

9.14

Class #15: Motor systems 1

Questions on Schneider chapter 14:

- 1) 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 movements described.
- 2) 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.
- 3) Locomotion is often initiated because of activity generated in what diencephalic structure?
- 4) Grasping with the hands in large primates is largely controlled by neocortex. What brainstem structure appeared earlier in evolution and controlled this kind of movement?
- 5) What other kind of grasping is common in animals, including mammals? Describe a pathway from the midbrain that might be involved (a speculation that could guide anatomical experiments). What type of non-midbrain pathway is likely to be involved?
- 6) What two sensory modalities most strongly shaped the evolution of the forebrain?
- 7) Discuss the type of connections that the early forebrain must have used to influence the general-purpose movements referred to in questions one and two.
- 8) Where are the innate circuits underlying the locomotor patterns we call “gaits”? Discuss the pathways whereby a locomotor gait is initiated.
- 9) Maintaining balance of the body during standing or locomotion depends on reticulospinal pathways from the hindbrain, and on two other descending pathways. What are they?
- 10) What primary sensory neurons project directly to the cerebellar cortex?
- 11) Describe major inputs to the red nucleus of the midbrain.
- 12) What are the two portions of the red nucleus, and how are they different in their major outputs? How are they different in large primates on the one hand and cats or rodents on the other?
- 13) Where are the most rostral somatic motor neurons located?

Questions on additional readings (classes 15-17):

Swanson (2003) ch 6)pp 97-122:

1. What are the three major divisions of the motor system? How do the motor neurons differ in these three divisions?
2. Where are the rostral-most somatic motor neurons located? Where are the caudal-most somatic motor neurons located?
3. The muscles that move the lips and the muscles that move the jaw are controlled by different groups of motor neurons that send their axons out through two different cranial nerves. What are these motor neuron groups (brainstem nuclei) and cranial nerves?
4. How does Swanson characterize the motor system as a hierarchy? (His conception of the system is characterized in figures which were inspired by the ethologist Niko Tinbergen and by physiological and anatomical studies.)

Nauta & Feirtag (1986) chapter 7 pp 91-107. [Note: Some of this material will be dealt with again later in a class session on the corpus striatum.]

5. Why is the pyramidal tract called “pyramidal”? (p. 96)
6. On what type of neurons do most of the axons in the corticospinal tract synapse? (p. 96)
7. Name at least two major structures of the extrapyramidal motor system (pp. 97-101).
8. The *substantia nigra* is found within the _____ (forebrain/midbrain/hindbrain). Many of its neurons contain a black pigment called _____. Its major neurotransmitter is _____.
9. The cerebellum receives input from primary sensory neurons of which sense organ? Through which cranial nerve? Briefly describe some clinical symptoms caused by cerebellar lesions (pp. 102-103).
10. Which eye muscles are responsible for moving the eyes away from the midline (away from the nose)? And towards the midline (towards the nose)? Name two midbrain structures the stimulation of which can elicit eye movements (pp. 104-105).

Striedter (2005) chapter 7, pp. 217-245

11. According to Striedter, in a “typical” mammalian brain an “average” neuron is connected to at least how many neurons? What is the current estimate of the number of neurons in a “typical” human brain? (p. 217)
12. What is the “epigenetic population matching” mechanism in neural development? Why is this mechanism described as “epigenetic”? How can such a mechanism facilitate emergence of morphologically diverse brains in evolution? (pp. 220-221) Name two molecules that might be involved in epigenetic population matching (classes 12-13 lectures).

13. Describe Ebbesson's "parcellation hypothesis" of brain evolution (pp. 228-229). Describe one example supporting this hypothesis (p. 233). How is (the weaker version of) Ebbesson's theory related to patterns of axonal growth during development? (pp. 233-234)
14. What is the "large-equals-well-connected" rule first proposed by Terrence Deacon (1990)? Why is this rule reasonable judging from the perspective of brain development? (pp. 237-238)

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