1. We learned in the class that BMP-4 induces dorsal ectoderm to form epidermis, yet parts of the dorsal ectoderm also differentiate into neural ectoderm. It is also known that some BMP-4 antagonists (such as noggin, chordin, and follistatin) are secreted from certain embryonic tissue nearby where the neural ectoderm is given rise.

   a) What is the mechanism that BMP-4 and its antagonists shape the neural ectoderm?

   Default mechanism: BMP-4 instructs the epidermis formation of ectoderm, yet the organizer and organizer-derived mesoderm secrete antagonists to prevent the future neural ectoderm from becoming epidermis.

   b) According to your answer for 1a), give the names of embryonic parts (e.g. Notochord, floor plate, Spemann’s organizer etc) or germ band (e.g. ectoderm, endoderm, mesoderm) where the BMP-4 antagonists are expressed before and after the gastrulation.

   Before: Spemann’s organizer, mesoderm
   After: mesoderm underling neural plate

2. According to the early experiment done by Rita Levi Montochini that the chick spinal sensory ganglia exuberantly innervate a piece of mouse tumor which is placed next to the chick spinal chord.

   a) What will you explain how mouse tumor can induce the innervation of chick sensory ganglia?

   The tumor tissue can produce some kind of molecule (e.g. NGF) that is able to induce the outgrowth and the innervation of chick sensory ganglia.

   b) Rita Levi Montochini also found that the closer the mouse tumor is, the more chick sensory ganglia innervate the tumor. Based on your answer in 2a), how will you explain this phenomena?

   The molecule that tumor produces can be secreted into media. The closer the tumor the higher the concentration of growth factor.
3. How is apoptosis different from necrosis? Why is apoptosis sometimes called “programmed cell death”?

Apoptosis is considered “programmed” because the factors involved are encoded in the cell’s genome. Apoptosis is a clean, cell-autonomous process while necrosis is caused by outside factors and is unclean.

4. By putting together the given players involved in apoptosis, briefly describe the sequential events happened when a cell is undergoing program cell death. The players need to be used are: Bcl-2, Apaf, Cytochrome C, Caspase proteins, mitochondria, and BH3-only molecules.

Bcl-2 resides on mitochondrial membrane → death signals activate BH-3 domain proteins → BH-3 domain proteins move to mt. membrane and poke holes on mt. → Cyto. C is released from mt. → Cyto. C help to multimerize Apaf → multimerized Apaf activate caspase protein → cleavage cascade → cell death

5. In the lectures, we learned that by using hierarchy of protein modification, a small portion of intracellular or extracellular molecules are able to conduct a great influence on cellular behaviors. What’s a major advantage of using such a propagation cascade?

Such a propagation cascade allows for tight control of the process and allow for amplification of the signal.