

Developmental Biology  
3090-01  
Week 3, Tuesday  
9/9/14

### **Lecture 5) Development of the Drosophila Body Plan III**

These notes will be most helpful when used with the PDF slides posted to the blackboard site that correspond with the appropriate lecture. Slide numbers start with the slide after the lecture outline slide (for this set slide #1 is titled The Effects of Mutations in the Zygotic Developmental Genes).

Review: Dpp is very active in the dorsal region. Sog inhibits Dpp by preventing it from binding to its receptor. Tld binds and degrades Sog, limiting the activity of Dpp and promoting activity of Dpp.

#### **Slide 1:**

Gap mutants- lack large regions of body

Pair Rule mutants- lack portions of every other segment

Segmentation mutants- All (14) segments are damaged

**Slide 2:** Gap genes allow for anterior and posterior development. Hunchback is a gap gene.

Incomplete bullet: All encode transcription factors.

-missing regions, in general, correspond to where the gene is expressed

**Slide 3:** Hunchback is turned on only when bicoid reaches threshold level. This relationship is determined by altering the levels of bicoid and observing the changes.

Bicoid is a maternal affect gene.

Incomplete bullet: This level is obtained only in the anterior.

**Slide 4:** Bicoid binds the hunchback promoter.

Hunchback expression can be monitored using a lacZ reporter fusion gene. lacZ turns clear sugar substance blue. Mutating the promoter affects lacZ activity.

Missing bullet: Hunchback promoter fused to the bacterial lacZ gene.

#### **Slide 5:**

Incomplete bullet: Limits of gap gene expression determined by bicoid and hunchback.

Hunchback does act as a morphogen.

Use mutants to see if gene expression changes. If expression increases, its function was to repress the gene. If expression decreases, its function was to promote expression.

**Slide 6:** Parasegments: individual developmental units in drosophila embryo that give rise to segments.

Missing bullets:

-visualized by gene activity

- offset from segments by half a segment (they do not line up perfectly)

Parasegments are present in early embryo, but not segments.

**Slide 7:** Genes are expressed in 7 stripes just before cellularization.

Incomplete bullet: All pair ruled genes expressed in alternate parasegments.

**Slide 8:** Each stripe for gene are controlled by a different element of the promoter.

**Slide 9:** At least 7 elements controlling 7 stripes. Elements have different pattern of transcription factors. Stripes are very temporary.

### **Clicker Question!**

Are all transcription factors morphogens?

a) Yes

b) No

c) All transcription factors in drosophila

**Answer:** No

Slide 10: How do we know pair rule controls expression? A mutant would not have the engrailed pattern.

Slide 11: Engrailed pattern is stable.

Compartment- Talking about cell lineage. Region of the organism that contains all the descendants of the cells that were present when the region was first set up. All the cells in a compartment have the same lineage.

Engrailed is permanent, pair ruled disappears.

Slide 12: Different segments have specific identifiable features.

wg= wingless (no wings)

hh= hedgehog (bristles, dendricles cover whole segment- embryo looks spiky)

Missing bullet: Anterior region duplicated in mirror image.

Slide 13: Segmentation genes stabilize segment boundaries.

Slide 14:

Incomplete bullets:

- hh and wg are the secreted signal proteins (ligands)
- patched and frizzled are the receptors

KNOW slides 15 and 16 (Hedgehog and Wingless signaling pathways)!!

Slide 15: Know patched, smoothened, and Ci. Ci acts as a transcription factor. Ci is cleaved, goes to repressor, and no genes are transcribed.

When hedgehog is present, Ci acts as a gene activator.

Smoothened acts to protect Ci from phosphorylation. hh prevents inhibition of smoothened and which protects Ci from phosphorylation.

Slide 16: wg= wnt (drosophila version and vertebrate version)

Know wnt, frizzled, beta catenin, TCF.

Active pathway prevents degradation of beta catenin. Activates transcription.

### **Clicker Question!**

What will happen in a smo null mutant when Hh binds patched?

- a) Ci genes transcribed
- b) Ci genes are repressed
- c) Ci becomes an activator
- d) Ci never acts as a repressor

Answer: B- Ci target genes are repressed