1. What are the 3 main functions of the nervous system?
   1. Sensory function – sensing
   2. Integrative function – connecting sensory information to movement
   3. Motor function – moving

2. What are the 2 major divisions of the nervous system?
   1. Central Nervous System
   2. Peripheral Nervous System

3. Describe the anatomy of the Central Nervous System (CNS).

4. Describe the anatomy of the Peripheral Nervous System (PNS).

5. What are the 2 main divisions of the PNS?
   1. Sensory division - receive sensory info from receptors
   2. Motor division – initiates movement of muscles and organs
6. What are the 2 systems within the motor division of the PNS?

1. Somatic Nervous System – controls skeletal muscle
   - voluntary
   - involuntary

7. What are the 2 divisions of the Autonomic Nervous System?

1. Sympathetic division
2. Parasympathetic division

8. What is the difference between the Sympathetic and Parasympathetic divisions?

- **Sympathetic**
  - increased activity
  - “fight or flight”
  - digestive and urinary functions stop
  - blood flow increases to muscles
  - heart rate increases, blood pressure rises,
  - pupils dilate,
  - increased sweating,
  - breathing increases.

- **Parasympathetic**
  - decreased activity,
  - “rest and relax”,
  - promotes digestion,
  - blood flow increases to organs,
  - blood pressure and heart rate return to normal,
  - pupils constrict,
  - normal breathing rate.

9. Draw a neuron, label the following parts and give their functions:

- **Cell body, nucleus, axon, myelin, schwann cell, nodes of Ranvier dendrites, synaptic knob (axon terminal), impulse,**

- **Cell body** – contains organelles
- **Nucleus** – contains all of the chromosomes
- **Axon** – long nerve wire that carries the impulse from the cell body to the synapse.
- **Myelin** – fatty insulation around axon that improves the conduction speed of nerve impulses
- **Schwann cell** – cells that wrap around axon and coat it with myelin
- **Nodes of Ranvier** – gaps between myelin where action potentials occur
- **Dendrites** – branches from the cell body that receive info from other cells
- **Synaptic knob (axon terminal)** – end of axon that releases neurotransmitter
- **Impulse** – one way electrical signal from cell body to synaptic knobs
10. How fast does an impulse travel in a myelinated axon? In an unmyelinated axon?

- 120 meters/sec
- .5 meters/sec

11. How long are axons?

- Some are less than a millimeter (in brain)
- Others like ones in the legs can be over a meter long

- If the cell body was the size of a tennis ball...
  - Axon would be 1.5 miles long and .5 inches thick
  - Dendrites would fill a room

12. What are neuroglial cells?

- Cells of the nervous system that are NOT neurons
- Help with structural framework, myelin production, and clean up (phagocytosis)
- Microglial cells, Oligodendrocytes, Astrocytes, Ependymal cells, Schwann Cells

13. Name 3 structurally different neurons.

1. Bipolar – one input (dendrite), one output (axon)
   - eyes, nose, ears

2. Unipolar – one output with 2 branches (fused dendrites and axon)
   - most sensory neurons of PNS

3. Multipolar – many inputs (dendrites), one output (axon)
   - most in CNS
14. What are the 3 types of functionally different neurons?

1. Sensory Neurons - receive sensory information
2. Interneurons – only found in CNS, links between neurons
3. Motor Neurons – stimulate muscles or glands

15. What is an action potential?

- Depolarization and repolarization that sends an electrical impulse down an axon
- Action potentials cause neurotransmitter release at the synaptic knob that signals another neuron to fire.

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16. Why are electrolytes important in your diet?

- Sodium, Potassium, and Calcium are the ions involved in an action potential

Nutrition Facts

Sodium: 350 mg
Potassium: 55 mg
Calcium: 15 mg

17. Describe the major events of an action potential.

1. Neuron membrane at resting potential (-70 mV)
2. Threshold stimulus received (-55 mV)
3. Na+ channels in membrane open and Na+ ions rush in
4. Membrane is depolarized
5. K+ channels in membrane open and K+ ions rush out
6. Membrane is repolarized
7. Wave of action potentials travel down the axon → called a nerve impulse

18. Draw an axon when it is polarized (resting) and when it is depolarized (firing). Label Na+ ions.

http://www.blackwellpublishing.com/matthews/actionp.html
19. Are action potentials “all-or-none” responses?
- Yes.
- Once the threshold is reached, the axon fires.

20. Do neurons touch each other?
- No, there is a space called the postsynaptic gap.

21. What happens when the action potential reaches the synapse?
- The synapse releases neurotransmitter, which signals the next cell to fire.

22. How many types of neurotransmitters are found in the body? List 7 and give their location and major action.
- About 50 types
  1. Acetylcholine – CNS, PNS – muscle contraction at neuromuscular junction
  2. Norepinephrine – CNS, PNS – waking, feeling good
  3. Dopamine – CNS, PNS – emotional responses, addictive behaviors, pleasure
  4. Serotonin – CNS – sleeping, sense perception, temperature regulation, mood, appetite
  5. Endorphins – CNS – body’s natural painkillers
  6. GABA – CNS - inhibitory
  7. Nitric Oxide – CNS, PNS – learning and memory, and vasodilation

23. How do drugs affect neurotransmitters?
- Some imitate neurotransmitters:
  - Morphine binds to endorphin receptors
  - Nicotine binds to acetylcholine receptors
- Some increase neurotransmitters by blocking reuptake:
  - Cocaine increases dopamine
  - Ecstasy increases serotonin
- Some block neurotransmitters (or receptors):
  - Alcohol binds to GABA receptors
24. What neurotransmitter triggers addiction in humans?

- Dopamine
- Dopamine receptors form the brain’s natural reward system
- All drugs trigger this system

25. Draw and label the cross section of the spinal cord. What is the function of afferent neurons and efferent neurons?

- Afferent neurons are sensory neurons that carry stimuli to the spinal cord and brain for analysis
- Efferent neurons are motor neurons that carry impulse back to muscle for a response
- D.A.V.E. = Dorsal Afferent, Ventral Efferent
- M.E.S.A. = Motor Efferent, Sensory Afferent

26. Explain what happens in a reflex arc.

- Afferent neuron receives info (tack) and sends it to spinal cord
- Interneuron in spinal cord connects sensory neuron to motor neuron
- Efferent neuron sends signal to muscle to MOVE!

27. How do pain killers work?

- Usually block pain messages by preventing neurotransmitter release or binding
- Ex. Codene
28. Are there people born without the ability to feel pain?

- Yes.
- CIPA - congenital insensitivity to pain with anhidrosis
- Genetic disease that affects nerve endings
- Sufferers feel no pain or extreme temperatures.

29. What is a neurotoxin?

- A poison that affects the synapse
- Either causes neurons to fire repeatedly or prevents them from firing.
- Ex. tetanus, pufferfish

- Pufferfish contains the neurotoxin called tetrodotoxin
- It is eaten as a delicacy in Japan, called “fugu.”
- Each fugu chef must have a special license
- A few people do get poisoned
- Tetrodotoxin is found in the liver, skin and eggs

30. List the 12 cranial nerves. How can you remember them?

1. Olfactory (I)
2. Optic (II)
3. Oculomotor (III)
4. Trochlear (IV)
5. Trigeminal (V)
6. Abducens (VI)
7. Facial (VII)
8. Vestibulocochlear (VIII)
9. Glossopharyngeal (IX)
10. Vagus (X)
11. Accessory (XI)
12. Hypoglossal (XII)

Oh Once One Takes The Anatomy Final Very Good Vacations are Here!
31. How much does the brain weigh?

- About 3 lbs.

32. What are the meninges of the brain? What is meningitis?

- There are 3 meninges that cover the brain:
  - Dura mater – outer hard layer
  - Arachnoid – middle “spider web-like” layer
  - Pia mater – closest to the brain

- Meninges “PAD” the brain

- Meningitis is an infection of the meninges that can be deadly and it often occurs on college campuses
  - especially USC

33. What fluid acts as a shock absorber and cushions the brain and spinal cord?

- Cerebrospinal Fluid (CSF)
34. What are the ventricles of the brain? What is hydrocephalus?

- Fluid (CSF) filled cavities of the brain
- CSF is not reabsorbed in the subarachnoid space and builds up in ventricles
- Brain damage will occur if a shunt is not inserted to drain fluid to stomach

35. Draw, label and give the function of the four lobes of the brain

1. Frontal lobe – concentration, planning, problem solving, also contains primary motor cortex, Broca’s area = speech
2. Parietal lobe – speech, words, also contains somatosensory cortex
3. Occipital lobe – visual recognition, visual images
4. Temporal lobe – sensory interpretation, visual and auditory memories

36. Why do many teenagers make stupid mistakes?
36. Why do ALL teenagers make stupid mistakes?
- Because the frontal cortex, involved in reasoning and decision making doesn’t fully mature until about 20 years old.
- Teenagers rely primarily on their amygdala, a more emotional part of the brain, for decision making rather than their frontal cortex.

37. What are the main characteristics of Alzheimer’s?
- Kills 100,000 people each year
- 8th leading cause of death in the U.S.
- Symptoms include...
  - Memory loss
  - Disorientation of time and place
  - Difficulties with concentration, language, judgment
- Plaques and tangles form in the neurons of the brain and disrupt function

38. What is the function of the following parts of the brain:
1. Cerebral Cortex – perception, emotion, thought, planning, reasoning, etc.
2. Corpus Callosum – large bridge of nerve fibers that connect right and left hemispheres of cerebral cortex
3. Hypothalamus – monitors info from the autonomic N.S. and controls pituitary gland, regulates sleep and appetite
4. Optic Nerve – transmits electrical signals from the eyes to the brain.
5. Pituitary gland – secretes hormones that control growth, pregnancy and childbirth, metabolism, sex organ function, and water regulation
6. Meninges – 3 layer protective covering of the brain
7. Thalamus – sensory relay station
8. Skull – hard bony protection for the brain
9. Pineal Gland – biological clock, circadian rhythms
10. Arbor Vitae – “tree of life” found on the cerebellum
11. Cerebellum – coordinates movement by connecting several parts of the brain, motor learning
12. Spinal Cord – bundle of nerve fibers that carry messages to and from the brain
13. Medulla – controls breathing, heartbeat, and other autonomic functions, also controls vomit, cough, sneeze, swallow, suckle reflexes
14. Pons – also controls breathing, heart rate, main CNS/PNS relay center, may be involved in dreaming
39. What is a sulcus? What is a gyrus?

- Sulci are the grooves in the brain
- Gyri are the ridges or bumps on the brain

40. What do Michael J. Fox and Muhammad Ali have in common?

- Both have Parkinson’s Disease
- Disease is caused by genetic and environmental factors
- Dopamine neurons die off.
- Lack of dopamine causes many symptoms such as…
  - Slow movement
  - Muscular rigidity
  - Tremors

41. What are the primary motor cortex and the primary somatosensory cortex? What structure separates them?

- Primary motor cortex – sends voluntary movement commands from the cortex to the spine (corticospinal tract)
- Somatosensory cortex – receives tactile sensory information from the skin
- Both have a body map called a homunculus (“little man”)
- The central sulcus separates them
42. What is hemisphere dominance?

- In 90% of population...
  - Left hemisphere is dominant for reading, writing, speaking, analytical thinking.
  - Right hemisphere is dominant for visual experience (art), musical understanding, emotion, intuitive thinking.

43. What is epilepsy? What are some treatments?

- The abnormal, random firing of groups of neurons.
- Can cause...
  - Strange sensations, emotions, behavior.
  - Convulsions and muscle spasms.
  - Loss of consciousness.
  - Seizures.
- Treatments include...
  - Antiepileptic drugs.
  - Vagus nerve stimulation.
  - Surgical removal of epileptic centers.
  - Cutting the corpus callosum.

44. What is autism? What is an Autistic Savant?

- A wide spectrum of disorders.
- Symptoms include...
  - Impaired communication skills.
  - Lack of social skills.
  - Repetitive behaviors.
- About 10% of those with autism are Autistic Savants.
  - They have an extraordinary ability in memory, calculations, art, or music.
  - Ex. Rainman.

45. What is Capgras syndrome?

- Sufferers are convinced that their loved ones have been replaced by imitators or aliens.
- Occurs because of a neural disconnection between facial recognition centers and emotional centers in the brain.
  - Limbic system and visual cortex are disconnected.
- The person looks familiar but that warm feeling that normally occurs when you see them is gone.
46. Do some people taste colors or see smells?
- Yes
- Synesthesia is a disorder where sensory neurons get crossed, so patients' hearing, seeing, smelling, tasting, touching senses are cross wired.

47. What does “brain plasticity” mean?
- The brain has the ability to change and adapt to new environments.
- Neurons actually mold (form new connections and break off old ones) to new circumstances.
- Ex. Learning new motor skills, musical skills.

48. What is phantom limb?
- Painful or non-painful sensations coming from an amputated limb
- Occurs in 70-80% of amputees
- Caused by sensory cortex reorganization (brain plasticity)
- Neurons in the area devoted to sensing the limb form new connections while maintaining some of the old ones causing cross wiring.
- Ex. Touching an area on the face may cause sensation in the amputated arm.

49. What is a conditioned stimulus?
- Previously neutral stimulus that is repeatedly paired with an unconditioned stimulus and after time elicits a conditioned response.
- Ex. Pavlov's dog $\rightarrow$ bell paired with food and after time bell elicits salivation.

50. What is an EEG?
- Electroencephalogram
- Measures brain activity
51. Why do we need to sleep? What are the five stages of sleep?

- To recover from the day’s activity physically (repair muscles) and mentally (learning and memory)
- **Stage 1** – light sleep, awakened easily, sudden muscle jolts
- **Stage 2** – muscle movements stop, 50% of sleep time
- **Stage 3** – transition to deep sleep
- **Stage 4** – deep sleep, very groggy if awakened here, bedwetting, night terrors, sleepwalking occur here
- **REM** – Rapid Eye Movement, visual dreams, EEG looks the same as waking, 20% of sleep time

52. How long is a complete sleep cycle in the average human? How long do we need to sleep?

- 90 mins
- Depends on age

53. Why do we dream?

- Most scientists think REM sleep helps learning and memory
- Dreams may be due to the cerebral cortex’s attempt to make sense of random signals it receives from the pons and thalamus

54. Which two mental disorders does Hollywood always get mixed up?

- Schizophrenia and Multiple personality disorder (MPD)
- **Schizophrenia**
  - may be delusional, have hallucinations, confused thinking
  - Apathetic, emotionally unresponsive
- **Multiple personality disorder (Dissociative identity disorder)**
  - Two or more identities that take over the person’s behavior
  - More likely than any other disorder to end in suicide
  - Sometimes set on by extreme emotional or physical stress

55. What is a cerebral aneurysm? Lack of oxygen to a tissue is called? Death of that tissue from the lack of oxygen is called?

- Bulging, or ballooning out of part of the wall of a vein or artery in the brain
- Causes sudden severe headache, nausea, vomiting, vision loss, loss of consciousness
- Emergency treatment to prevent or stop any bleeding
- Ischemia and necrosis may occur and cause loss of function