BICH/GENE 431 KNOWLEDGE OBJECTIVES

Chapter 19 – Gene Regulation in Development
Axes of polarity in developing embryo: dorsal/ventral, anterior/posterior, left/right, proximal/distal
Totipotent cells, pluripotent cells, committed cells, terminally differentiated cells
Three basic strategies for cell-specific gene expression
  - localization of mRNA
    How are mRNAs attached to actin filaments or microtubules?
    Examples of mRNA localization: ash1 mRNA in budding yeast – what does it control and why?; macho1 mRNA in sea squirt – what does it do?
  - cell-cell communication
    uses signal transduction pathways
    Examples of cell-cell communication: B. subtilis sporulation using SpoIIIR protein from forespore cell to signal mother cell; Delta/notch signaling to distinguish neuroblast vs. epidermal cells during spinal cord development in Drosophila
  - morphogen gradients
    What is a morphogen? Know some common examples.
    General idea of how morphogen gradients work differentially at a distance
    Example of Shh signaling to control vertebrate neuron formation in formation of neural tube
Drosophila Dorsal gradient and control of gene transcription
  - example of morphogen gradient; dorsal/ventral axis
  - Drosophila early development; syncytium
  - Know how Dorsal gradient is established: roles of Spatzle, Toll receptors, Cactus phosphorylation, nuclear transport of Dorsal
  - Dorsal target genes: sog, rhomboid, twist; how does Dorsal gradient result in differential transcription of these target genes?; importance of different affinities for binding of Dorsal to various enhancers
  - Role of Snail protein to restrict expression of sog and rhomboid
Drosophila development: segmentation genes
  - example of anterior/posterior patterning
  - localization of bicoid, oskar mRNAs in egg and early embryo; know mechanism for localization
  - Know how Bicoid and Nanos make a steep anterior gradient of Hunchback; maternal and zygotic expression of hunchback
  - Know how Hunchback differentially regulates gap genes: kruppel, knirps, giant; importance of different numbers of Hunchback binding sites in enhancers
  - Know how pair-rule gene (example is even-skipped: eve) is regulated to give stripes; roles of repressor proteins to limit both edges of stripes