habenular nuclei? (160)
Creates emotional responses to smells

32. What are three functions of the thalamus? (160)

- **Relay sensory information to the cerebral cortex from the spinal cord.**
- **Relay somatic motor system information between the spinal cord and the cerebral cortex.**
- **Formation of memories.**

33. What are six things the hypothalamus regulates or controls? (161-162)

- **Blood sugar levels**

- **Water balance**
- **Body temperature**
- **Sleep patterns**
- **Hunger sensations**
- **Thirst sensations**

34. What are two functions of the cerebellum? (163)
- **Regulate equilibrium and balance**
- **Receives input from proprioceptors and compares intended movements with what is actually happening.**

35. What two things does the reticular formation regulate and where is it found? (164-166)
- **Located: runs through the midbrain, pons and medulla oblongata.**
- **Regulates muscle tone**
- **Consciousness and awakening**

36. What are the functions of the midbrain other then those found in the reticular formation (i.e., substantial nigra, red nucleus, and the superior and inferior colliculus)? (164-)
- **Substantial nigra: Nuclei that regulate and coordinate muscle movements. (degenerate in parkinsons)**
- **Red nucleus: Involved in unconscious movements of skeletal muscle to maintain balance.**
- **Superior colliculus: Involved in reflex movements of the eyes and head in response to visual and other stimuli**
- **Inferior colliculus: Involved in reflex movements of the head and body in response to auditory stimuli**

37. What is the major function of the pons other then those found in the reticular formation (i.e., pneumotaxic and apneustic areas)? (166)
The pneumotaxic and apneustic areas together with the medullary rhythmicity area help regulate breathing.

38. What two major things does the medulla oblongata control (i.e., the cardiovascular center and the medullary rhythmicity center)? (166)
- **Cardiovascular center: rate and force of heart contractions**
- **Medullary Rhythmicity center: Rhythm of breathing, swallowing, vomiting, coughing, sneezing, and hiccupping.**

39. Where do cranial nerves originate and where do spinal nerves originate? How many pairs of cranial nerves are there? (167)
- **Cranial nerves originate in the brain**
- **Spinal nerves originate from the spinal cord**

40. What nerves are capable of repairing cut axons? (167)

- **Nerves outside of the central nervous system can regrow their axons if they are cut, so minor nerve damage can be repaired in the PNS.**

41. On a diagram of the brain be able to match the cranial nerves with their name and number. (167-168)