Lecture 2: Building a Functional Nervous System

Dr. Andrew Bass

Pre-lecture Preparation

Watch Pre-class video if posted on the website, though not all Bass lectures may use them.
Review lecture outline below, which is intended to complement content in slides presented in class.

Required Reading

Bear et al.: Chapter 1.

Further Optional Reading

Bear et al.: Chapter 7; Chapter 13: 470-471.

Learning Objectives

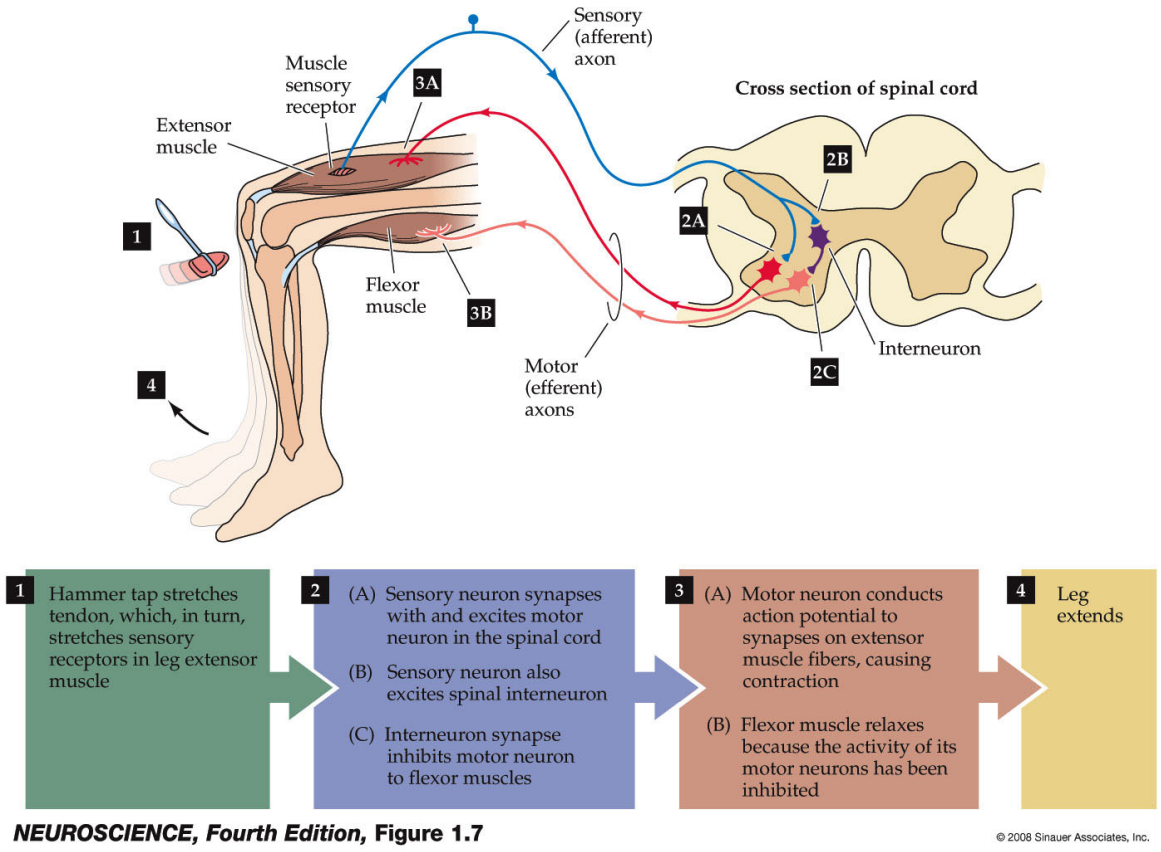
1. Be able to discuss how the stretch/knee jerk-reflex is a simple model for how the nervous system combines sensory input with motor output to produce a behavior.
2. Be able to discuss the critical principle underlying localization of function in the nervous system: topography.
3. Be able to apply experimental methods to demonstrate localization of function in the nervous system, and discuss the advantages and disadvantages of each.
4. Be able to identify and locate the major divisions of the brain and of the cerebral cortex on an appropriate diagram, and to predict a major symptom arising from damage to each division.

Lecture Outline (complements content in slides presented in class)

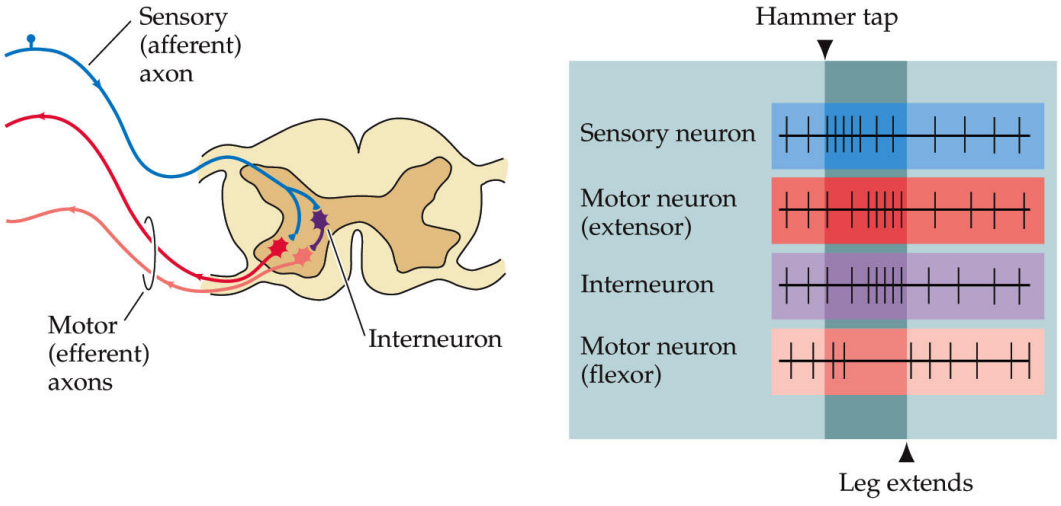
1. How is the nervous system built to go from sensing a stimulus to the movement of muscles that produce a behavior?

    a. Spinal cord circuits provide simple examples of how the nervous system is built to get from sensation to integration, and then to movement that underlies a behavioral response to the stimulus.

    The knee jerk reflex is an example of how a simple behavior is accomplished by a circuit in the spinal cord (Figures 1.7, 1-8 on the next page are from Kandel et al., 2000).

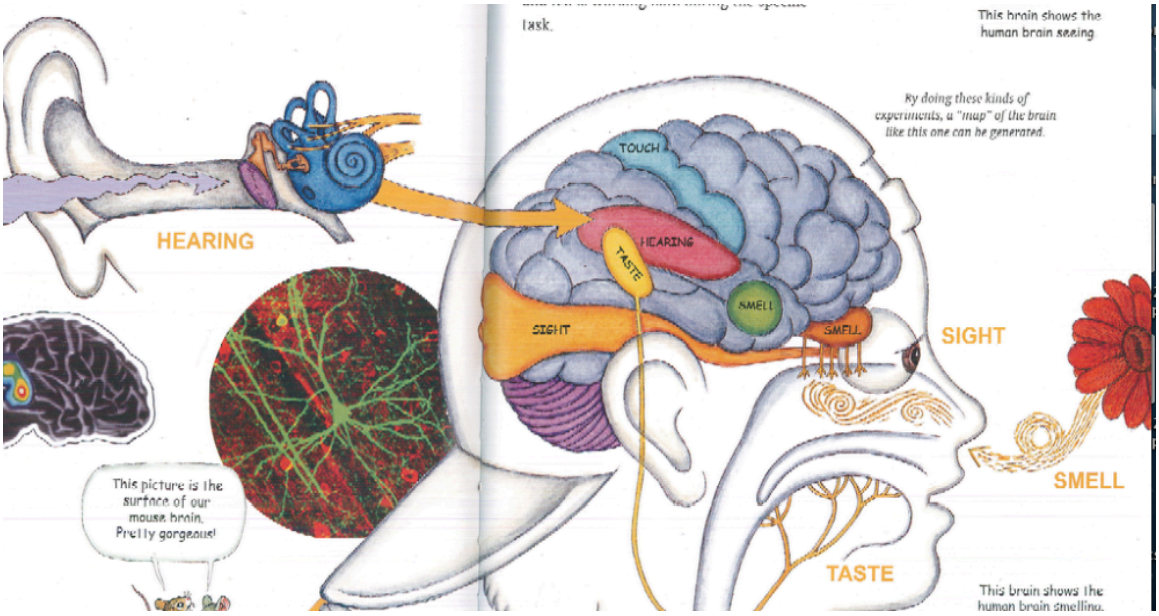


***NEUROSCIENCE, Fourth Edition,* Figure 1.7**



***NEUROSCIENCE, Fourth Edition,* Figure 1.8**

2. What are the critical principles that demonstrate localization of function in the nervous system?



From *Brain* by DeSalle & Wynne, 2011, American Museum of Natural History

3. What experimental methods have neuroscientists used to demonstrate localization of function and what might be the advantages and disadvantages of each approach?
   a. Brain damage (lesions)
   b. Brain stimulation
   c. Brain mapping (fMRI)
   d. Advantages of localization of function?
      - minimize distant connections and thereby the amount of space taken up by neurons dedicated to one function
      - efficient and simple way to assemble complex neural circuits during development
   e. Any disadvantages in having localization of function?

4. What are the major divisions of the brain?
   a. Can you identify and locate on an appropriate diagram the four divisions of the CNS?
   b. Can you identify and locate the four lobes of the cerebrum?
   c. Can you identify and locate the primary sensory and motor cortices? Can you predict a major symptom arising from damage to each of these regions?

Study Questions

1. Clearly define, in your own words, what is meant by ‘localization of function’ in the nervous system. Then, discuss (or hypothesize) why functions are localized in the nervous system.
2. A ‘neo-phrenologist’ claims that love and hate are processed by different parts of the brain. Propose two experiments that you might use to test the validity of this claim, including some indication of which technical methods you will use. (N.B. – literal phrenology, i.e. the measurement of bumps and hollows on the skull, is not an answer that we are looking for).
3. Evaluate the usefulness of lesions and the symptoms of lesions in our understanding of the nervous system.