

Huntley Science Olympiad Invitational
February 4, 2017

Anatomy and Physiology Event

Nervous/Endocrine Systems & Sense Organs

School _____ Team Number _____

Students Names _____

Time: 50 Minutes

What you may have out:

- ONE 8.5 x 11" two-sided page of information
- TWO non-programmable, non-graphing calculators

Final Score _____

Nervous System

- Multiple sclerosis results from an autoimmune disease that primarily involves
 - destruction of the hippocampus.
 - destruction of the myelin sheath.
 - destruction of regions of the motor cortex.
 - deterioration of parts of the spinal cord.
- Which of the following statements about resting potential is *true*?
 - A resting membrane allows much more sodium than potassium to diffuse across it.
 - The concentration of sodium is much higher inside the cell than outside.
 - The resting potential exists because of differences in glucose concentration inside and outside the cell.
 - The sodium-potassium pump contributes to the resting membrane potential.
- Once an action potential is triggered, there is a
 - reversal of the membrane polarity, with the interior of the cell becoming positively charged.
 - reversal of the membrane polarity, with the interior of the cell becoming negatively charged.
 - sudden rush of potassium into the neuron.
 - sudden impermeability of the membrane to the transport of ions.
- Once the threshold potential is reached,
 - K⁺ channels open.
 - Na⁺ channels close.
 - an action potential is inevitable.
 - the interior of the cell becomes negative with respect to the outside.
- During transmission across a typical chemical synapse,
 - neurotransmitter molecules are stored in the synaptic cleft.
 - action potentials trigger chemical changes that make the synaptic vesicles fuse with each other.
 - vesicles containing neurotransmitters diffuse to the receiving cell's plasma membrane.
 - neurotransmitter molecules bind to receptors in the receiving cell's plasma membrane.
- The signal that crosses a synapse is stopped when
 - a second action potential traveling down the signaling cell "sounds a retreat," and the neurotransmitters return to the signaling cell.
 - the responding cell runs out of sodium and is no longer able to respond to the stimulus.
 - the responding cell runs out of potassium and is no longer able to respond to the stimulus.
 - the neurotransmitter is enzymatically broken down or transported back to the signaling cell.
- Neurotransmitters that open Na⁺ channels and trigger action potentials in receiving cells are called
 - inhibitory.
 - cross-linked.
 - excitatory.
 - obligatory.
- Parkinson's disease is associated with a deficiency in
 - dopamine.
 - serotonin.
 - acetylcholine.
 - endorphins.

9. Which of the following statements regarding the brain is *true*?

- A) Ventricles in the brain are filled with interstitial fluid.
- B) The blood-brain barrier helps to maintain a stable chemical environment for the brain.
- C) Layers of connective tissue, called epithelium, surround and protect the brain and spinal cord.
- D) White matter is mainly dendrites.

10. When you are very nervous, perhaps before you must speak in front of your college class, you notice that your mouth is dry and your heart is racing. This is most likely due to stimulation by the

- A) enteric division of your autonomic nervous system.
- B) sympathetic division of your autonomic nervous system.
- C) parasympathetic division of your autonomic nervous system.
- D) motor division of your parasympathetic nervous system.

11. A physician friend of yours is telling you about a patient with a head injury who suddenly stopped breathing. Your friend explains that the bony rim was pressing against the breathing center. You guess that the "bony rim" (whatever that is) must have been exerting pressure in the region of the

- A) basal ganglia and hippocampus.
- B) cerebellum and cerebrum.
- C) thalamus and hypothalamus.
- D) medulla oblongata and pons.

12. The human cerebral cortex accounts for what percentage of the total mass of the brain?

- A) 20%
- B) 40%
- C) 60%
- D) 80%

13. When the human brain's normal electrical activity is suddenly altered, a seizure can result. Seizures cause several behavioral and physical complications such as sudden mood changes, muscle spasms, or uncontrollable body shaking. Seizure impulses often start in one hemisphere of the brain and travel to the other. Which of the following surgical treatments would reduce the severity of seizures?

- A) severing the suprachiasmatic nucleus so that the patient's biological clock has altered circadian rhythms
- B) severing the corpus callosum so that the brain has diminished ability to send messages between the two cerebral hemispheres
- C) severing the parietal lobe so that speech capabilities are diminished
- D) stimulating the cerebrum to allow the retention of short-term memory capabilities

14. You recently sprayed your apartment with insecticide to remove an infestation of cockroaches. In your kitchen, you noticed some roaches lying on their backs twitching furiously before they died. This aroused your curiosity, so you decided to investigate exactly how the insecticide works on the nervous system. In your research, you discover that the insecticide you used contains a permanent acetylcholinesterase inhibitor.

Acetylcholine is a neurotransmitter that stimulates skeletal muscle to contract. Acetylcholinesterase removes acetylcholine from the synapse after the signal is received. Exposure to high pesticide concentrations has a similar effect on humans, which can also be caused by exposure to the nerve gas Sarin and other chemical agents. Why did the insecticide cause uncontrollable twitching in the roaches?

- A) Acetylcholine was released, but the insecticide prevented it from diffusing across the synapse.
- B) Acetylcholine was released, but the insecticide prevented it from binding to the receptor sites of the postsynaptic neurons.
- C) The insecticide caused continuous stimulation of the muscles.
- D) The insecticide prevented acetylcholinesterase from being removed from the synapse.

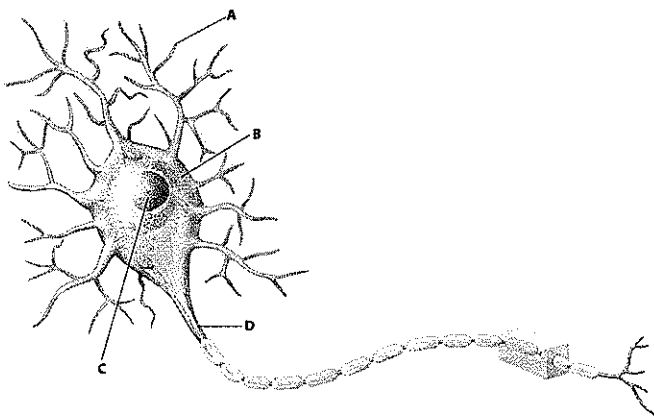
15. Action potentials relay different intensities of information due to the

- A) amplitude of action potentials relative to the strength of the stimulus.
- B) frequency of action potentials relative to the strength of the stimulus.
- C) duration of action potentials relative to the strength of the stimulus.
- D) shape of action potentials relative to the strength of the stimulus.

16. The effect of a sending neuron on a receiving neuron is typically greater when _____ neurotransmitters bind to the receiving neuron and the synapse is _____ the base of the receiving cell's axon.

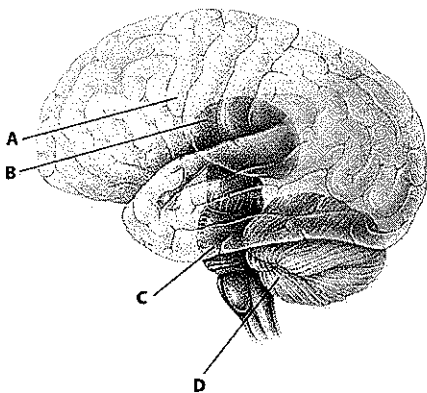
- A) more; close to
- B) fewer; close to
- C) more; far from
- D) fewer; far from

17. Which part of this diagram of a neuron depicts the axon?



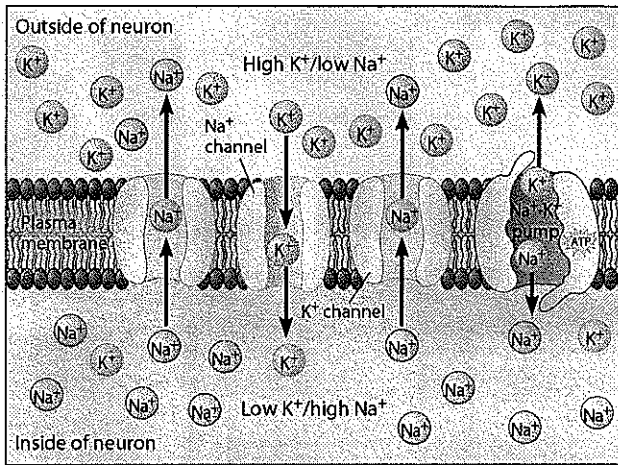
- A) part A
- B) part B
- C) part C
- D) part D

18. Which part of this diagram of the human brain depicts the thalamus?

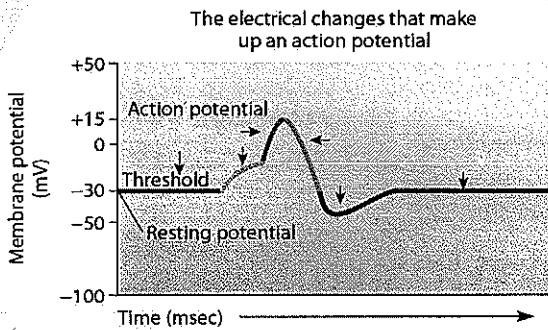


- A) part A
- B) part B
- C) part C
- D) part D

19. Describe what is happening in the following figure.



- A) Resting potential is not restored.
- B) The neuron is experiencing resting potential.
- C) There are fewer positive charges on the inside of the neuron, so it is less negative.
- D) The neuron is working to restore the resting potential of -70 mV.

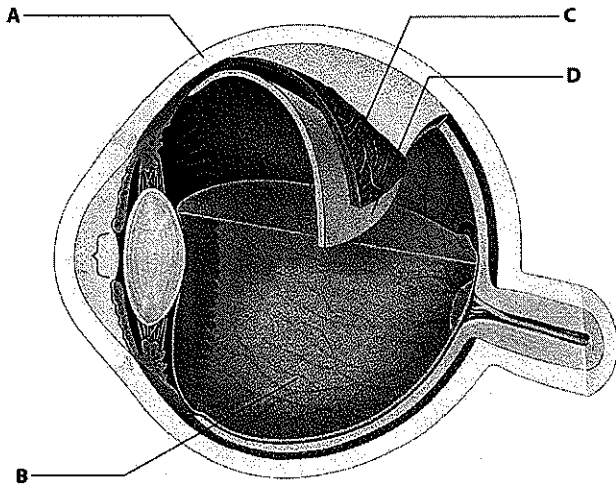


20. Why do the two parts of the graph marked with arrows look identical?

- A) They represent the depolarization and repolarization of the membrane.
- B) They represent the minimum change in the membrane's voltage that must occur to generate and complete the action potential.
- C) They represent the stimulus that begins and ends the action potential.
- D) They represent the resting potential before and after the action potential has occurred.

Sense Organs

21. Which part of this figure depicting an eye is the retina?



- A) part A
- B) part B
- C) part C
- D) part D
- E) none of the above

22. Which part of the figure above is the sclera?

- A) part A
- B) part B
- C) part C
- D) part D
- E) none of the above

23. Which part of the figure above is the choroid?

- A) part A
- B) part B
- C) part C
- D) part D
- E) none of the above

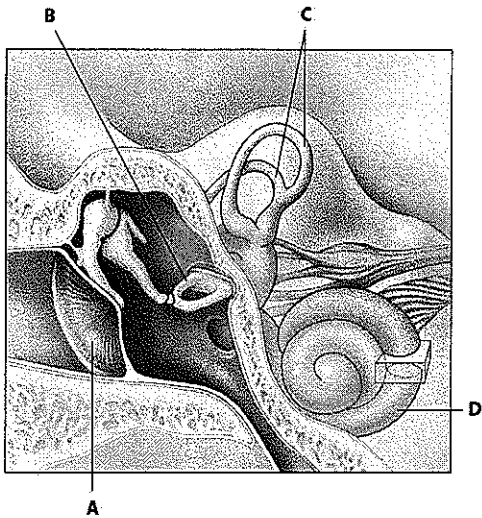
24. Which part of the figure above is the vitreous humor?

- A) part A
- B) part B
- C) part C
- D) part D
- E) none of the above

25. Which part of the figure above is the aqueous humor?

- A) part A
- B) part B
- C) part C
- D) part D
- E) none of the above

26. Which part of this figure depicting an ear is the cochlea?



- A) part A
 - B) part B
 - C) part C
 - D) part D
 - E) none of the above
27. Which part of the figure above is the tympanic membrane?
- A) part A
 - B) part B
 - C) part C
 - D) part D
 - E) none of the above
28. Which part of the figure above is the semicircular canal?
- A) part A
 - B) part B
 - C) part C
 - D) part D
 - E) none of the above
29. Which part of the figure above is the anvil?
- A) part A
 - B) part B
 - C) part C
 - D) part D
 - E) none of the above
30. Which part of the figure above is the stirrup?
- A) part A
 - B) part B
 - C) part C
 - D) part D
 - E) none of the above

31. Which part of the figure on the previous page is responsible for balance?

- A) part A
- B) part B
- C) part C
- D) part D
- E) none of the above

32. Which part(s) of the figure on the previous page contain mechanoreceptors? Circle all that apply.

- A) part A
- B) part B
- C) part C
- D) part D
- E) none of the above

33. Mechanoreceptors (touch and pressure) are not evenly spaced on your body. What is an advantage of having mechanoreceptors located farther apart?

- A) allows often used parts of the human body to feel pressure more severely than areas where mechanoreceptors are closer together
- B) allows often used parts of the human body to feel pressure less severely than areas where mechanoreceptors are closer together
- C) allows for greater dendrite regeneration after the body has experienced excessive pressure
- D) allows for a thicker epidermis than in areas where mechanoreceptors are closer together

34. Integration of sensory stimuli occurs

- A) in highly specialized receptors such as the organ of Corti.
- B) in all receptors.
- C) in the brain.
- D) in the central and peripheral nervous systems.

35. A molecule that is detected by our sense of smell first binds to

- A) specific receptor proteins on the cilia of receptor cells located in the epithelium of the upper nasal cavity.
- B) hairs that extend beyond the mucous layer and line the upper and lower nasal cavities.
- C) special mechanoreceptor cells located in the epithelium of the lower nasal cavity.
- D) special receptor proteins located at the surface of thermoreceptor cells lining the upper nasal cavity.

36. You are driving at night and decide to pass a slow-moving car. As you look at the car as you pass, it dawns on you that although you can see the car, you can't tell what color it is. This is due to

- A) the poor ability of cones to function in low light.
- B) the poor ability of rods to function in low light.
- C) a reduced ability to focus in low light situations.
- D) the constriction of your pupil in low light situations, which reduces color vision.

37. Where does the information from the light receptors undergo its first level of neural processing?

- A) in the retina
- B) in the optic nerve
- C) in the primary visual cortex
- D) in the hippocampus

38. A person whose eyeball is shorter than normal suffers from
- A) hyperopia.
 - B) myopia.
 - C) astigmatism.
 - D) presbyopia.
39. Which of the following correctly lists the order of structures through which light must pass on its way to the retina of the human eye?
- A) pupil, cornea, aqueous humor, lens
 - B) lens, aqueous humor, pupil, cornea
 - C) cornea, aqueous humor, pupil, lens
 - D) cornea, pupil, aqueous humor, lens
40. Which of the following lists structures involved *only* in the sense of hearing?
- A) middle ear bones, semicircular canals, basilar membrane
 - B) eardrum, utricle, organ of Corti
 - C) oval window, cochlea, aqueous humor
 - D) oval window, basilar membrane, organ of Corti

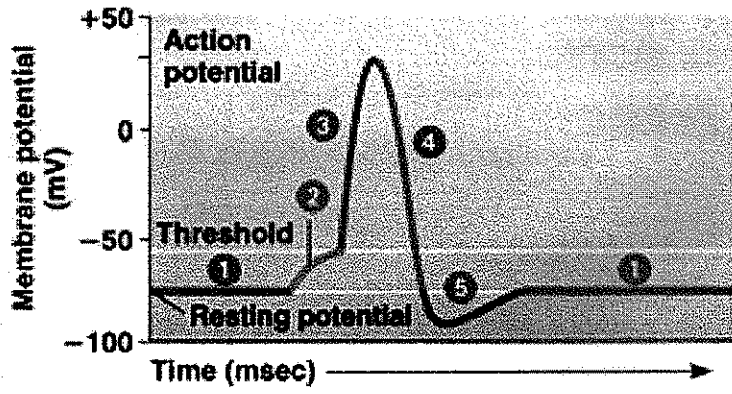
Endocrine System

41. Why must some hormones bind to a membrane receptor on a target cell's surface in order to activate it?
- A) for activation by ATP
 - B) because they are not water-soluble
 - C) because they cannot cross cell membranes
 - D) to stimulate endocytosis to internalize the hormone
42. The result of binding a signal molecule to its receptor is
- A) production of a protein by the target cell, followed by death.
 - B) cell division.
 - C) signal transduction.
 - D) partitioning of the nucleus within the target cell.
43. A target cell that is affected by a particular steroid hormone would be expected to have
- A) an intracellular receptor protein that binds the hormone.
 - B) a cell-surface receptor protein that binds the hormone.
 - C) enzymes that are activated or inactivated by the intracellular hormone-receptor complex.
 - D) enzymes that are activated or inactivated by the hormone's second messenger.
44. Which of the following statements about steroid hormones is *true*?
- A) Steroid hormones cause the production of cAMP.
 - B) Steroid hormones are polar molecules that cannot pass through the cell membrane.
 - C) Steroid hormones bind to receptors in the plasma membrane.
 - D) Steroid hormones bind to specific receptor proteins, and the complex acts as a gene activator.
45. Which of the following statements regarding endocrine glands is *true*?
- A) Some endocrine glands, like the pituitary, have other endocrine glands as their targets.
 - B) The sex organs and the thyroid gland produce steroid hormones.
 - C) The pancreas has only nonendocrine functions.
 - D) Most of the endocrine glands produce steroid hormones.

46. Which of the following endocrine glands synthesizes melatonin?
A) pineal
B) adrenal cortex
C) thyroid
D) parathyroid
47. Which of the following is an endocrine gland that raises blood calcium levels?
A) parathyroid
B) thyroid gland
C) pituitary gland
D) testes
48. Which of the following statements about glands and hormones is *true*?
A) The anterior pituitary produces multiple hormones that affect activity of other endocrine glands and cells of the body.
B) The posterior pituitary produces melatonin, which helps regulate biological rhythms.
C) The pineal gland is the master control center of the endocrine system.
D) The hypothalamus is an endocrine gland responsible for producing the hormone calcitonin.
49. Which of the following hormones is released by neurosecretory cells extending from the hypothalamus?
A) estrogen
B) growth hormone
C) oxytocin
D) calcitonin
50. TRH is a type of _____ hormone secreted by the _____.
A) steroid; thyroid gland
B) releasing; hypothalamus
C) peptide; thymus
D) releasing; anterior pituitary
51. Which gland requires the element iodine to produce its hormones?
A) adrenal medulla
B) thyroid
C) pineal
D) ovary
52. An excess of T₃ and T₄ in the blood is hyperthyroidism, which in its most common form is called
A) goiter.
B) sterility.
C) Graves' disease.
D) botulism.
53. What is the metabolic abnormality that underlies the characteristic symptoms of diabetes mellitus?
A) a failure of the kidney tubules to reabsorb enough glucose from the urine
B) an inability of the body's cells to switch from glucose metabolism to fat metabolism between meals
C) an inability of the body's cells to retain glucose they have absorbed from the blood
D) an inability of the body's cells to absorb enough glucose from the blood

54. Which of the following is a function of epinephrine?
- A) release of glucose from the liver
 - B) decreased heart rate
 - C) decreased metabolic rate
 - D) increased digestive activities
55. Which of the following act(s) mainly to regulate salt and water balance?
- A) mineralocorticoids
 - B) glucocorticoids
 - C) androgens
 - D) oxytocin
56. High levels of which of the following hormones can suppress the body's immune system?
- A) glucagon
 - B) mineralocorticoids
 - C) glucocorticoids
 - D) antidiuretic hormone
57. Which of the following glands secretes hormones that enable the body to respond to stress?
- A) pancreas
 - B) adrenal
 - C) pineal
 - D) parathyroid
58. Which of the following is a nonsteroid hormone?
- A) glucagon
 - B) a glucocorticoid
 - C) estrogen
 - D) androgen
59. Which of the following pairs of hormones have opposite effects?
- A) testosterone and melatonin
 - B) progesterone and insulin
 - C) parathyroid hormone and calcitonin
 - D) oxytocin and prolactin
60. Which of the following hormones affects the greatest variety of cell types?
- A) parathyroid hormone
 - B) melatonin
 - C) growth hormone
 - D) calcitonin

Tie breakers on next page...



Explain, in detail, what is happening in each numbered part of the graph.