

Name _____KEY_____

**Nsci2100: Human Neuroanatomy
2018 Final Examination**

Write your name on this page! On your bubble answer sheet, enter your name (last name, space, first name), internet ID (X.500 name) and student number. Please do it now!!!

Questions in blue are recycled from previous exams.

Lecture 3 development

1. From which primary germ layer does the nervous system develop?
 - A. mesoderm
 - B. neuroderm
 - C. ectoderm
 - D. endoderm
 - E. epiderm

2. The DNA in a dividing cell is replicated during what phase of the cell division cycle?
 - A. G1 phase
 - B. G2 phase
 - C. G3 phase
 - D. M phase
 - E. S phase

Lecture 4 ventricles, CSF & meninges

3. The falx cerebri ...
 - A. is part of the arterial blood system of the brain.
 - B. is between the right and left cerebral hemispheres.
 - C. is between the cerebral hemispheres and the cerebellum.
 - D. is between the cerebellum and the spinal cord.
 - E. is between the ventricles in the heart.

4. Cerebrospinal fluid (CSF) is produced by choroid plexus in the ...
 - A. spinal cord.
 - B. venous sinuses.
 - C. dura.
 - D. ventricles.
 - E. thorax.

Lecture 5 blood supply

5. Which of the following statements regarding dural venous sinuses is NOT true?
 - A. Dural venous sinuses drain into the internal jugular veins.
 - B. Dural venous sinuses distribute blood coming from the heart to most parts of the brain.
 - C. Dural venous sinuses are between the two layers of the dura.
 - D. Cerebrospinal fluid (CSF) ultimately drains into the dural venous sinuses.

6. Which of the following has the lowest level of oxygen (O₂) and the highest level of carbon dioxide (CO₂) in its blood?
- A. aorta
 - B. pulmonary artery
 - C. vertebral artery
 - D. internal carotid artery
 - E. None of the above are correct as all are similar in their O₂/CO₂ levels.

Lecture 6 cells

7. Which of the following statements is true regarding protein synthesis?
- A. Ribosomes read a gene in the DNA while synthesizing a protein.
 - B. Proteins are synthesized by linking together amino acids in a specific sequence.
 - C. Most proteins are synthesized in the nucleus.
 - D. Synthesis of a protein is a process called transcription.

Lecture 7 electrical properties

8. A particularly strong excitatory input to a neuron is likely to result in ...
- A. an action potential with a higher voltage (i.e. an action potential with greater depolarization).
 - B. a longer action potential (i.e. an action potential that is slower to decay).
 - C. more action potentials (i.e. more frequent action potentials).
 - D. an action potential with little or no refractory period.
9. The myelin covering on an axon ...
- A. protects the axon from trauma (i.e. mechanical damage).
 - B. protects the axon from certain pathogens.
 - C. keeps the neurotransmitter from leaking away from the axon.
 - D. keeps the action potential from jumping between neighboring axons.
 - E. results in faster action potentials along the axon.

Lecture 8 synaptic communication

10. Metabotropic receptors when activated by an appropriate neurotransmitter ...
- A. open as a channel through the cell membrane allowing ions to move through the membrane.
 - B. activate a signaling cascade inside the neuron that leads to opening or closing of nearby ion channels.
 - C. digest the neurotransmitter thus degrading it.
 - D. do not alter (directly or indirectly) the resting membrane potential of the neuron.
 - E. function to stop the action potential in the presynaptic terminal.

Lecture 9 spinal cord

11. The spinocerebellar tract runs in what region of the spinal cord?
- A. ventral funiculus
 - B. lateral funiculus
 - C. dorsal funiculus
 - D. central gray
 - E. ventral horn

12. The patellar tendon stretch reflex involves axons of sensory neurons that synapse on what cells?
- A. motor neurons in the spinal cord only
 - B. interneurons in the spinal cord only
 - C. motor neurons and interneurons in the spinal cord
 - D. motor neurons and interneurons in the spinal cord and relay neurons in the medulla

Lecture 12 brainstem (from Dr. Wessendorf)

13. The axon bundles that connect the cerebellum to the brainstem include ...
- A. the dorsal cerebellar peduncles.
 - B. the ventral cerebellar peduncles.
 - C. the lateral cerebellar peduncles.
 - D. the middle cerebellar peduncles.
 - E. the posterior cerebellar peduncles.

Lecture 13 forebrain (from Dr. Wessendorf)

14. Which of the following is NOT part of the telencephalon?
- A. the basal ganglia
 - B. cerebral neocortex
 - C. olfactory bulbs
 - D. hippocampus
 - E. None of the above is correct, as all are part of the telencephalon.
15. Which part of the diencephalon is most directly involved with control of aggression and sexual activity?
- A. hypothalamus
 - B. thalamus
 - C. epithalamus
 - D. subthalamus

Lecture 14 cranial nerves (from Dr. Wessendorf)

16. What level of the brainstem has motor neurons that innervate the extraocular (eye) muscles?
- A. pons
 - B. midbrain
 - C. medulla
 - D. thalamus
 - AB E. More than one of the above are correct.
17. Which cranial nerve has a direct role in controlling the rate of heart contractions?
- A. optic (CN II)
 - B. oculomotor (CN III)
 - C. glossopharyngeal (CN IX)
 - D. vagus (CN X)
 - E. None of the above are correct. The heart is controlled by spinal nerves only.

Lecture 15 & 16 somatosensory system (from Dr. Wessendorf)

18. Piezo2 is an ion channel expressed by certain sensory neurons that is activated by ...
- A. low temperatures.
 - B. tissue damage.
 - C. sound.
 - D. mechanical force.
19. Which statement regarding nociceptors is NOT true?
- A. Polymodal nociceptors fire in response to a temperature over 50° C.
 - B. Most nociceptors are free nerve endings.
 - C. Mechanical nociceptors fire in response to stimuli over any part of a large, continuous patch of skin.
 - D. Cold nociceptors have thresholds starting at about 0° C.
20. Which of the following are effects of opiates?
- A. inhibition of neurotransmitter release from nociceptive afferent neurons
 - B. inhibition of nociceptive relay neurons in the spinal cord
 - C. activation of prefrontal cortex
 - D. More than one of the above are correct.

Lecture 17 & 18 vision

21. Tears are secreted onto the front surface of the eye by the ...
- A. tarsal gland.
 - B. lacrimal gland.
 - C. nasal gland.
 - D. meibomian gland.
 - E. scleral gland.
22. Visual information from visual cortex is described as being carried in 'streams'. What stream is most important for identifying a photograph of your mother?
- A. dorsal stream
 - B. frontal stream
 - C. ventral stream
 - D. limbic stream
 - E. posterior stream
23. Which of the following statements regarding cone cells is NOT true?
- A. The light sensitive protein used by cone cells is rhodopsin.
 - B. Cone cells are most sensitive to one of three wavelengths of light (i.e. colors).
 - C. Cone cells function poorly in low illumination (i.e. low light).
 - D. Cone cells are in the photoreceptor cell layer of the retina.
 - E. Cone cells have synapses with horizontal cells and bipolar cells.

Lecture 19 hearing & vestibular

24. Which of the following is an important brain center for processing and relaying auditory information?
- A. vestibular nucleus
 - B. inferior colliculus
 - C. inferior olivary nucleus
 - D. cuneate nucleus
 - E. lateral geniculate nucleus

25. What is the function of a tiny muscle that attaches to an auditory bone in the middle ear?
- A. No such muscle exists.
 - B. The muscle amplifies low volume (quiet) sounds so they can be heard.
 - C. The muscle protects the auditory system from extremely loud sounds.
 - D. The muscle contracts in response to a pressure differential between the middle ear and outside world to reduce pain (such as when taking off in an airplane).
 - E. The muscle is important for sensing repetitive sounds such as when someone is beating a drum the same way continually.

Lecture 20 chemical senses

26. Taste information is carried into the central nervous system by axons in which cranial nerve?
- A. trigeminal nerve (CN V)
 - B. facial nerve (CN VII)
 - C. glossopharyngeal nerve (CN IX)
 - D. accessory nerve (CN XI)
 - BC E. More than one of the above are correct.
27. Axons in most sensory systems are relayed from station to station in the brain organized in a pattern that matches the physical map of their initial receptors. We call this a topographic pattern of connections. Which sensory system is an exception to this generalization?
- A. auditory
 - B. olfactory
 - C. somatosensory
 - D. vision

Lecture 23 motor system

28. What symptom is likely following a stroke in the precentral gyrus near the lateral sulcus?
- A. paralysis of the leg and/or foot
 - B. paralysis of the face
 - C. loss of the sense of touch on the leg and/or foot
 - D. loss of the sense of touch on the face
 - E. an inability to use vision to locate objects in space
29. Neurons in which of the following locations are mostly to synapse with a skeletal muscle fiber?
- A. spinal cord ventral horn
 - B. spinal cord dorsal horn
 - C. hypothalamus
 - D. sympathetic ganglion
 - E. precentral gyrus in the cortex

Lecture 24 basal ganglia

30. Which of the following statements regarding the basal ganglia is NOT true?
- A. A main output of the basal ganglia is from the globus pallidus internus.
 - B. The main output of the basal ganglia is to thalamus.
 - C. The main output of the basal ganglia uses glutamate as the neurotransmitter and is excitatory.
 - D. The main input to the basal ganglia is from neocortex.
 - E. The subthalamic nucleus is part of the basal ganglia circuitry.

31. What two structures are separated by the internal capsule?
- A. globus pallidus and putamen
 - B. putamen and caudate
 - C. hypothalamus and thalamus
 - D. thalamus and substantia nigra
 - E. substantia nigra and red nucleus

Lecture 25 cerebellum

32. Which of the following receives a major input from the cerebellum and sends axons that synapse with lower motor neurons?
- A. red nucleus
 - B. inferior olivary nucleus
 - C. ventrolateral nucleus in the thalamus
 - D. pontine nucleus
 - E. caudate nucleus
33. In most regions of the cerebellar cortex, Purkinje cells send axons to the ...
- A. spinal cord.
 - B. inferior olivary nucleus.
 - C. a deep cerebellar nucleus.
 - D. red nucleus.
 - E. ventrolateral nucleus.

Lecture 26 eye movements (from Dr. L. McLoon)

34. Optokinetic nystagmus allows you to
- A. fixate on stationary objects when your body is rotating.
 - B. fixate on slowly moving objects when the head is held still.
 - C. maintain your focus on a single spot in the visual world.
 - D. view close objects.
 - E. see during brief head movements.

Lecture 27 autonomic nervous system

35. The conscious perception of bloatedness or gas in the colon involves sensory information relayed from the thalamus to what area of cortex?
- A. prefrontal cortex
 - B. precentral gyrus
 - C. postcentral gyrus
 - D. posterior parietal lobe
 - E. insular cortex
36. Activation of which of the following neurons is most important for getting an erection of the penis or clitoris?
- A. preganglionic sympathetic neurons in the sacral spinal cord
 - B. preganglionic parasympathetic neurons in the sacral spinal cord
 - C. somatic motor neurons in the sacral spinal cord
 - D. enteric neurons in the wall of the venous sinusoids

Lecture 28 reticular formation & sleep (from Dr. Riedl)

37. Which of the following disorders is characterized by interruptions in REM sleep?

- A. Night terrors
- B. Sleep walking
- C. Restless leg syndrome
- D. Parkinson's disease

38. The reticular formation is said to be responsible for “accompanying” movements. Which of the following statements about accompanying movements is NOT true?

- A. Accompanying movements typically follow a conscious movement.
- B. Accompanying movements are often necessary to maintain balance.
- C. Accompanying movements often involve input from several sensory systems.
- D. Accompanying movements are usually unconscious.

Lecture 29 hypothalamus (from Dr. Wessendorf)

39. What part of the hypothalamus contains the neurons that constitute the “master clock” of the body?

- A. Suprachiasmatic nucleus
- B. Arcuate nucleus
- C. Preoptic nucleus
- D. Dorsomedial nucleus
- E. Supraoptic nucleus

Lecture 30 limbic system (from Dr. Wessendorf)

40. A stroke in which of the following would most likely interfere with laying down long-term memory?

- A. Hippocampus
- B. Fornix
- C. Mammillary nuclei
- D. Mammillothalamic tract
- all E. More than one of the above are correct.

Lecture 33 cerebral cortex I (from Dr. Heilbronner)

41. Which developmental structure contains the cerebral cortex?

- A. myelencephalon
- B. metencephalon
- C. dorsal telencephalon
- D. Ventral Telencephalon
- E. Diencephalon

42. Which lobe of the cerebral cortex contains the hippocampus, cingulate gyrus, and parahippocampal gyrus?

- A. temporal Lobe
- B. occipital Lobe
- C. parietal Lobe
- D. frontal Lobe
- E. limbic Lobe

43. What are the primary white matter bundles connecting the left and right hemispheres of the cerebral cortex?
- A. internal capsule and uncinate fasciculus
 - B. cingulum bundle and superior longitudinal fasciculus
 - C. anterior commissure and cingulum bundle
 - D. corpus callosum and anterior commissure
 - E. internal capsule and inferior longitudinal fasciculus
44. Brodmann areas are defined by the microscopic appearance of the density and arrangement of neurons in each layer, a feature called ...
- A. connectivity.
 - B. lobes.
 - C. cytoarchitecture.
 - D. function.
 - E. size.

Lecture 34 cerebral cortex II (from Dr. Heilbronner)

45. Which of these brain imaging methods is used to examine white matter?
- A. X-Ray computerized tomography
 - B. Functional magnetic resonance imaging
 - C. Positron emission tomography
 - D. Magnetic resonance imaging
 - E. Diffusion tensor imaging
46. Which statement accurately describes the advantages and disadvantages of positron emission tomography (PET) vs functional magnetic resonance imaging (fMRI)?
- A. fMRI requires injection of a radioactive tracer, but PET does not.
 - B. fMRI has better temporal and spatial resolution than PET.
 - C. PET measures the blood-oxygenation level dependent signal, which changes over the course of minutes.
 - D. PET is optimized to examine the organization of white matter.
 - E. fMRI relies on X-ray signals, so is less safe than PET.
47. A patient who has trouble visually attending to the left visual field (neglect) likely has damage to the ...
- A. right parietal association cortex.
 - B. left parietal association cortex.
 - C. left frontal association cortex.
 - D. right frontal association cortex.
 - E. right temporal association cortex.
48. Damage to the temporal association cortex may cause difficulty in ...
- A. visual attention.
 - B. decision-making.
 - C. abstract planning.
 - D. naming things.
 - E. emotion regulation.

Lecture 35 language in the brain (from Dr. Heilbronner)

49. Which of these disorders that affects the cerebral cortex can be treated by tissue plasminogen activator (TPA)?
- A. Hemorrhagic stroke
 - B. Epilepsy
 - C. Ischemic stroke
 - D. Mental Illness
 - E. Neurodegeneration
50. Damage to what area, in which part of the brain leads to language production difficulties, while leaving language comprehension intact?
- A. Broca's area, located in the ventral posterior frontal lobe
 - B. Wernicke's area, located in the ventral posterior frontal lobe
 - C. Broca's area, located in the posterior and superior temporal lobe
 - D. Wernicke's area, located in the posterior and superior temporal lobe
 - E. Auditory cortex
51. Which of the following statements is true about language acquisition?
- A. Language acquisition does not require early exposure.
 - B. Sign language learning follows a very different developmental trajectory than spoken language learning.
 - C. Language learning is easiest during one's twenties.
 - D. Infants are born with a genetic predisposition to learning whichever language their parents speak.
 - E. Infants are born sensitive to a wide variety of phonemes; many of these are lost as a particular language is learned.
52. An imbalance in excitation vs inhibition in the cerebral cortex may cause ...
- A. stroke.
 - B. epilepsy.
 - C. neurodegeneration.
 - D. tumor.
 - E. mental illness.

Lecture 36 drug abuse & addiction (from Dr. Thomas)

53. Researchers who formed the initial maps of brain regions that we now refer to as the "reward circuit" relied heavily on ...
- A. electrophysiology.
 - B. immunoblotting.
 - C. golgi staining.
 - D. functional magnetic resonance imaging (fMRI).
 - E. electrical brain stimulation.
54. Which of the following statements regarding the ventral tegmental area (VTA) is NOT true?
- A. The VTA is in the midbrain near the substantia nigra.
 - B. Neurons in the VTA send axons to the striatum.
 - C. Neurons in the VTA send axons to prefrontal cortex.
 - D. Neurons in the VTA use dopamine as their neurotransmitter.
 - E. All the above are true.

55. Experimental lesions to the mesolimbic dopamine system in rats in a study of “taste reactivity” allowed researchers to determine that:
- A. Dopamine release is necessary for a stimulus to be recognized as pleasurable.
 - B. Loss of dopamine results in exaggerated responses to a pleasurable stimulus.
 - C. Loss of dopamine results in an unpleasant stimulus eliciting responses normally associated with a pleasurable stimulus.
 - D. Loss of dopamine has no effect on the expression of a response elicited by a pleasurable stimulus.
56. Repeated administration of cocaine to a rodent results in ...
- A. an increase in the number of dendritic spines on medium spiny neurons in the nucleus accumbens.
 - B. a decrease in the number of dendritic spines on medium spiny neurons in the nucleus accumbens.
 - C. increased death of neurons in the nucleus accumbens.
 - D. increased death of neurons in the prefrontal cortex.
 - E. an increase in the number of neurons in the dentate gyrus of the hippocampus.

Lecture 37 walking (from Mr. Zeidler)

57. Which of the following is true regarding the central pattern generator (CPG) for walking?
- A. CPG function requires input from the somatosensory system.
 - B. CPG function requires input from the cerebellum.
 - C. The CPG is a network of neurons in the cerebral cortex.
 - D. The CPG includes inhibitory interneurons whose axons cross the midline.
 - E. More than one of the above are correct.
58. What aspect of spinal electrical stimulation was necessary to rehabilitate walking in patients?
- A. Continuous stimulation for the duration of the gait
 - B. High amplitude stimulation to recruit many motor neurons
 - C. Patterned stimulation to match the phase of the gait
 - D. Intermittent stimulation during periods of non-walking to promote plasticity
59. Typically, while walking, activation of the motor neurons for extensor muscles in one leg will roughly coincide with...
- A. activation of the motor neurons for flexor muscles in the same leg.
 - B. inhibition of the motor neurons for flexor muscles in the same leg.
 - C. activation of the motor neurons for extensor muscles in the other leg.
 - D. inhibition of the motor neurons for extensor muscles in the other leg.
 - E. More than one of the above are correct.
60. Which of the following tracts provides proprioceptive information to the cerebellum during walking?
- A. vestibulocerebellar tract
 - B. spinocerebellar tract
 - C. rubrocerebellar tract
 - D. pontocerebellar tract
 - E. dorsal columns

Lecture 38 neurodegenerative diseases (from Dr. Lesne)

Everyone received credit for #61.

61. What neuropathological lesions characterize frontotemporal dementia?

- A. neurofibrillary tangles
- B. Lewy bodies
- C. TDP43 inclusions
- D. FUS inclusions
- E. amyloid plaques

62. Identify the major symptom characterizing the clinical presentation of Alzheimer's disease.

- A. bradykinesia
- B. chorea
- C. rigidity
- D. dysarthria
- E. cognitive decline

63. Among neurodegenerative diseases inducing motor disorders, which disease primarily affects the basal ganglia in the forebrain?

- A. Alzheimer's disease
- B. Parkinson's disease
- C. Amyotrophic lateral sclerosis (ALS)
- D. Huntington's disease
- E. Frontotemporal dementia

64. Four drugs (Donepezil, Rivastigmine, Galantamine and Memantine-HCl) have been shown to cure Alzheimer's disease. True or false?

- A. true
- B. false

Lecture 39 injury & regeneration

65. If the axon of an upper motor neuron in motor cortex is cut in upper spinal cord, what will happen to it?

- A. Over a period of two weeks or more, the two ends of the axon will reconnect.
- B. The distal portion of the axon that is no longer connected to the soma will degenerate. The portion of the axon still connected to the soma will regenerate and reconnect with lower motor neurons.
- C. The distal portion of the axon that is no longer connected to the soma will degenerate. The portion of the axon still connected to the soma will attempt to regenerate, but will fail. The cell will ultimately atrophy.
- D. The distal portion of the axon that is no longer connected to the soma will grow a new soma.
- E. At least for the next several months, there will be almost no change in the cell.

66. Following an injury to the spinal cord, which of the following cell types in the spinal cord is likely to proliferate by cell division?

- A. neurons with long projecting axons
- B. interneurons
- C. astrocytes
- D. oligodendrocytes
- E. schwann cells

67. Under which of following conditions will degeneration of a leg muscle be the fastest and most severe?
- A. lying in bed with minimal movement for a month
 - B. a spinal cord injury in a mid thoracic level that completely severs the cord
 - C. cutting the peripheral nerve to the muscle
68. What is the Nogo protein?
- A. It is a neurotrophin that is important for keeping neurons healthy.
 - B. It is a component of CNS myelin that can inhibit axon regeneration.
 - C. It is a protein in neurons that promotes axon regeneration.
 - D. In its misfolded form, it is a toxic protein that causes a neurodegenerative disease.

Lecture 40 adult neurogenesis & stem cells

69. New neurons are normally produced by cell division in a few locations in the adult nervous system. Which of the following is NOT normally produced in the adult?
- A. granule cells in the dentate gyrus of the hippocampus
 - B. olfactory receptor neurons in the epithelium of the nasal cavity
 - C. interneurons in the olfactory bulb
 - D. ventral horn neurons in the spinal cord
70. Cell division in the subventricular zone (SVZ) in the adult brain produces neurons that are important for what function?
- A. sense of smell
 - B. sense of balance and motion
 - C. sense of taste
 - D. certain types of learning
71. Which of the following statements regarding the drug fluoxetine, a commonly used antidepressant better known as Prozac, is correct?
- A. The effectiveness of fluoxetine requires cell division in the subventricular zone (SVZ).
 - B. Fluoxetine increases cell division in the subgranular zone (SGZ).
 - C. Fluoxetine reduces cell division in the subgranular zone (SGZ).
 - D. Fluoxetine impairs spatial and episodic memory.
72. Induced pluripotent stem cells (iPSCs) ...
- A. are normally present in many adult tissues in very low abundance.
 - B. are normally present in the umbilical cord.
 - C. can be harvested from the inner cell mass of a blastocyst stage embryo.
 - D. can be harvested from embryos of any stage.
 - E. can be made in the laboratory from differentiated cells such as fibroblasts from skin.

Lecture 41 learning, memory & decision making (from Dr. Redish)

73. We know that memory is not stored as a literal and accurate record of events because...
- A. sometimes you cannot state what you remembered.
 - B. if memory was stored that way, we could never make good decisions.
 - C. studies testing memory find that people change their reports based on leading questions.
 - D. The premise in this question is wrong because memory is stored as a literal record of events.

74. Imagination re-uses perceptual neural circuits. True or false?

- A. true
- B. false

75. Engaging in social laughter utilizes which decision-making system?

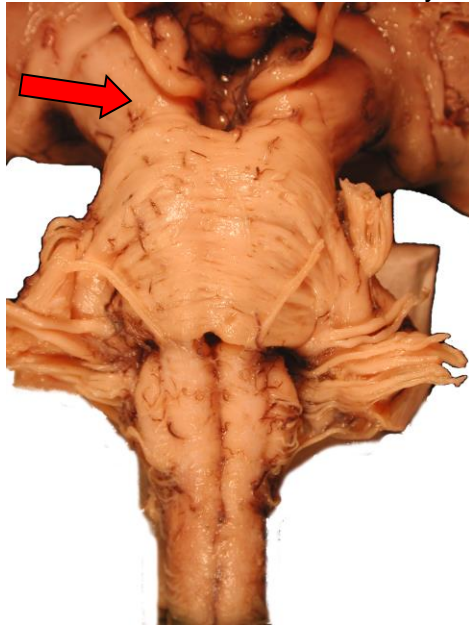
- A. reflex
- B. pavlovian
- C. deliberation
- D. procedural

76. What brain region is particularly important for procedural memory?

- A. hippocampus
- B. striatum and cerebellum
- C. amygdala
- D. neocortex

Lab (from Dr. Riedl)

77. What structure is indicated by the red arrow in this photograph of a human brainstem?



- A. cerebellar peduncle
- B. pyramid
- C. cerebral peduncle
- D. pyramidal fascicle
- E. internal capsule

78. You saw an example of sensory adaptation with sustained stimulation of the cockroach spine. Which of the following would be another example of sensory adaptation?

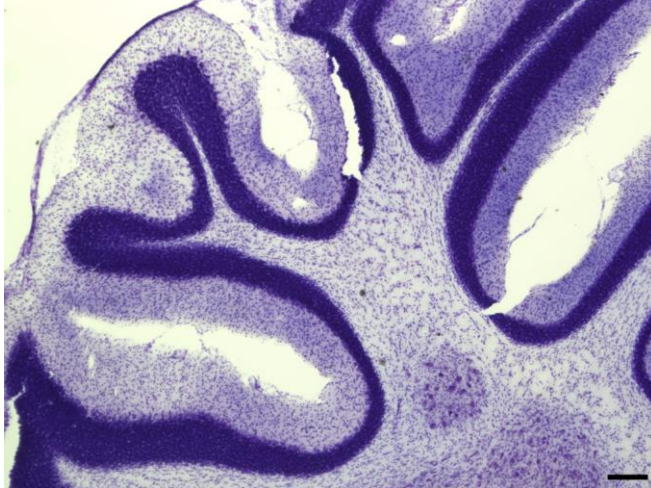
- A. scratching in response to exposure to poison ivy
- B. shivering in response to cold temperature
- C. sweating in response warm temperature
- D. becoming accustomed to a warm bath, so that it no longer feels warm
- E. no longer feeling pain after an injury has healed

Everyone received credit for #79.

79. In the cockroach leg, movement of the joint will elicit a response from which of the following organs?

- A. campaniform organ
- B. golgi tendon organ
- C. patellar tendon
- D. muscle spindle
- E. achilles tendon

80. What brain structure is shown in the following micrograph?



- A. cerebellum
- B. hippocampus
- C. cerebral cortex
- D. brainstem
- E. superior colliculus

Extra credit

81. The faculty of Nsci2100 wish you a joyous holiday. True or false?

- A. True
- B. False

The End!

**Please turn in this exam and your bubble sheet in the box at the back of the room.
Double check that your name is on both.**

*Have a wonderful and safe holiday!
...HO, HO, HO!*