

## 9.14

### Classes #13 - 14: Axon growth

#### *Questions based on Schneider chapter 13:*

- 1) Ramon y Cajal described the axonal growth cone from his Golgi studies of developing chicks and mammals. However, he never saw a living growth cone. How was this first accomplished, and by whom?
- 2) To see growth cones in histological material, methods other than the Golgi stain can be used. Give an example.
- 3) Study the model of a growth cone depicted in figure 13.3. Describe the dynamics of axon growth using the concepts of fundamental cellular events named by Lewis Wolpert (chapter 8).
- 4) Describe membrane incorporation in the growing axon.
- 5) What technical advances in neuroembryology can attributed to Ross G. Harrison ? How did Speidel's method differ from Harrison's?
- 6) 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?
- 7) 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?
- 8) How is the pattern of growth of the mammalian optic tract different?
- 9) What was the major result in Hibbard's experiment on transplanted amphibian Mauthner cells?
- 10) 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.
- 11) Contrast tropic and trophic effects on growing axons.
- 12) How could the same molecule be critical for both axonal attraction and axonal repulsion?
- 13) What is meant by exuberant axonal projections?
- 14) Describe how optic-tract axons, and no doubt other types of axons, shift from one mode of growth to another mode of growth during development.

- 15) Describe the role of ephrins and ephrin receptors in the development of retinal projections to the midbrain tectum.
- 16) Describe two factors that can increase the competitive growth vigor of a developing axon.
- 17) Describe a phenomenon of plasticity of the map of developing projections from the retina to the midbrain.
- 18) What is collateral sprouting in the development of CNS axons? Describe the phenomenon and two factors which affect when, where and in what axons it can occur. What can modulate the amount of collateral sprouting?
- 19) What is apoptosis?
- 20) Contrast two major possible purposes in naturally occurring neuronal death.
- 21) Describe what happens to regeneration of CNS axons in mammals early in development as the animal grows older. In brief, why does it happen?
- 22) Describe a method that has shown some success for eliciting CNS axon regeneration.

***Questions on other readings; also, Schneider lectures and text:***

1. What are the four mechanisms of directed axon growth summarized by Purves & Lichtman?
2. Give an example of an extracellular matrix (ECM) molecule found in the CNS, and the role it may have.
3. Give an example of evidence that netrins or semaphorins can function as diffusible attractants or repellants for growing CNS axons.
4. How can a “stripe assay” using “membrane carpets” be used to study the basis for retinotectal map formation? (Zigmond et al., p. 541-543.)

***Supplementary questions:***

5. Describe three roles of neurotrophins in the brain.
6. Give an example of innervation-dependent neuronal death/survival.

***Some of the following questions may require some web searching:***

7. Contrast apoptosis and necrosis.

8. What are trk receptors? (What binds to them, and what is the result?)
9. How is the intracellular protein bcl-2 involved in regulating the above processes?
10. Describe other effects of bcl-2

MIT OpenCourseWare  
<http://ocw.mit.edu>

## 9.14 Brain Structure and Its Origins

Spring 2014

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.