HD-3: Segmentation
Ed Laufer, February 24, 2009

Learning Objectives

The axial body plan is organized into repeating mesodermal structures called somites

Somites form progressively from presegmental mesoderm at the caudal end of the growing embryo, through a “clock and wavefront” mechanism that involves Notch, FGF and Wnt signaling

Malfunctioning of this signaling system cause vertebral segmentation defects

Somites are subdivided by inductive signals emanating from the surrounding embryonic structures

Somites differentiate into axial skeleton, muscles, dermis and tendons

Cells at different cranial-caudal and different dorsal-ventral locations in the embryo express different combinations of transcription factors “telling” cells where they are and hence modulating the structures they produce

Along the cranial-caudal (“anterior-posterior”) axis, Hox genes provide a combinatorial code for cell fate

The homeobox is a highly conserved DNA-binding domain of the Hox proteins

There are 4 clusters of Hox genes (A->D) with a total of 13 gene families (low numbered Hox genes are expressed more cranially)

Hox genes are also used in adult cells as transcription factors that regulate growth and differentiation, but not pattern

Suggested reading

Schoenwolf (Larsen’s):

- Segmentation clock pp 87-94
- Somite patterning pp 128-130
- Early fly and homeosis pp 151-154
- Musculoskeletal development pp 217-234 (first half of Chap 8).

Gilbert:

- Hox genes pp 361-364.
- Paraxial mesoderm pp 443-455. (455-457 muscle development)
- Vertebra formation pp 457-460.