

Questions for Midterm Review

A. Review all questions in “Homework 3,” on the worksheet slides.

B. Selections from questions on book chapters:

Chapters 1-2

- 1) Contrast the meanings of “synapse” and “bouton” in descriptions of neuronal structures.
- 2) What membrane structures had to evolve in order for action potentials in axons to evolve?
- 3) What are oligodendrocytes and Schwann cells?
- 4) Contrast retrograde degeneration and anterograde degeneration.
- 5) What was a major difference between the tract-tracing methods of Marchi and Nauta?
- 6) Describe one method that uses axonal transport in order to study axonal connections.
- 7) What is the method of diffusion tensor imaging? What are its advantages and its limitations?

Chapters 3-4

- 8) Define primary and secondary sensory neurons and motor neurons. What is the intermediate network?
- 9) In which subdivision of the CNS do visual inputs enter? Describe or name the two visual inputs found in many chordates.
- 10) Compare the specializations for taste senses of two fish, the fresh-water buffalofish and the catfish, and how the hindbrain is affected.
- 11) What structure in the midbrain has become greatly enlarged in most predatory teleost fish? Contrast the motor functions of two major outputs of this structure, one involving descending axons that cross the midline and the other involving an uncrossed descending projection.
- 12) What was the major cause of the first three major expansions of the forebrain in evolution?

Chapters 5-7

- 13) Why should neuroscientists have a special interest in Cynodonts (lived ~230 million years ago)?
- 14) A great expansion of the neocortex in mammals was correlated with expansion of other brain structures as well. Name or describe two specific non-endbrain structures that showed such expansion in evolution.
- 15) What secondary sensory nuclei receive input from axons of the eighth cranial nerve?
- 16) What is a dermatome? Why is the face not included in dermatome maps?
- 17) What is the oldest ascending somatosensory pathway that reaches the brain? Contrast this pathway with another pathway that ascends from the spinal cord—a pathway that has often been called the “paleolemniscus” (the ancient ribbon)?
- 18) What cranial nerves carry information from electroreceptors in certain fish? Why is electroreception so useful for these fish?
- 19) What is the major difference in somatosensory neocortex of the raccoon and the coatimundi?
- 20) What is a striking specialization (specific function unclear) in the brain of the Echidna (the spiny anteater of Australia)?
- 21) What, in a simple phrase, is meant by diaschisis? Describe an example. Why is an understanding of this phenomenon so important in the interpretation of species differences in brain lesion effects?
- 22) What part of the forebrain is most involved in the changes that occur during habit formation, or procedural learning (implicit learning)?
- 23) The limbic system is characterized by close interconnections with what portion of the upper brainstem?

Chapters 8-9, 9a

- 24) What are the four basic cellular events that result in transformation of the very early embryo from fertilized cell to morula to blastula to gastrula? (These were summarized by Lewis Wolpert G.) Give an example of what is meant by each event.
- 25) What is the notochord, and what is its role in neurulation? Describe the process of neurulation.
- 26) What is sonic hedgehog, and what are two major roles it plays in spinal cord development?

- 27) Describe the two types of cell division that occur adjacent to the ventricular surface of the neural tube.
- 28) What are neural crest cells, and what do they become in vertebrate development?
- 29) What is the lateral horn?
- 30) Where do the largest axons in the dorsal roots originate? Describe two of their termination sites within the spinal segment of their dorsal root.
- 31) Describe the axons and connections of a withdrawal reflex (flexion reflex).
- 32) What are propriospinal fibers? Describe a specific function of connections of these fibers.
- 33) What is another name for the cranio-sacral system? Describe one example of its functions.
- 34) What is another name for the thoracolumbar system? Describe one example of its functions.
- 35) What is the enteric nervous system?
- 36) What is the decelerator nerve that innervates the heart? Where are the cells of origin of that nerve, and what neurotransmitter is released at its endings?
- 37) What are the names of the three layers of the meninges that surround the brain and spinal cord?
- 38) What cells make the cerebrospinal fluid (CSF)? How does the CSF get from the ventricles of the brain into the subarachnoid space surrounding the brain?
- 39) What type of glial cell always comes in between the circulatory system and the neurons of the central nervous system?

Chapters 10, 11, 12

- 40) How is the hindbrain embryologically very similar to the spinal cord?
- 41) Briefly describe segmentation of the hindbrain and the evidence for it.
- 42) Contrast trigeminal nerve and trigeminal lemniscus.
- 43) What is the meaning of the term “pons”? What is a major input, and what is the major output, of the cells of the pontine gray matter?

- 44) What two regions of the midbrain are called the limbic midbrain areas? What is the neuroanatomical basis for this designation?
- 45) At the base of the midbrain (ventral side) one finds a fiber bundle that shows great differences in relative size in different species. Give examples. What are the fibers called and where do they originate?
- 46) In the telencephalon, what are the two major divisions of the pallium (cortex)? What are the two major divisions of the subpallium (striatum)?
- 47) This division of pallial and subpallial regions of the endbrain is supported by the existence of two pathways followed by their output axons, as well as by axons coursing in the opposite direction. What are these two groups of axons called by embryologists and comparative neuroanatomists?
- 48) What are neuromeres? What are prosomeres?
- 49) What two sensory modalities most strongly shaped the evolution of the forebrain?
- 50) The neocortex has layers that are not present in the dorsal cortex of reptiles and amphibians. The layers are the more superficial layers 2-4. Those layers contain many inhibitory interneurons that do not arise from the ventricular layer of the developing cortex. Where do they come from?

Chapter 13

- 51) The study of axonal growth was advanced by a discovery by Rita Levi-Montalcini and Victor Hamburger. Describe the discovery. What did it lead to?
- 52) How do axons that originate in the distal part of the leg of a grasshopper appear to find their way to a central ganglion in a consistent pattern?
- 53) How is the pattern of growth of the mammalian optic tract different?
- 54) There is much evidence that chemical guidance is a major factor in the growth of axons. However, there are multiple types of chemical guidance, with involvement of many different molecular substances. Describe major types of chemical guidance.
- 55) Contrast tropic and trophic effects on growing axons.
- 56) What is meant by exuberant axonal projections?
- 57) Describe two factors that can increase the competitive growth vigor of a developing axon.
- 58) What is apoptosis?

- 59) Describe what happens to regeneration of CNS axons in mammals early in development as the animal grows older. In brief, why does it happen?
- 60) Describe a method for inducing regeneration of the severed optic tract in adult hamsters.

Chapter 14, 15, 16

- 61) The overview of the motor system begins with a description of general purpose movements that are used for many different purposes. Name the three types of general-purpose movements .
- 62) Before a neocortex evolved, the midbrain had evolved structures for controlling the three types of general-purpose movements. Name the structure where the output pathway for each of these movements originates.
- 63) What two sensory modalities most strongly shaped the evolution of the forebrain?
- 64) Where are the innate circuits underlying the locomotor patterns we call “gaits”? Discuss the pathways whereby a locomotor gait is initiated.
- 65) Describe two major inputs to the red nucleus of the midbrain.
- 66) What is the basic spatial layout of motor neurons at one of the spinal cord enlargements?
- 67) Describe the three lesions in the Lawrence and Kuypers study of the descending motor system pathways.
- 68) Describe functions of the three major pathways or groups of pathways that were separately destroyed in the study.
- 69) Motor neurons that innervate striated muscles are located in the spinal cord and in which brain subdivisions?
- 70) Neuroanatomical experiments indicate that the primary motor cortex of rhesus monkeys contains a rostral older part and a more caudal newer part. How are these two parts different?
- 71) Name a movement pattern in an animal or human that is largely under the control of hindbrain and spinal cord structures and is centrally generated, once it is triggered. How is it different from a reflex (even though it may be called a reflex by neurologists)?
- 72) How is central generation of a temporal pattern possible? What two types of mechanism other than S-R circuits are described in chapter 16?

Chapter 17

73) What are two different types of mechanisms whereby the overall state of all or much of the brain can be changed?

74) Describe four axonal systems that are very widely projecting—systems where activity changes may change the overall state of the brain.

C. Names: Why were each of these scientists important in the history of neuroanatomy?

Fritch and Hitzig
Ramon y Cajal
Charles Scott Sherrington
Otto Loewi
Hans Spemann
Bror Rexed
Ross Harrison
Karl Lashley
Walle Nauta
Rita Levi-Montalcini
Hans Kuypers

D. Definitions

- a) Anterograde degeneration
- b) Retrograde degeneration
- c) Notochord
- d) Primary sensory neuron
- e) Secondary sensory neuron
- f) Interneuron
- g) Motor neuron
- h) Oligodendrocyte
- i) Schwann cell
- j) Dermatome
- k) Sulcus limitans
- l) Basal plate
- m) Alar plate
- n) Sensory placode
- o) Homeobox genes
- p) Lateral horn
- q) Ventral roots
- r) Preganglionic motor neuron
- s) Propriospinal axons
- t) Rhombic lip
- u) Obex
- v) Cynodont

- w) Barrel fields
- x) Pyramidal tract
- y) Betz cell
- z) Mosaic evolution
- aa) Wulst
- bb) Filopodia
- cc) Collateral sprouting
- dd) Endogenous activity

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