Anatomy and Physiology EXAM

2017 Golden Gate Science Olympiad Invitational

Time limit: 50 minutes

Names: _____

Team Number: _____

School: _____

You may write on this exam

**Tiebreakers are indicated by asterisks on the exam and answer sheet.

(Point values) are indicated on the exam.

Questions 56-74 are located at a STATION. Each team will be called up to spend 5 minutes at this station.

Endocrine System

Questions 1-15. (1 pt each) The following answer choices are used for the first 15 questions. Write the answer choice that is best described for each question. Answers may be used once, more than once, or not at all.

Adrenaline (epinephrine) Erythropoeitin (EPO) Melatonin Adrenocorticotropic hormone (ACTH) Estrogens Noradrenaline (norepinephrine) Aldosterone Follicle-stimulating hormone (FSH) Oxytocin Androgens (e.g. testosterone) Gastrin Parathyroid hormone (PTH) Angiotensinogen Ghrelin Progesterone Antidiuretic hormone (ADH/vasopressin) Glucagon Prolactin (PRL) Atrial-natriuetic hormone (ANP) Growth hormone (GH) Relaxin Calcitonin GH-releasing hormone (GHRH) Secretin Calcitriol Human chorionic gonadotropin Somatostatin Cholecystokinin Insulin Thrombopoietin Corticotropin-releasing hormone (CRH) Leptin Thyroid-stimulating hormone (TSH) Cortisol Luteinizing hormone (LH) Thyroxine (T4)

1. Promotes growth of bones and cartilage by triggering insulin-like growth factor (IGF) release from the liver.
2. Released from the posterior pituitary when cells that detect the osmolarity of blood shrink.
3. Secreted by beta cells of the islets of Langerhans.
4. Activates the conversion of vitamin D to its active form.
5. Secreted from the anterior pituitary and increases spermatogenesis by activating the seminiferous tubules.
6. In the event of pregnancy, this hormone can be detected in the mother's urine.
7. Inhibits the release of growth hormone (GH) by antagonizing GH-releasing hormone (GHRH).
8. Secreted from the heart, this hormone acts to lower blood volume and pressure.
9. A hormone derived from the amino acid tryptophan.
10. Promotes milk production and secretion.
11. Secreted from the adrenal cortex, this hormone raises blood glucose level.
12. Acting in the duodenum of the small intestine, this hormone promotes release of bile from the liver and digestive enzymes from the pancreas.

13. This hormone is released by adipose tissue and acts to decrease hunger.

14. Derived from the neurotransmitter serotonin, this hormone helps regulate circadian rhythms.

15. A glucocorticoid released in response to stress.

Questions 16-18 relate to regulation of blood calcium levels.

16. (2) Which two hormones act antagonistically to regulate blood calcium levels?

17. (2) Describe two mechanisms by which one of these hormones acts in the kidney to raise blood calcium level (one sentence per mechanism).

18. (1) Regulation of blood calcium levels is critical for survival. For example, low blood calcium can lead to convulsive skeletal muscle contractions. Name one other cellular process that depends on normal calcium concentrations.

Questions 19-27. (1 pt each) For each of the following, indicate whether the hormone is

A. Glycoprotein B. Protein C. Peptide D. Amine E. Steroid

19. Testosterone

20.

21. Aldosterone

22. Growth hormone

23. Thymosin

24.

25. Insulin

26. Oxytocin

27.

28. (1) All steroid hormones are derived from which molecule?

29. (2) Why are steroid hormones recognized by intracellular receptors, whereas protein, peptide, and amine hormones are recognized extracellularly? Explain in 1-2 sentences.

Question 30 uses the following information and figure.

To manipulate gene expression, molecular biologists often use the Cre-LoxP system to delete sections of the genome. In this system, if a cell expresses the Cre protein, the Cre protein will always enter the nucleus and act on the DNA.

For better control, researchers can attach the Cre protein to the estrogen receptor (ER), creating the fusion protein Cre-ER. Cre-ER remains in the cytoplasm until the researchers add tamoxifen to the cell, at which point Cre-ER enters the nucleus and acts on the DNA (see figure). Because Cre-ER cannot enter the nucleus until tamoxifen is added, the gene will only be deleted after the addition of tamoxifen, giving researchers temporal control over the system.

30. (2**) Based on the given information, which of the following must be true about tamoxifen?

A. Tamoxifen is a hormone that naturally occurs in the human body. B. Tamoxifen is a steroid hormone with a structure of four fused carbon rings. C. Tamoxifen is a hydrophobic molecule. D. Tamoxifen can enter the nucleus and bind to DNA, causing deletions in the genome. E. Tamoxifen binds to the estrogen receptor less strongly than estrogen binds to the

estrogen receptor.

Questions 31-34. (2 pt each) For each disorder of the endocrine system, indicate which statements are true by writing the corresponding letter or letters on the answer sheet. Each disorder may have one or more answers.

A. This disorder may be caused by an autoimmune response. B. This disorder often involves the hormone insulin. C. This disorder may be caused by hyperthyroidism. D. This disorder is associated with iodine deficiency.

31. Type I diabetes mellitus

32. Type II diabetes mellitus

33. Grave's disease

34. Goiter

35. (1) Which of the following is NOT a symptom of hypoglycemia?

A. Polyuria B. Dilated pupils C. Heart palpitations D. Feeling numb E. Difficulty speaking

36. (3**) Patients with chronic diabetes mellitus can develop complications including damage to the

heart, kidney, nerves, and retina. One possible mechanism explaining this wide range of complications is microangiopathy, or damage to small blood vessels. Why might blood vessels in particular be damaged in diabetes mellitus (1-2 sentences)?

Questions 37 -39 (1 pt each). For each of the following hormones, indicate whether a patient with Grave's disease would have increased, decreased, or normal levels in the blood.

A. Increased B. Decreased C. Normal

37. T

3

38. T

4

39. Thyroid Stimulating Hormone, TSH

40. Thyrotropin Releasing Hormone, TRH

Questions 41-50. (1 pt each) For each of the following hormones, name the endocrine gland the hormone is released from. Specify posterior or anterior pituitary where appropriate.

41. Melatonin

42. Parathyroid hormone

43. Adrenocorticotropic hormone

44. Antidiuretic hormone

45. Luteinizing hormone

46. Glucagon

47. Gonadotropin-releasing hormone

48. Follicle-stimulating hormone

49. Norepinephrine

50. Corticotropin-releasing hormone

Questions 51-55. (1 pt each) Use the following diagram and answer the statements by indicating the letter of the most appropriate structure.

51. This letter represents the anterior pituitary.

52. This letter represents the hypothalamus.

53. These neurons secrete hormones such as

oxytocin.

54. These neurons secrete hormones such as

Gonadotropin-releasing hormone

55. This is also known as the infundibulum

Nervous System: STATION (4 minutes)

Whole Brain Anatomy: Questions 56-63 (1 pt each) For each statement, write the letter on the tag of the corresponding structure on the whole human brain specimen.

56. This area receives somatosensory input from the thalamus.

57. Electrical stimulation of part of this area's "homunculus" will elicit movement in the corresponding body structure.

58. This structure includes the pia mater, arachnoid space, and the dura mater.

59. Damage to this region resulted in a drastic change in personality for Phineas Gage.

60. This region contains cells that are selective for visual stimuli moving in a particular direction.

61. This region contains the primary auditory cortex.

62. This region contains "association cortices", including multi-sensory integration areas.

63. This structure helps with fine motor control of actions including pointing.

Nervous System: STATION (4 minutes)

Sagittal section: Questions 64-69. (1 pt each) For each statement, write the letter on the tag of the corresponding structure on the sagittal section specimen.

64. Patients with epilepsy sometimes have axons in this structure severed, leading to "split brain" personalities.

65. This region is considered the "sensory relay" station because it receives information from most sensory organs before sending that information to the cortex.

66. Some neurons in this region produce hormones that activate the anterior pituitary gland.

67. This structure contains the cranial nerve nuclei of cranial nerves V through VIII

68. This cortical structure is considered part of the limbic system.

69. This structure contains climbing fibers and Purkinje cells.

Coronal section: Questions 70-74. (1 pt each) For each statement, write the letter on the tag of the corresponding structure on the coronal section specimen.

70. Cells in this structure manufacture cerebrospinal fluid.

71. Bilateral removal of this structure led to severe memory impairments in patient H.M.

72. This structure contains axons that cross between the cerebral hemispheres.

73. This area is known as the "insular cortex".

74. This subcortical structure forms part of the basal ganglia.

Questions 75-80. For each statement, select the letter corresponding to the appropriate region of the neuron schematic.

75. **This region is likely to contain the highest concentration of AMPA and NMDA receptors.

76. GABA would be found concentrated vesicles here.

77. The lowest threshold for initiating an action potential is in this region.

78. This region is known as a “Node of Ranvier”.

79. This region synthesizes rRNA for making ribosomes.

80. This region might make contact with a postsynaptic dendritic spine.

Questions 81-88. For each question, select the most appropriate type of nervous system cell type.

A. Astrocyte B. Oligodendrocyte C. Microglia D. Schwann Cell E. Ependymal cell F. Neuron

81. This type of cell forms the myelin sheath in the central nervous system.

82. This type of cell first degenerates in multiple sclerosis.

83. This type of cell is involved in the production of cerebrospinal fluid.

84. The endfeet of this type of cell help form the blood brain barrier.

85. **This type of cell is derived from the yolk sac.

86. This type of cell is shown here in an image taken from the retina:

87. When activated, this type of cell expresses many similar proteins as macrophages.

88. This type of cell is found in both the central nervous system and the peripheral nervous system.

Questions 89-97. (1 pt each) Consult the figure below, which plots membrane potential over time during the course of an action potential.

89. (1) The y-axis of this graph is unlabeled. At what approximate value (in mV) is a typical neuron's resting potential?

90. (1) At what approximate value (in mV) does the peak of this graph occur in a typical neuron?

91. (1) The x-axis of this graph is unlabeled. About how long (in ms) does it take for an action potential to occur?

For the following questions, indicate which phase of the action potential (A, B, C, or D) is best described by the statement.

A

B

C

D

92. The net flow of ions consists of positive ions flowing inward.

93. The net flow of ions are consists of positive ions flowing outward.

94. Voltage-gated potassium channels have the highest conductance

95. **Voltage-gated sodium channels are inactivated (not closed)

96. A positive feedback loop is occurring

97. The membrane potential is primarily determined by non-voltage-gated potassium channels.

98. We usually think of action potentials as propagating in one direction, from the cell body to the axon terminals. Which of the following is most responsible for this unidirectional propagation?

A. Consumption of ATP B. Inactivation of sodium channels C. Opening of potassium channels D. Inactivation of the sodium-potassium ATP-ase pump E. Opening of calcium channels

99. (2) When can an action potential in an axon travel “backwards”, toward the cell body?

100. (2) Can an action potential in an axon ever propagate bidirectionally, both toward the

cell body and away from the cell body? Explain in 1-2 sentences.

101. (2) In (1800), the pioneer neurobiologists Golgi and Santiago Ramon y Cajal disagreed

over whether neurons primarily communicated via electrical or chemical synapses. We now know that chemical synapses are the most widely used, although electrical synapses also exist. What is the structural difference between a chemical and an electrical synapse?

102. (2) What is one benefit to a neuron using chemical synapses instead of electrical

synapses?

103. (2) What is one benefit to a neuron using electrical synapses instead of chemical

synapses?

104. (2) Put the following presynaptic events during neurotransmitter release in order:

I. Synaptic vesicles fuse with the presynaptic membrane II. Voltage-gated calcium channels open III. An action potential reaches an axon bouton IV. Calcium concentration inside the presynaptic terminal increases

105. (1) Which of the following is NOT a neurotransmitter?

A. Dopamine B. Glutamate C. Glycine D. Bicuculline E. Substance P

106. (1) When GABA binds to the GABA receptor, which ions flow through the receptor?

A. Sodium ions B. Potassium ions C. Calcium ions D. Chloride ions E. Magnesium ions

107. (1) Which of the following is considered an “excitatory” neurotransmitter, meaning that

flow of ions through its receptor will depolarize a neuron in resting state?

A. Glutamate B. Dopamine C. Serotonin D. Endorphins E. Epinephrine

Questions 108-112. (1 pt each) Refer to the following diagram.

108. Which letter labels the dorsal horn?

109. Which of the following letters labels white matter?

1. A 2. H 3. B 4. D

110. Which letter labels a dorsal root ganglion?

111. Which letter points to the axons of motor neurons leaving the spinal cord?

112. Which letter contains cerebrospinal fluid?

Questions 113-114 refer to the following diagram. (1 pt each)

A

B

C

D

113. Which letter corresponds to alpha waves?

114. At what Hz do delta waves oscillate?

115. (1) In which stage of sleep do sleep spindles occur?

A. Stage 1 B. Stage 2 C. Stage 3 D. Stage 4 E. REM sleep

116. (1) Which of the following is true about REM sleep?

A. Neurons stop firing during sleep, except during REM sleep. B. During REM sleep, the brain uses the same or more oxygen and glucose than in a waking

state. C. REM sleep is the most restorative part of sleep for restoring subjective feelings of

energy and mood. D. REM sleep is characterized by low levels of acetylcholine and high levels of serotonin. E. During REM sleep, the muscles are paralyzed in a tetanic contraction to prevent acting

out of dreams.

117. (1) Which of the following occurs after activation of the autonomic nervous system?

A. Pupils constrict B. Salivary glands increase activity C. Heart rate slows D. Bronchi of the lungs dilate E. Stimulation of gallbladder

118. (1) Which neurotransmitter do the preganglionic axons of the autonomic nervous

system use?

119. (2) What is one major anatomical difference between sympathetic and parasympathetic

ganglia of the autonomic nervous system?

Questions 120-122. (1 pt each). Use the following answer choices.

A. Central nervous system B. Somatic nervous system C. Sympathetic nervous system D. Parasympathetic nervous system E. Enteric nervous system

120. Motor neurons of this system control peristalsis

121. Postganglionic neurons of this system use epinephrine and norepinephrine as

neurotransmitters

122. This system stimulates contraction of skeletal muscles under voluntary control.

Questions 123-130. (1 pt each). For each of the following drugs, indicate

1) to which receptor the drug binds to have its main mechanism of action (select from A-G)

A. Cannabinoid receptors B. Muscarinic acetylcholine receptors C. Nicotinic acetylcholine receptors D. GABA receptors E. Dopamine receptors F. Adenosine receptor G. AMPA receptors

2) what the drug's effect on the receptor is, (select from H-J).

H. Agonist I. Antagonist J. Neither agonist nor antagonist

Drug Receptor (A-G) Effect on receptor (H-J)

Alcohol 123. 124.

Caffeine 125. 126.

Nicotine 127. 128.

THC 129. 130.

Sense Organs

Questions 131-135. (1 pt each) For each sense, indicate which types of sensory receptors are used.

A. Mechanoreceptors B. Thermoreceptors C. Chemoreceptors D. Pain receptors E. Photoreceptors

131. Vision

132. Hearing

133. Smell

134. Taste

135. Light touch

136. (1) Which of the following is considered a “general sense”?

A. Hearing B. Vestibular system C. Proprioception D. Smell E. Taste

Questions 137-139. (1 pt each) The graph below plots the response of a hair receptor, a Pacinian corpuscle, and a muscle spindle in response to a continuous touch stimulation starting at 0 seconds.

137. Receptor Type 1 is most likely a:

A. Hair receptor B. Pacinian corpuscle C. Muscle spindle

138. Receptor Type 2 is most likely a:

A. Hair receptor B. Pacinian corpuscle C. Muscle spindle

139. Receptor Type 3 is most likely a:

A. Hair receptor B. Pacinian corpuscle C. Muscle spindle

140. (2) Which TWO of the following are proprioceptors?

A. Muscle spindle B. Ruffini's endings C. Meissner's corpuscles D. Hair follicles E. Golgi tendon organ

141. (1) Which of the following receptors acts as a thermosensor?

A. Ruffini's endings B. TRP channels C. Meissner's corpuscles D. Piezo channels E. Merkel Cells

1

2

3

142. (6**) Draw a simple neural circuit for the knee-jerk (patellar) reflex. Include and label the location of the sensory receptors, neuron cell bodies, and synapses.

Questions 143 – 148. (1 pt each) For each statement, write the corresponding letter from the following diagram of a human eye.

143. In aquatic animals, this structure is harder than it is in humans, because the external and internal eye environments have similar refractive indices.

144. This structure contains the cell bodies of horizontal cells and bipolar cells.

145. This structure contains the pigment melanin to limit reflection of light within the eye.

146. In humans, light refracts the most when it enters this structure.

147. This structure contains axons of retinal ganglion cells.

148. This structure controls how much light enters the eye.

149. (1) At which of the following structures does the process of phototransduction occur?

A. Sclera B. Lens C. Vitreous humor D. Retina E. Optic nerve

150. (2**) Why, anatomically, do we have a “blind spot” in humans? (1-2 sentences).

151. (1) When red and green wavelengths of light are mixed, we see yellow. Which of the following best explains this phenomenon?

A. Human eyes have three cones: red, green, and blue cones. B. Yellow light activates red and green cones equally, and does not activate blue cones. C. Yellow light consists of both red and green wavelengths, but no blue wavelengths. D. Objects that are yellow reflect red and green wavelengths of light equally. E. Blue cones are inhibited by yellow light.

152. (1) Which of the following is true concerning rods and cones?

A. Loss of rods leads to legal blindness. B. Rods are responsible for color vision, while cones are responsible for detecting movement. C. The highest concentration of rods exists at the fovea. D. Rods can respond to the presence of just one photon of light, while cones cannot. E. Only rods use the pigment molecule retinal, which is derived from vitamin A.

153. (1) Which neurotransmitter do rods and cones release?

A. Glutamate B. GABA C. Dopamine D. Acetylcholine E. Cyclic GMP

154. (1**) Which of the following is NOT true about how a rod responds to the presence of light?

A. Absorption of light causes a change in configuration of the molecule rhodopsin. B. The signal caused by photons is greatly amplified through signal transduction pathways within the rod. C. In the presence of light, rods fire action potentials which signal to downstream bipolar neurons. D. The intracellular concentration of cyclic GMP decreases. E. Bipolar cells may be either depolarized or hyperpolarized by the neurotransmitter released by a rod, depending on the receptors the bipolar cell expresses.

155. (1) Which of the following is a mechanism for increasing visual acuity at the fovea?

A. The fovea contains a higher density of rods than anywhere else in the retina. B. Intrinsically photosensitive retinal ganglion cells (ipRGCs) at the fovea can directly detect

light. C. Photoreceptors at the fovea fire action potentials more rapidly than photoreceptors in

the periphery of the retina. D. At the fovea, fewer photoreceptors give input to a single retinal ganglion cell, whereas

in the peripheral retinal, many photoreceptors give input to a single retinal ganglion cell. E. The fovea is the densest area of all cell types in the retina, and has a dense network of

blood vessels to support these cells.

156. (2) What does it mean for rods to have a “dark current”?

Questions 157-160. (1 pt each) Refer to the following diagrams of the cochlea. Select the letter corresponding to the structure that most appropriately fits the statements.

157. This structure actively vibrates in response to sound, amplifying the signal.

158. This letter labels the organ of Corti

159. This letter labels the tectorial membrane

160. This structure vibrates differentially along its length in response to different frequencies

of sound.

161. (1) Which of the following correctly describes the basilar membrane?

A. The basilar membrane resonates at a high frequency at its base, where the membrane is the least stiff. B. The basilar membrane resonates at a high frequency at its base, where the membrane is wide and flat. C. The basilar membrane resonates at a low frequency at its base, where the membrane is the stiffest. D. The basilar membrane resonates at a high frequency at its tip, where the membrane is the least stiff. E. The basilar membrane resonates at a low frequency at its tip, where the membrane is wide and flat.

162. (4) What is a resonance frequency, and how does the concept of a resonance frequency contribute to the cochlea's ability to distinguish between frequencies of sound? (2 sentences).

Questions 163-165. Refer to the following figure showing a scanning electron microscopy (SEM) image of a hair cell.

163. (1) What is the name of the thin structures indicated by the arrow?

164. (1) When sound waves propagate to the inner ear, these structures move. Which of the following is true about this process?

A. Movement of endolymph within the cochlea prevents these structures from moving B. Forces on the tiplinks causes mechanically-gated sodium channels to open C. When the basilar membrane vibrates, sodium ions flow into inner hair cells D. Depolarization of inner hair cells causes an action potential in the hair cell E. Mechanically-gated ion channels only open if these structures are bent in one direction.

165. (1) Name one difference between these structures in the cochlea and these structures in the semicircular canals.

166. (1) Which of the following is true regarding ions in the cochlea?

A. The fluid bathing the apical surface of inner hair cells has a high concentration of potassium ions. B. The fluid bathing the basal surface of inner hair cells has a high concentration of potassium ions. C. When inner hair cells are stimulated, potassium ions flow out of the cell. D. When inner hair cells are stimulated, potassium ions flow into mechanically-gated ion channels connected to the top of the tip link. E. Inner hair cells are impermeable to calcium when they are not activated.

167. (1) Which of the following is FALSE regarding ribbon synapses formed by inner hair cells?

A. Ribbon synapses release glutamate onto neurons of the vestibulocochlear nerve (cranial nerve VIII). B. Inner hair cells synapse onto a single nerve fiber, whereas outer hair cells are innervated by many nerve fibers. C. The amount of neurotransmitter released by a ribbon synapse is graded, and depends on a receptor potential. D. Release of neurotransmitter from a ribbon synapse depends on intracellular calcium concentration. E. Neurotransmitters are constantly being released from a ribbon synapse, even when a hair cell is not activated.

168. (1) Which of the following structures is NOT located in the inner ear?

A. Utricle B. Semicircular canals C. Cochlear nucleus D. Outer hair cells E. Saccule

169. (1) What is the name of the membrane separating the middle ear from the inner ear, to which the stapes transmits movement?

170. (1) Which of the following best describes the receptors in the utricle, semicircular canals, and the saccule?

A. Nociceptors B. Mechanoreceptors C. Chemoreceptors D. Ligand-gated ion channels E. G-protein coupled receptors

Questions 171-174. (1 pt each) Refer to the diagram below.

171. Which number refers to the cochlea?

172. Which number points to the structure containing a cupula?

173. Which number points to the utricle?

174. Which number points to the structure that detects vertical acceleration?

175. (1) Which of the following is found in an otolith?

A. Magnesium carbonate B. Calcium sulfate C. Calcium carbonate D. Potassium sulfate E. Sodium carbonate

Questions 176-180. (1 pt each) Refer to the diagram below.

176. This structure contains olfactory glomeruli.

177. This letter points to the nasal cavity

178. This letter points to the nasopharynx

179. Axons of the olfactory receptor neurons pass through this structure.

180. This structure contains the axons of mitral and tufted cells.

181. (1) Olfactory receptors are members of which class of receptors?

A. Ligand-gated ion channels B. Mechanically-gated ion channels C. Metabotropic glutamate receptors D. G-protein coupled receptors E. TRP channels

182. (1) In which of the following are olfactory receptor neurons located?

A. Olfactory glomeruli B. Palate C. Olfactory epithelium D. Olfactory tract E. Olfactory cortex

G

B C A H

D

F

E

183. (1) At which of the following structures are olfactory inputs that share an olfactory

receptor type physically grouped together?

A. Olfactory epithelium B. Olfactory glomeruli C. Thalamus D. Piriform cortex E. Olfactory inputs are always dispersed in a seemingly random manner.

184. (1) Which of the following is NOT a target of the olfactory tract?

A. Amygdala B. Piriform cortex C. Entorhinal cortex D. Thalamic nucleus E. All of the above are targets of the olfactory tract

185. (3) Which three basic tastes are mediated by G-protein coupled receptors in taste buds?

Choose from:

A. Sweet B. Sour C. Salty D. Bitter E. Umami

186. (1) How many transmembrane domains do G-protein coupled receptors have?

187. (1) Which of the following is not true about G-protein signaling?

A. G proteins can couple a receptor to the opening of an ion channel B. G proteins transmit a signal from the cell surface to the nucleus C. G proteins are targets of many pharmaceutical drugs D. G proteins are turned “on” when they cleave GTP into GDP E. G proteins use second messengers to amplify a signal

188. (2) Put the following events of G-protein signaling in order:

I. Taste molecule binds to a G-protein coupled receptor II. IP induces release of calcium from the endoplasmic reticulum III. Phospholipase C cleaves PIP2 IV. Calmodulin activates downstream protein kinases V. G-protein binds to GTP

189. (2) Which of the following cranial nerves does NOT carry sensory information about the taste or texture of food?

A. Cranial nerve V B. Cranial nerve VII C. Cranial nerve IX D. Cranial nerve X E. Cranial nerve XII

190. (1) Which of the following types of papillae has no taste buds?

A. Fungiform B. Filiform C. Foliate D. Circumvallate

191. (1) Which of the following types of papillae has the most sensitive taste buds?

A. Fungiform B. Filiform C. Foliate D. Circumvallate

192. In which of the following systems do sensory signals NOT synapse in the thalamus before reaching the associated primary cortical area?

A. Visual system B. Auditory system C. Somatosensory system D. Olfactory system E. Gustatory system

Questions 193-194. (1 pt each) Refer to the following figure, which schematizes different ways taste receptors can be organized in a taste bud.

193. Based on the figure above, which of the following best describes the labelled-line model of encoding taste inputs?

A. Different taste buds separated into regions of the tongue respond to specific taste modalities B. A single taste receptor cell expresses a single type of taste receptor only C. A taste receptor cell expresses receptors tuned to a single taste modality, and all taste receptor cells tuned to that modality are innervated by the same fibers. D. A taste receptor cell expresses receptors tuned to a single taste modality, and taste receptor cells tuned to all types of taste modalities are innervated by the same fibers. E. A taste receptor cell responds to multiple taste modalities, and activates specific downstream neurons based on which taste modality it received.

194. **Which of the following pieces of evidence would best support the labelled-line model?

A. Activation of a single type of taste receptor cell is sufficient for an animal to tell if the stimulus was sweet, salty, bitter, umami, or sour. B. A taste receptor cell was discovered which responds equally strongly to sucrose and sodium ions, but does not respond to glutamate or hydrogen ions. C. An animal cannot distinguish between sweet, salty, bitter, umami, and sour tastes unless multiple types of taste receptor cells are activated in combination. D. One can predict the taste modality of a stimulus by looking at which areas are activated in the gustatory cortex. E. The specification of a taste modality is encoded by a complex pattern of activity across multiple fibers innervating the taste receptor cells.

195. In Parkinson's disease, motor symptoms are caused by degeneration of cells in the

A. Primary motor cortex B. Striatum C. Substantia nigra D. Lewy bodies E. Hippocampus

196. (1**) Increased intraocular pressure in primary open-angle glaucoma is the result of

A. Excessive aqueous humor production. B. Excessive vitreous humor production. C. Resistance to fluid flow through the trabecular network. D. Resistance to fluid flow through the pupil. E. Inability of aqueous fluid to flow from the posterior to the anterior chamber.

197. (1) Which of the following disorders is acquired early in development, during pregnancy or childbirth?

A. Cerebral Palsy B. Alzheimer's C. Parkinson's D. Multiple Sclerosis E. Shingles

198. (2) Describe how re-activated varicella zoster virus can cause a rash on the skin – where is the virus dormant, and how does it travel to the skin? (1 sentence).

199. (2) Describe one similarity and one difference between patients with a lesion in Broca's area and patients with a lesion in Wernicke's area.

200. (1) Which of the following is a possible explanation for a person losing all vision in their left eye?

A. Severing of the optic chiasm B. Damage to the left lateral geniculate nucleus C. Damage to the left visual cortex D. Damage to the right visual cortex E. Damage to the left optic nerve

201. (1) Retinitis pigmentosa can lead to which of the following?

A. Myopia B. Hyperopia C. Presbyopia D. Nyctalopia E. Color blindness

202. (1) Which of the following can occur because an eye is too long or oval?

A. Myopia B. Hyperopia C. Presbyopia D. Nyctalopia E. Conjunctivitis

203. (1) Which of the following is NOT associated with otitis media?

A. Hearing loss B. Swelling or blockage of the Eustachian tube C. Pain with movement of the outer ear D. Patients with Down syndrome are more likely to have otitis media E. Inflammation of the nasopharynx

204. (1) Which of the following is believed to be a result of a decreased elasticity of the lens, possibly caused by changes in the proteins that make up the lens?

A. Myopia B. Hyperopia C. Presbyopia D. Nyctalopia E. Astigmatism

205. (2) Name two structural features of a brain with advanced Alzheimer's disease that are visible from a coronal section.

Anatomy and Physiology
ANSWER SHEET

2017 Golden Gate Science Olympiad Invitational
Time limit: 50 minutes

Names:

_____

Team Number: _____
School:

_____

Score: _____ / 240
Rank:

Only answers on the answer sheet will be graded.
If your short answers continue off the provided lines, make sure your answers are clearly labeled.

Endocrine

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21. ____

22. ____

23. ____

24. ____

25. ____

26. ____

27. ____

28. _____

29. _____

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30. **___

31. _____

32. _____

33. _____

34. _____

35. _____

36. **_____

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37. ___

38. ___

39. ___

40. ___

41. _____

42. _____

43. _____

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45. _____

46. _____

47. _____

48. _____

49. _____

50. _____

51. ____

52. ____

53. ____

54. ____

55. ____

Nervous System STATION

STATION: letters will be assigned to these when pinning

56. ____
57. ____
58. ____
59. ____
60. ____
61. ____
62. ____
63. ____
64. ____
65. ____
66. ____
67. ____
68. ____
69. ____
70. ____
71. ____
72. ____
73. ____
74. ____

Nervous system written

75. **____
76. ____
77. ____
78. ____
79. ____
80. ____
81. ____
82. ____
83. ____
84. ____
85. **____
86. ____
87. ____
88. ____
89. _____
90. _____
91. _____
92. ____
93. ____
94. ____
95. **____
96. ____

97. ____

98. ____

99. _____

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100. _____

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101. _____

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102. _____

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103. _____

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104. _____

105. ____

106. ____

107. ____

108. ____

109. ____

110. ____

111. ____

112. ____

113. ____

114. _____

115. ____

116. ____

117. ____

118. _____

119. _____

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120. ____

121. ____

122. ____

123. ____

124. ____

125. ____

126. ____

127. ____

128. ____

129. ____

130. ____

Sense organs

131. _____

132. _____

133. _____

134. _____

135. _____

136. _____

137. _____

138. _____

139. _____

140. _____

141. _____

142.

143. _____

144. _____

145. _____

146. _____

147. ____

148. ____

149. ____

150. **_____

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151. ____

152. ____

153. ____

154. **____

155. ____

156. _____

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157. ____

158. ____

159. ____

160. ____

161. ____

162. _____

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163. _____

164. ____

165. _____

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166. ____

167. ____

168. ____

169. _____

170. ____

171. ____

172. ____

173. ____

174. ____

175. ____

176. ____

177. ____

178. ____

179. ____

180. ____

181. ____

182. ____

183. ____

184. ____

185. _____

186. _____

187. ____

188. _____

189. ____

190. ____

191. ____

192. ____

193. ____

194. **____

195. ____

196. **____

197. ____

198. _____

199. _____

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200. _____

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201. ____

202. ____

203. ____

204. ____

205. ____

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