

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