

*Below are many questions based on the Schneider chapters and on lectures. Questions numbered 47-63 will be covered in class sessions 9-12. **The first 46 questions are for review, and can be answered from earlier lectures and Schneider chapters.** Many of these questions are answered in the other readings as well.*

1. The forebrain probably expanded in evolution initially because of the importance of _____.
2. Give an example of a “correlation center” that evolved as a connection between sensory analyzers and motor control mechanisms.
3. What are the “distance receptors”? What sense allows an animal to detect certain things that occurred earlier in time? Can you do this?
4. Give two examples of human “fixed action patterns” (FAPs, so named by ethologists).
5. Are the animals with the largest brains the most intelligent animals? What other factors influence brain size?
6. Name two animals with brains larger than the human brain.
7. What are two unique characteristics of the chordate phylum, one mesodermal and one ectodermal. (This phylum includes all vertebrates.)
8. Distinguish the terms “phylogeny” and “ontogeny”.
9. Give three examples of sensory specializations in particular species of vertebrates, specializations that include expanded representations in the CNS.
10. What are two additional behavioral specializations, in primates, that include expanded control areas in the CNS.

11. The first "Shmoo" CNS diagrams (Shmoo 1) depict a putative pre-mammalian brain. Such a brain is shown without a _____, an endbrain structure characteristic of all mammals.
12. In what two major divisions of the mammalian brain are the fluid-filled ventricles the largest?
13. Give a simple definition for the following terms: primary sensory neuron, secondary sensory neuron, motor neuron.
14. In what sense is a primary sensory neuron in the olfactory system the most primitive type of mammalian primary sensory neuron?
15. Define "dermatome". Describe a typical thoracic dermatome.
16. Describe the area of the body surface rostral to the dermatomes for the spinal nerves. What innervates this region?
17. Name three types of channels of conduction for sensory information entering the CNS.
18. Describe the behavior of an animal which has had the forebrain removed. (What behavior is the most normal, and what is the most abnormal?) Note some differences between different species in which this has been done.
19. Why are some animals more helpless after neocortex ablation than others?
20. What is "spinal shock" and why is it so different in widely different species?
21. "Diaschisis", or deafferentation depression, has a specific meaning in neurology, but is a frequently mis-used term. Explain the meaning of "corticospinal diaschisis."
22. What are two known mechanisms of recovery from deafferentation depression (diaschisis)?
23. Draw, on an outline of the embryonic mammalian CNS, the dorsal column - medial lemniscus pathway (the "neolemniscus") leading from skin to neocortex. Note where the axons decussate.
24. Make a similar drawing of the corticospinal tract's longest axons, from the large layer-5 pyramidal cells in the motor cortex, called Betz cells, to destination sites.
25. The telencephalon, or end-brain, contains major structures in addition to neocortex. What are two of these structures, present in all vertebrates?
26. What kinds of functions are associated with these endbrain structures?

27. In the embryonic spinal cord, the sulcus limitans separates the _____ plate dorsally from the _____ ventrally. Where are spinal interneurons located? Where are the motor neurons located?
28. Describe a major difference in appearance, in a frontal section, of the cervical spinal cord and the sacral spinal cord.
32. Write short definitions of the following terms:
- Propriospinal system of axons
 - Paravertebral ganglia (chains of ganglia)
 - Prevertebral ganglia, e.g., the celiac ganglion
 - Vagus nerve
 - Dorsal horn, ventral horn, lateral horn
 - Dorsal columns, lateral columns, ventral columns
 - Medial lemniscus
 - Motor cortex projections
 - Alar plate, basal plate, sulcus limitans
 - Neural crest cells
 - Preganglionic motor neurons
33. What are the spinal enlargements? Where are they, and why did they develop?
34. The neural tube forms as an invagination of the primitive _____.
35. Three examples of descending pathways in the spinal cord are _____.
36. Describe Otto Loewi's experiment that indicated that synaptic transmission was chemical in nature.
37. Loewi talked about two neurotransmitters acting on the heart: "acceleransstoff" and "vagusstoff" (the accelerator substance and the vagus substance). What did these two neurotransmitters turn out to be?
38. Summarize the difference in locations of preganglionic motor neurons of the sympathetic and the parasympathetic nervous systems.
39. Contrast the anatomy and the function of the sympathetic and the parasympathetic innervation of the iris, the heart and the intestinal tract.
40. The ventrobasal thalamic nucleus, or the ventral-posterior nucleus (Latin terms: *nucleus ventralis posterior*, *pars lateralis* and *pars medialis*) receives somatosensory input from both paleolemniscal and neolemniscal channels. The two CNS tracts that carry this input from the spinal cord are known as _____ and _____.

41. Which part of the brain develops the earliest? (Think of where the neural tube first closes.)
42. Neurulation begins with an inductive event. What part of the embryonic mesoderm induces the formation of the nervous system? To which germ layer of the gastrula does this part belong? How does it accomplish the induction?
43. The neural crest cells form from part of the neural plate that does not become incorporated into the neural tube. Cells of the neural crest form a number of separate structures. Name several of these.
44. Contrast two different kinds of mitosis. Where do mitoses occur in the developing spinal cord?
45. The walls of the early neural tube are called a neuroepithelium. Why is it called a "pseudostratified epithelium"?
46. Explain nuclear translocation as a mechanism of cell migration, and give an example of it.

47. How is the hindbrain embryologically very similar to the spinal cord?
48. Describe two "routine maintenance functions" of the hindbrain.
49. How is the hindbrain involved in some of the most complex human behavior?
50. In brain development, the cerebellum develops by cell migrations from the "rhombic lip". Describe the location of this structure.
51. The "pons" (meaning: bridge) is a prominent structure visible in mammalian brain dissections, located on the ventral side of the rostral hindbrain. What is a major input and the major output of the cells of the pontine gray matter?
52. What is the difference between the trigeminal nerve and the trigeminal lemniscus?
53. At the surface of the midbrain appear the "colliculi" or little hills: the anterior or superior colliculi and the posterior or inferior colliculi. With what sensory modalities do we usually associate the superior and the inferior colliculi? Are there other sensory systems that connect with these structures?
54. Name a pathway that originates in the midbrain and descends to the spinal cord. (In class we named two such pathways.)
55. Which cranial nerve carries somatosensory input from the face into the brain? Give the number of the nerve as well as its common name. Where are the primary sensory neurons of this nerve? Where are the secondary sensory neurons?

56. What causes quantitative distortions of the basic structural layout of the hindbrain? What is the major distortion that occurs in the development of the hindbrain of humans and other primates?
57. Two divisions of the diencephalon (the 'tweenbrain") usually considered to be the major divisions are the _____ and the _____. Briefly, indicate a major function of each of these divisions.
58. The largest bundle of myelinated axons coursing through the human midbrain is the _____. These fibers come from the _____.
59. In relative terms, the tree shrew and the squirrel have a very large _____ in the midbrain.
60. A fiber bundle that passes rostrally through the hindbrain and continues rostrally through the midbrain is the _____. (There are several possible answers.)
61. The mesencephalon, diencephalon, and telencephalon (midbrain, 'tweenbrain and endbrain) can each be divided into the same two types of regions, namely _____ and _____.
62. Developmental and comparative neuroanatomists refer to two major groups of axons that carry outputs of these two regions of the forebrain. These are called the _____ and _____.
63. Name two major sources of axons in each of these two bundles.

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Questions on readings: Nauta ch 5 (also, Schneider chapters & lectures)

1. Which primary sensory neurons are at the surface of the body?
2. What are muscle spindle organs? Describe their location and what they respond to. They are located at the sensory end of monosynaptic reflex arcs.
3. What is meant by a "lemniscus"?
4. Why is the term "spinothalamic tract" somewhat of a misnomer?
5. Draw, on an outline of the embryonic mammalian CNS, the spinothalamic pathway (the "palelemniscus) leading from skin to neocortex. Note where the axons decussate, and where there are synapses.

6. Contrast the medial lemniscus and the lateral lemniscus: modality represented, origin of the axons.
7. Which receptor cells, of a major sensory modality, are part of the forebrain?

Questions on readings: Allman ch 5

8. What property evolved in birds and mammals that required a ten-fold increase in energy expenditure?
9. Which is energetically more expensive, to heat the body or to cool it? How does this explain the body temperature of endothermic animals?
10. What does Allman mean when he writes that “in a sense teeth are displaced and transformed bits of brain tissue”?
11. How is parenting behavior related to temperature homeostasis?
12. Name several of the multiple functions of the hormone oxytocin.
13. What was a very important result of the major transformation of the hearing apparatus that occurred in the earliest mammals?
14. How is pedomorphism in early mammals related to relative brain size?
15. How is evolution of neocortex in mammals and related structures in birds related to temperature homeostasis?
16. What is the first region of the neocortex to develop?
17. Why does Allman think that the Wulst of the owl is more efficiently “wired” than the visual cortex of mammals?
18. What structure in birds is genetically related to the neocortex of mammals?

Questions on readings: Butler & Hodos (also, Schneider chapters & lectures)

19. Why do Butler and Hodos find the traditional enumeration of 12 cranial nerves to be inadequate? (p. 120, 133-134, 127)
20. Why do the authors suggest that embryonic hindbrain divisions result from a kind of "bar code" pattern of gene activity? (p. 122 col. 1, fig. 9-1)

21. Contrast neural crest and placodal origin of sensory and other structures (main features).
Give examples.

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9.14 Brain Structure and Its Origins

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