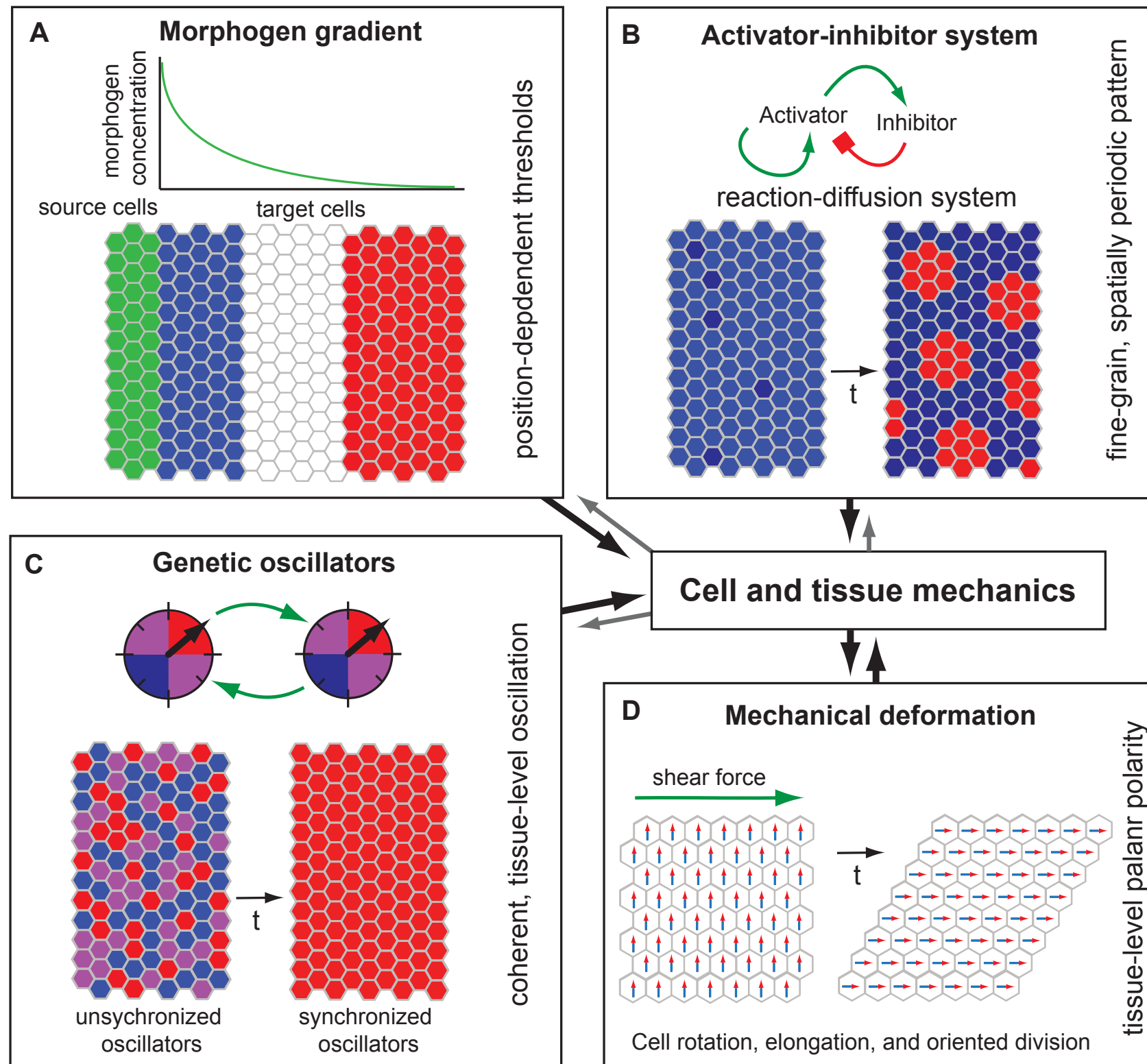
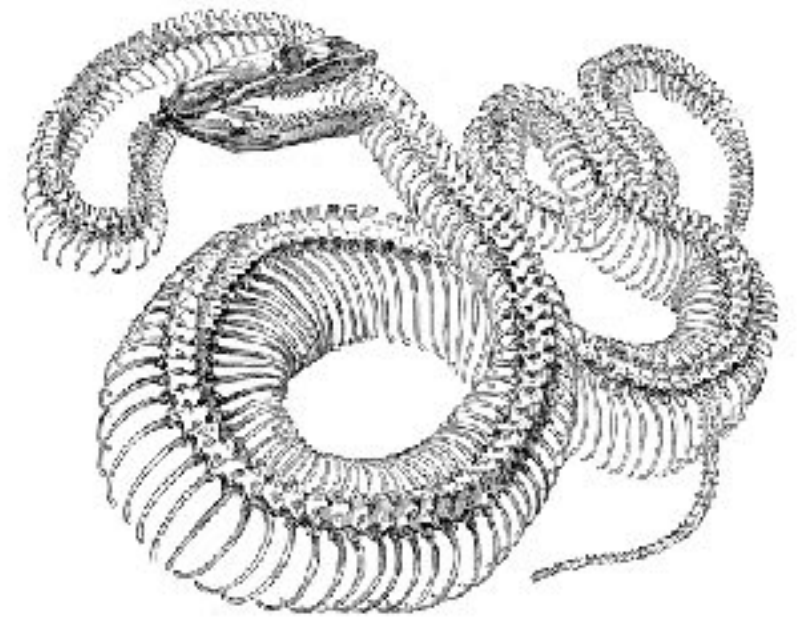
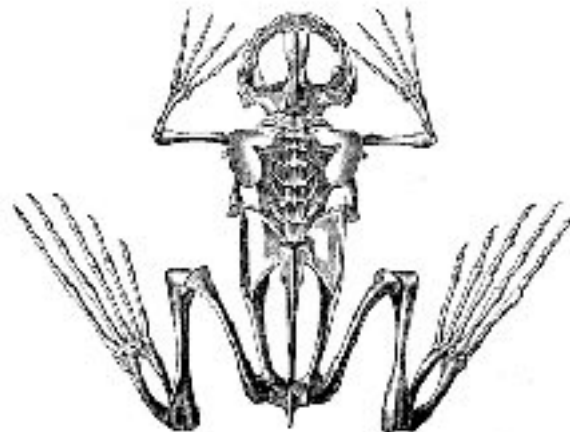
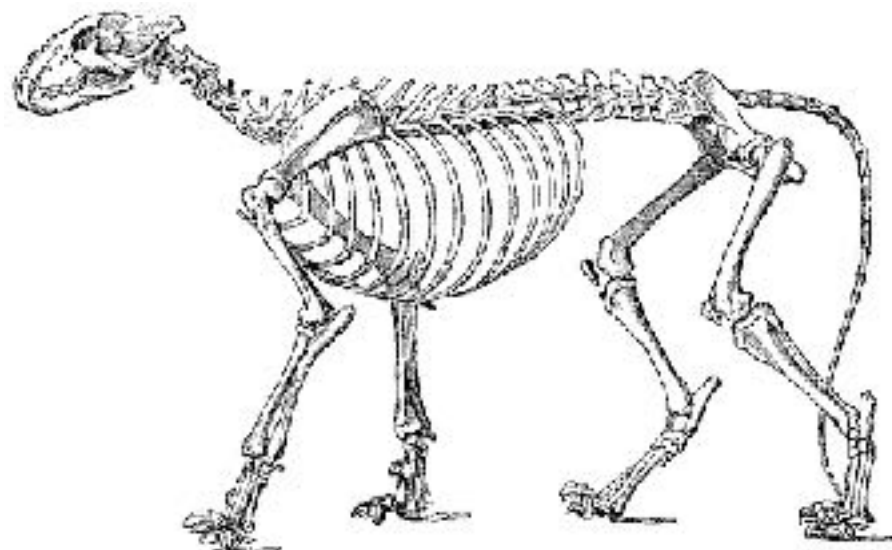
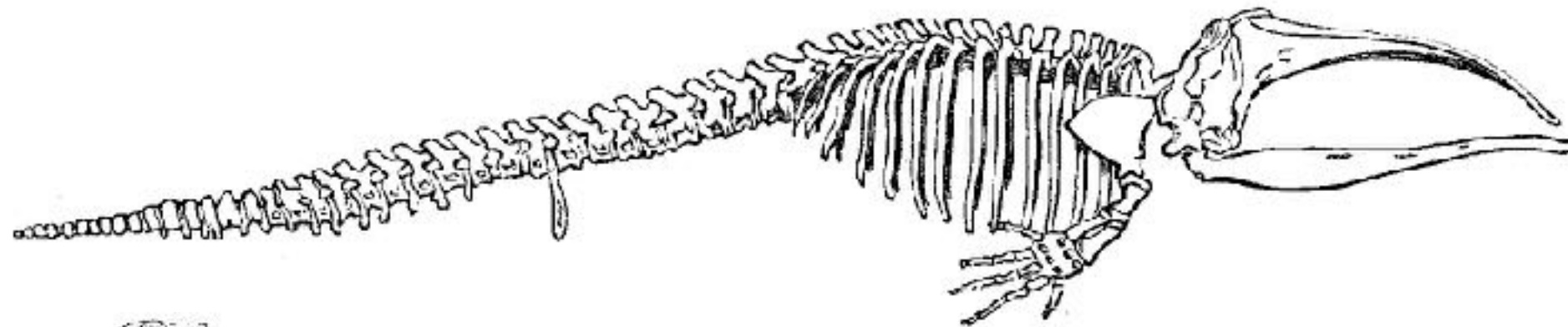


Patterning strategies



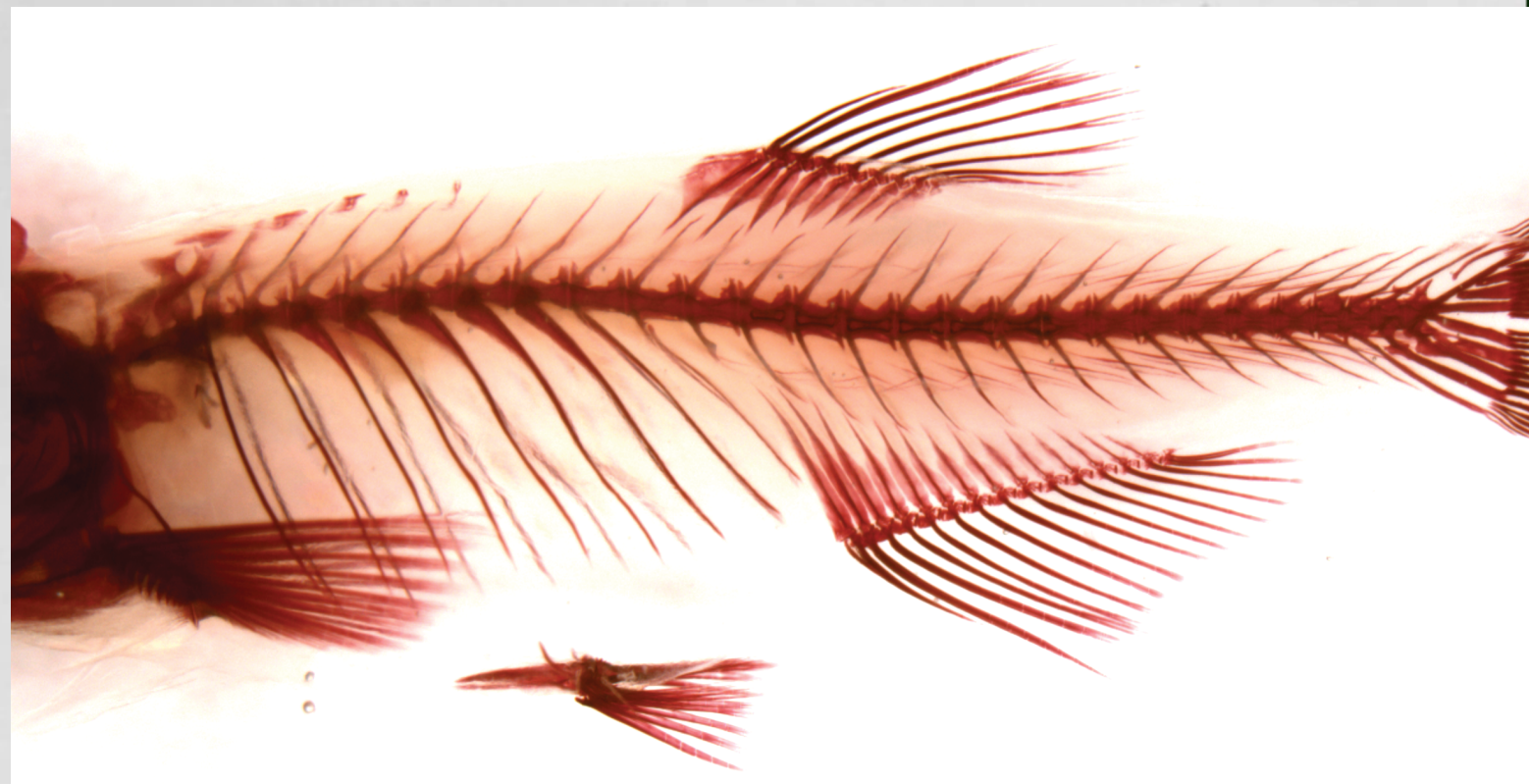
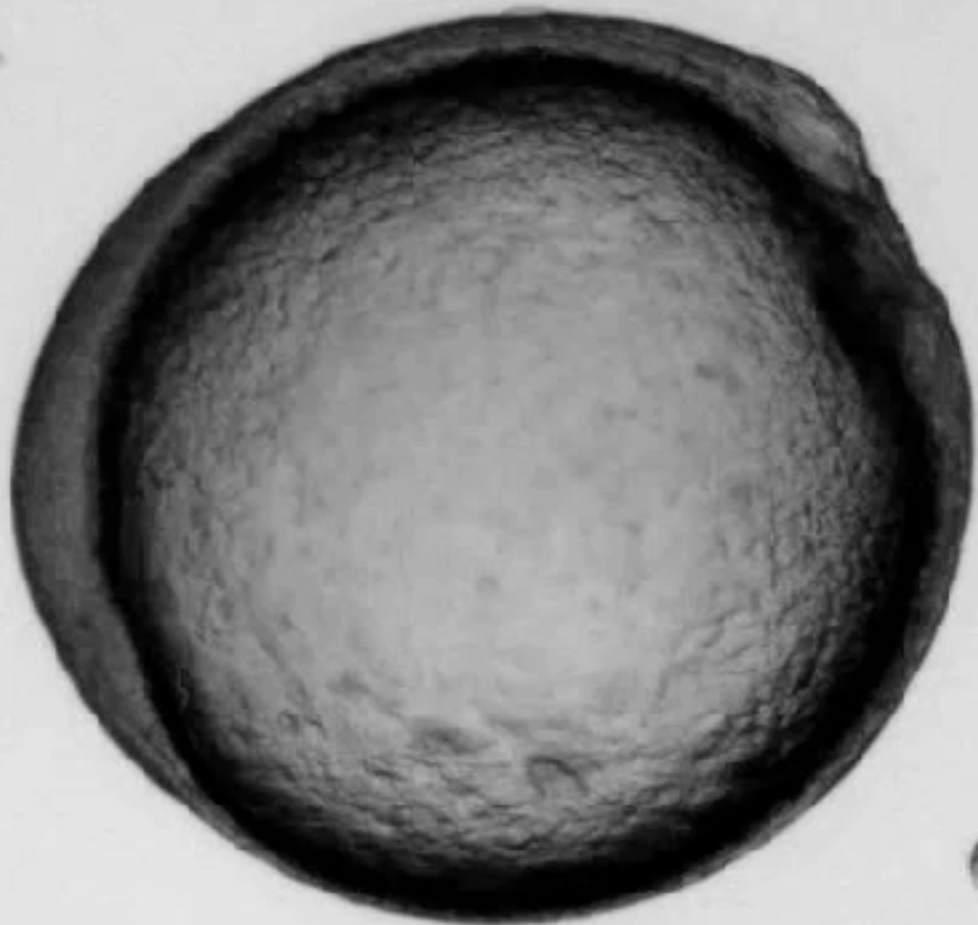


Body segmentation: backbone, ribs and muscles



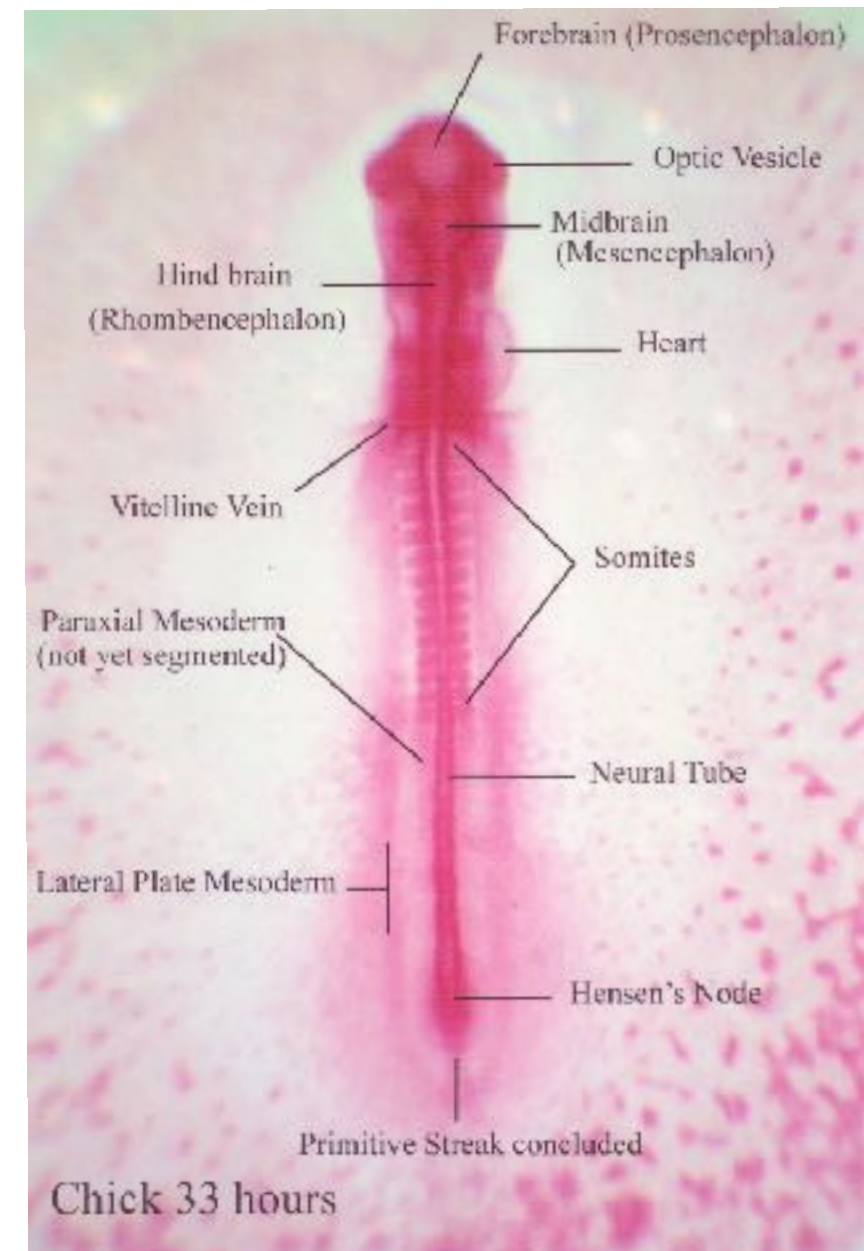
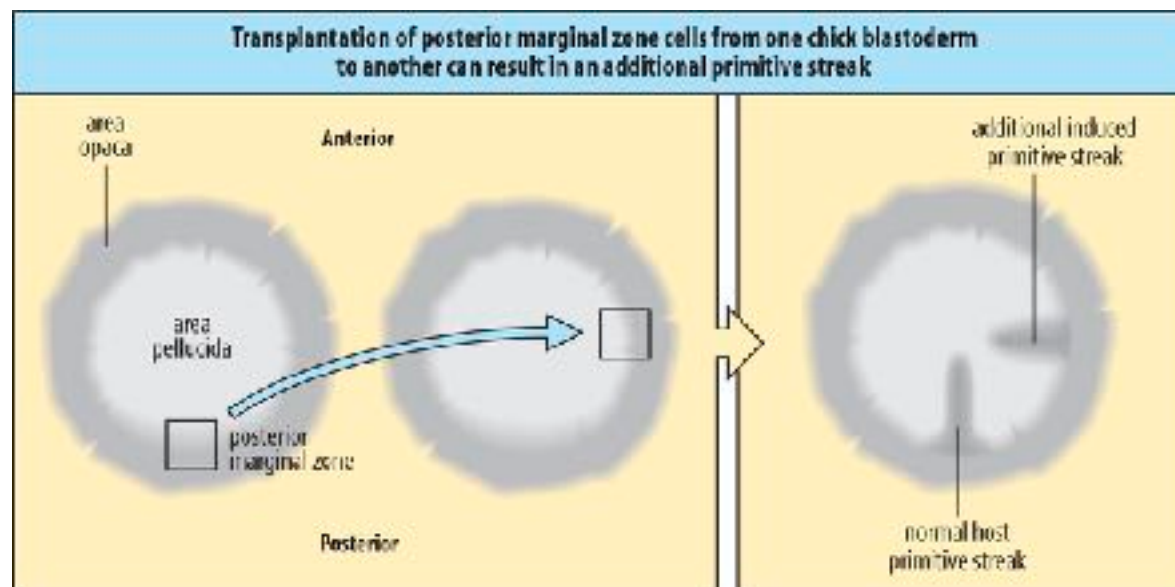
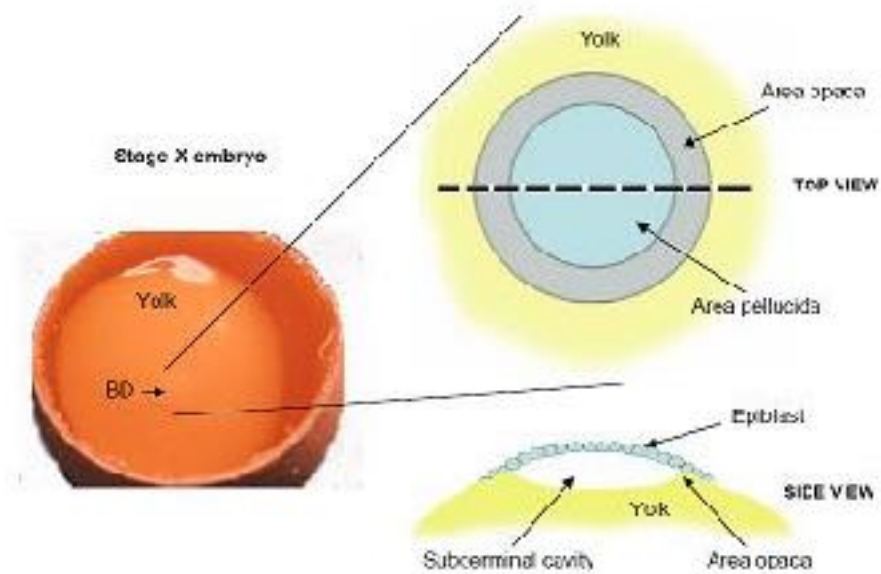
Body segments: added rhythmically and sequentially

0 min

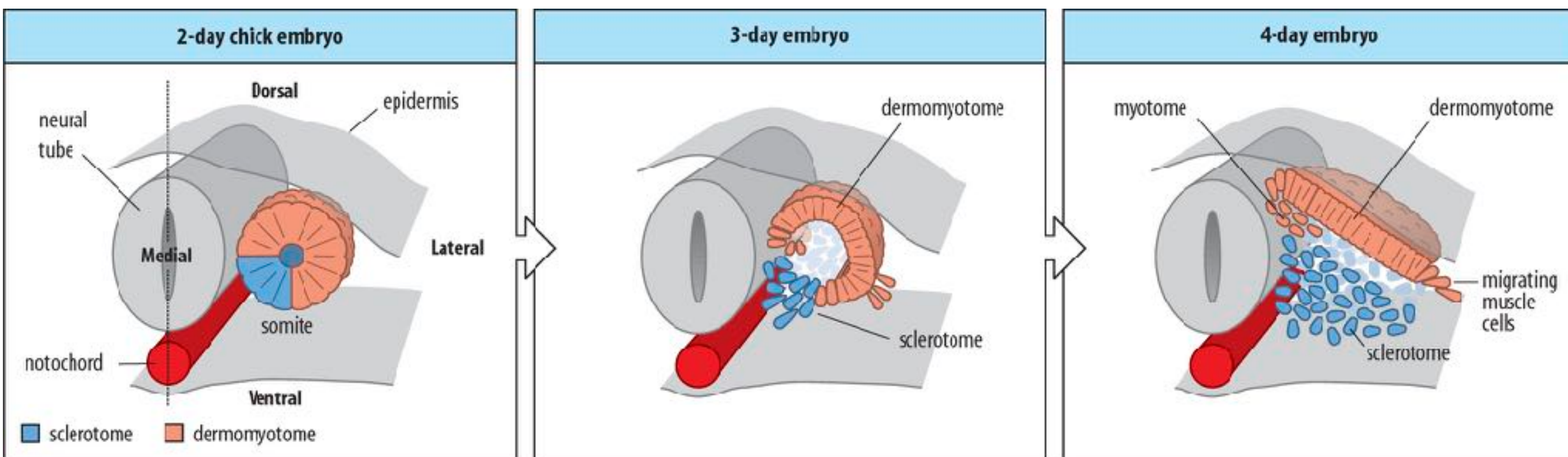


Chick embryos - tasty and useful

<https://www.youtube.com/watch?v=PedajVADLGw>



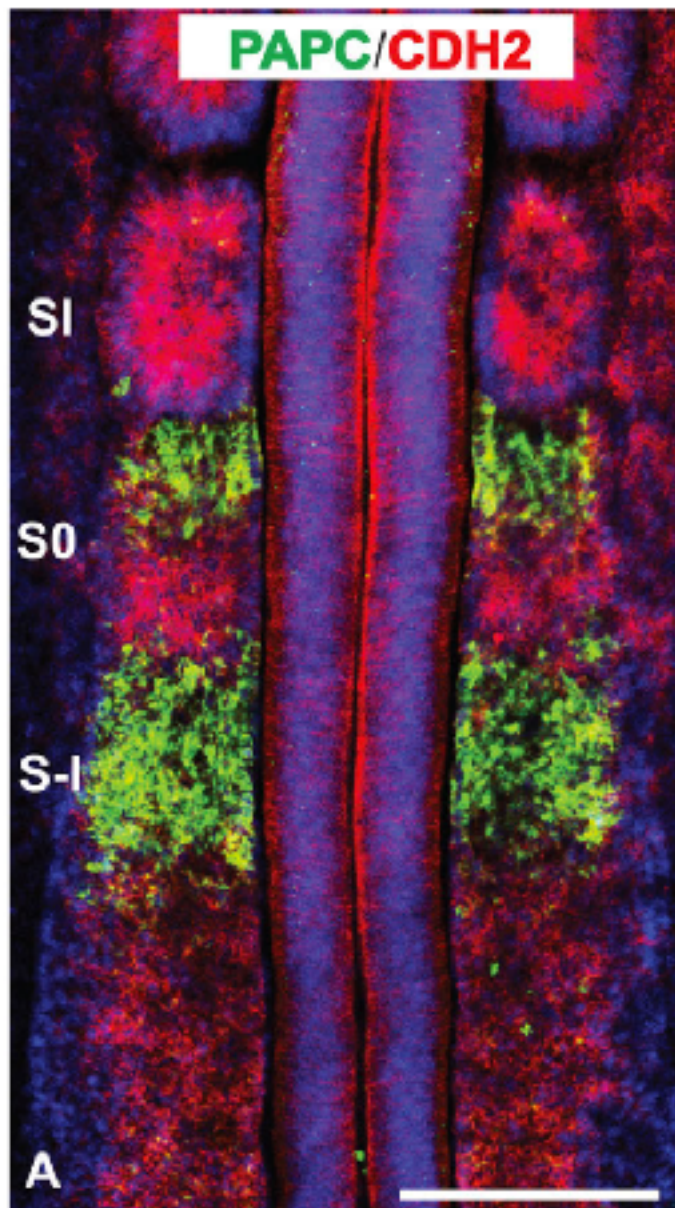
Somites are transient - give rise to muscles and bone



Sclerotome - bone: ribs, centra

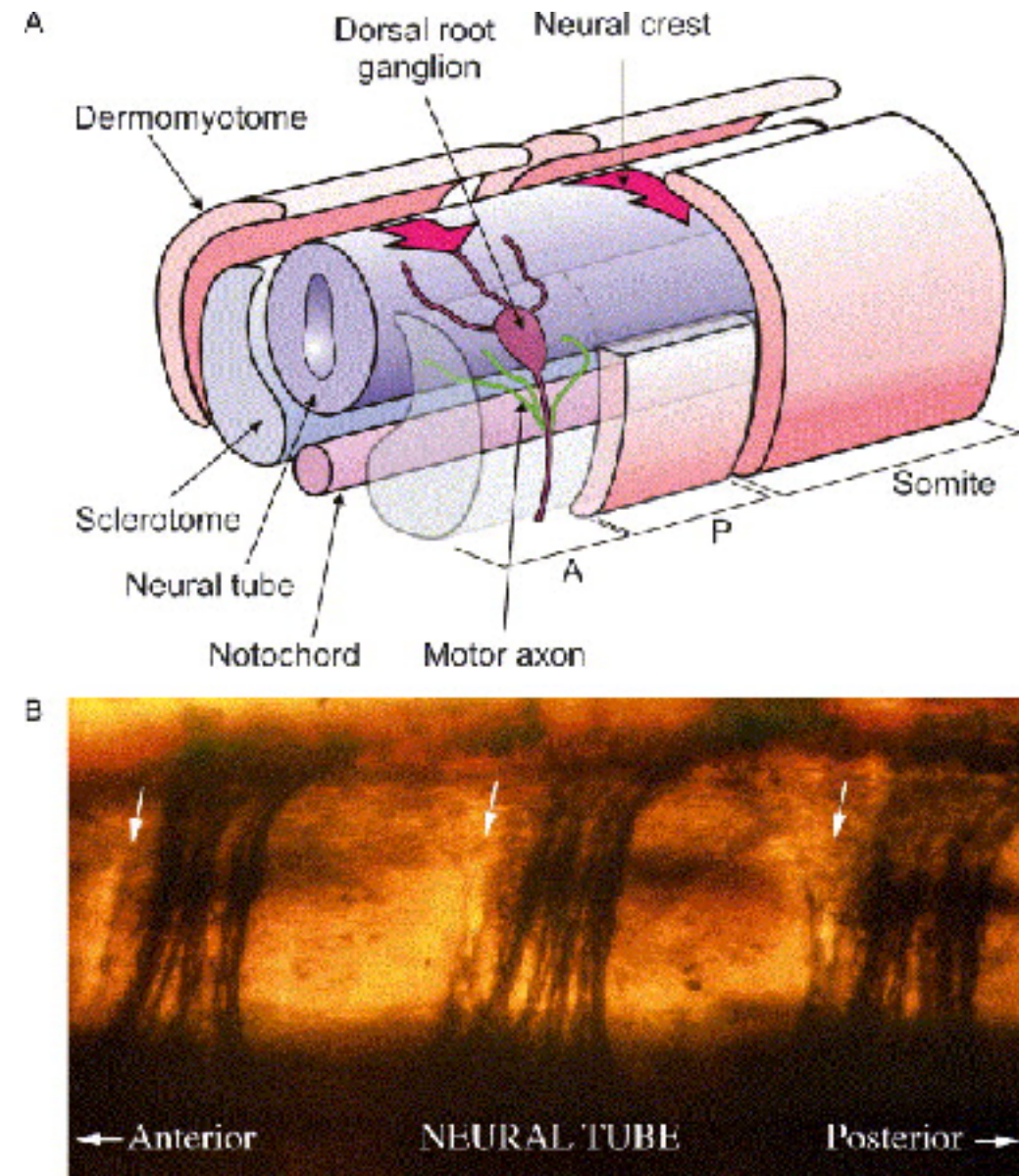
Dermomyotome - skin and muscles

Somites have A-P polarity - guides boundaries and other cells



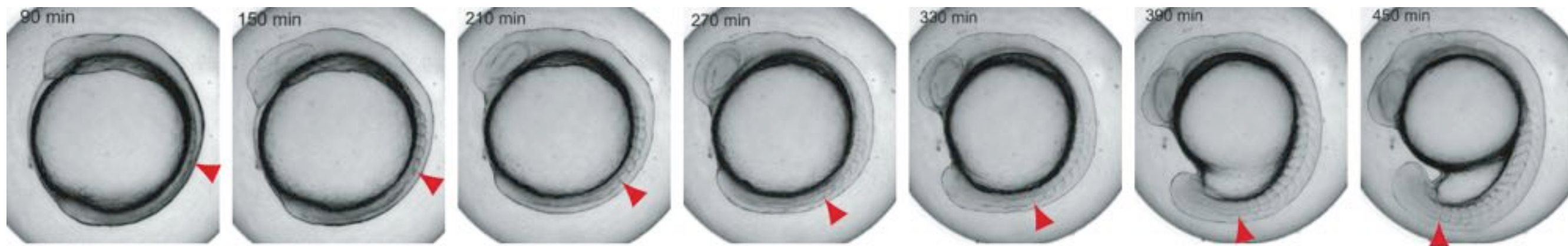
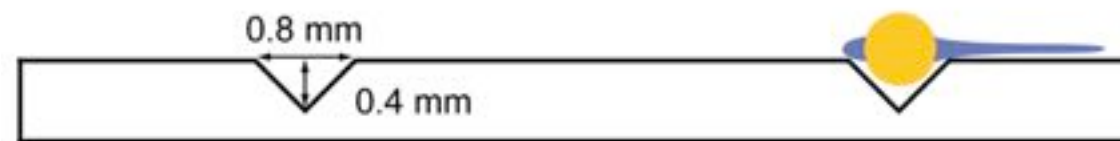
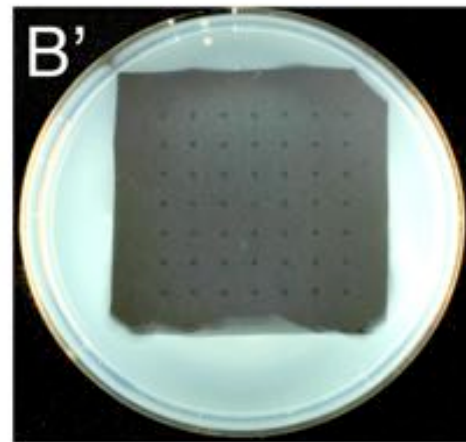
Paraxial protocadherin (PAPC)

N-cadherin (CDH2)



Measuring *Segmentation period* in the zebrafish

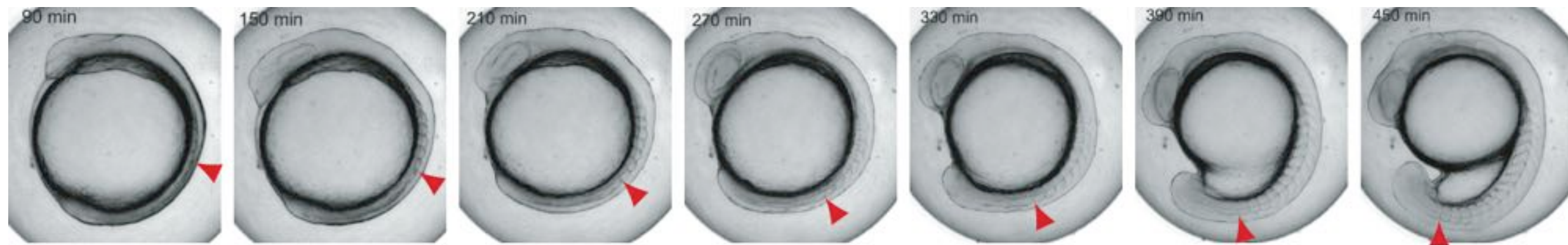
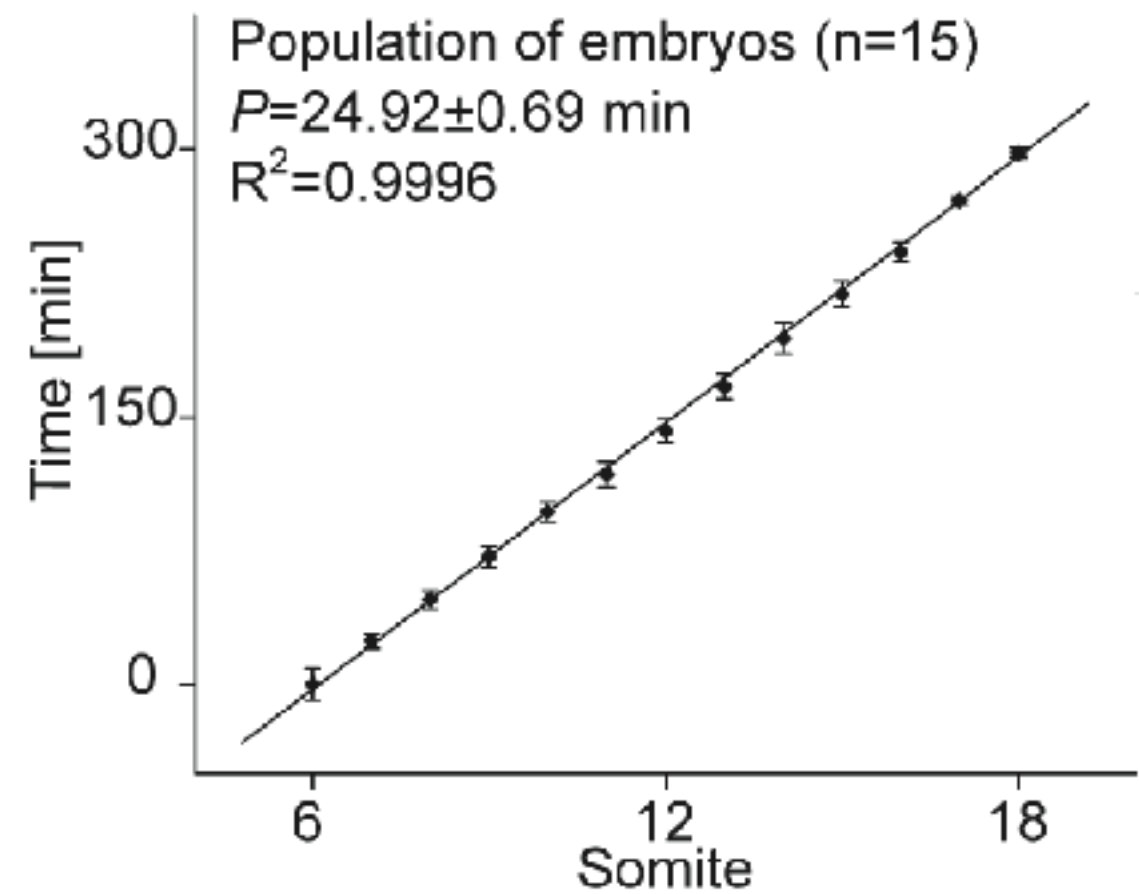
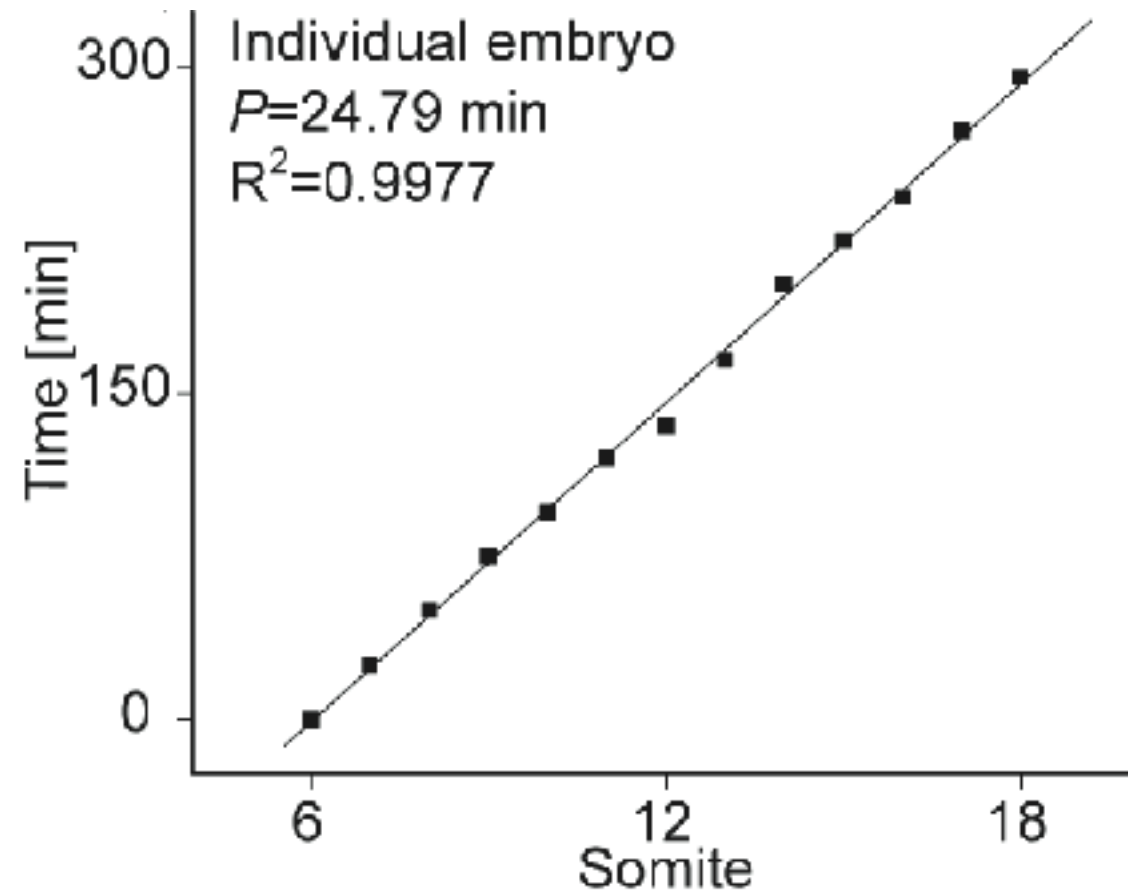
Schröter et al., 2008;
Herrgen et al., 2009



time →

Schröter, C., Herrgen, L., Cardona, A., Brouhard, G. J., Feldman, B., & Oates, A. C. (2008). Dynamics of zebrafish somitogenesis. *Developmental Dynamics*, 237(3), 545–553. <http://doi.org/10.1002/dvdy.21458>

***Segmentation period* ~constant and precise**

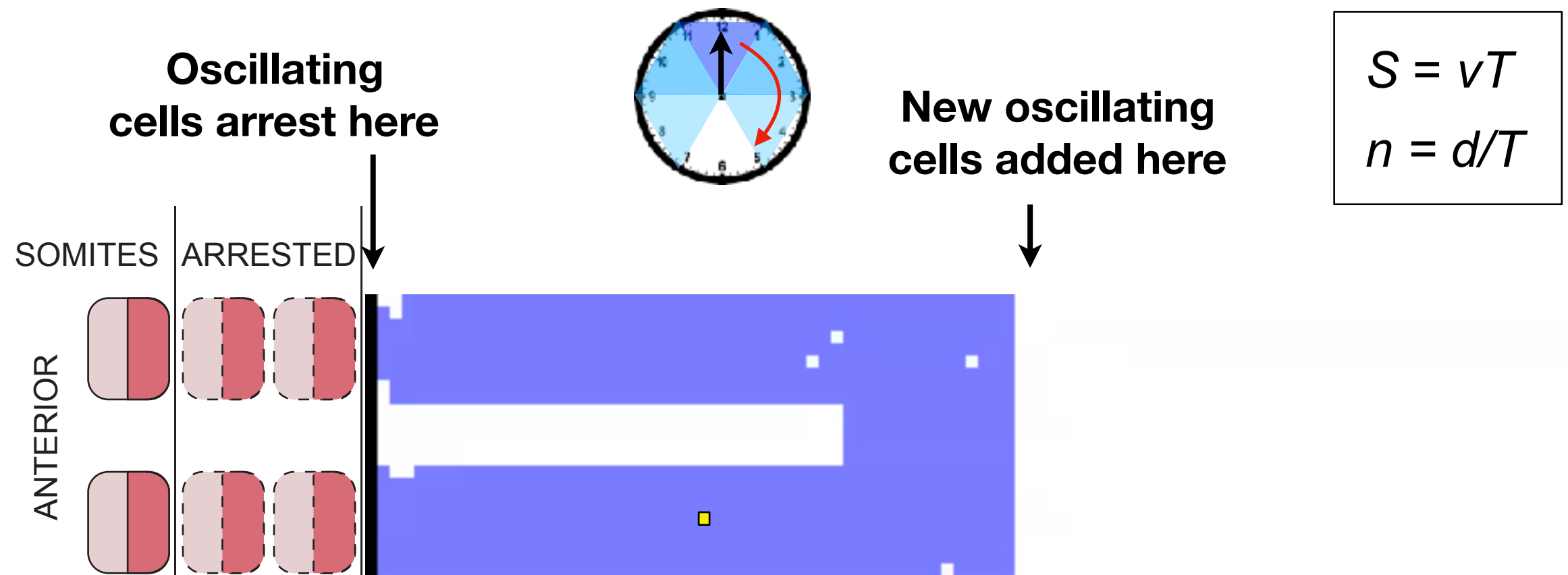


time →

Chick: ~90 min Mouse: ~2 hours

Clock and Wavefront - subdividing an embryo

Cooke and Zeeman, 1976



Morelli et al., 2009

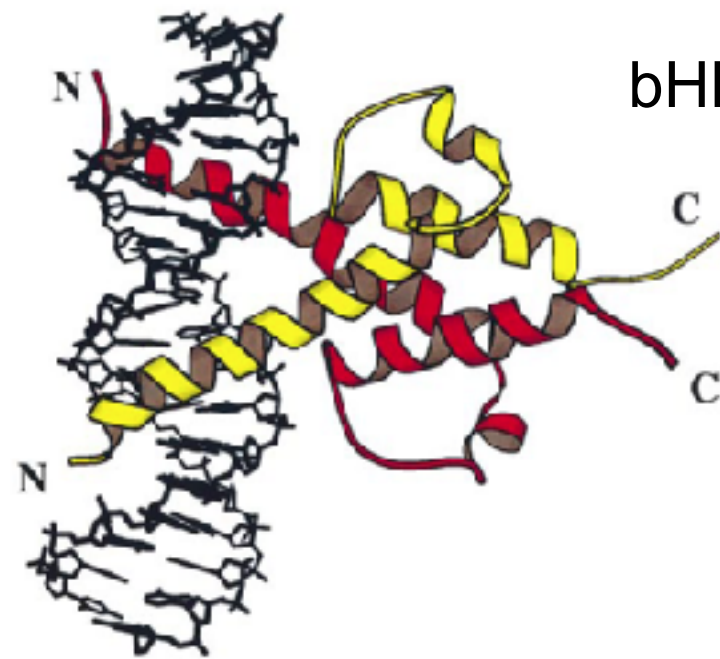
segment length = velocity of wavefront x period of clock

Oscillations require ***negative feedback***



Known example: the Circadian Clock

A model cellular oscillator - transcription translation cycle

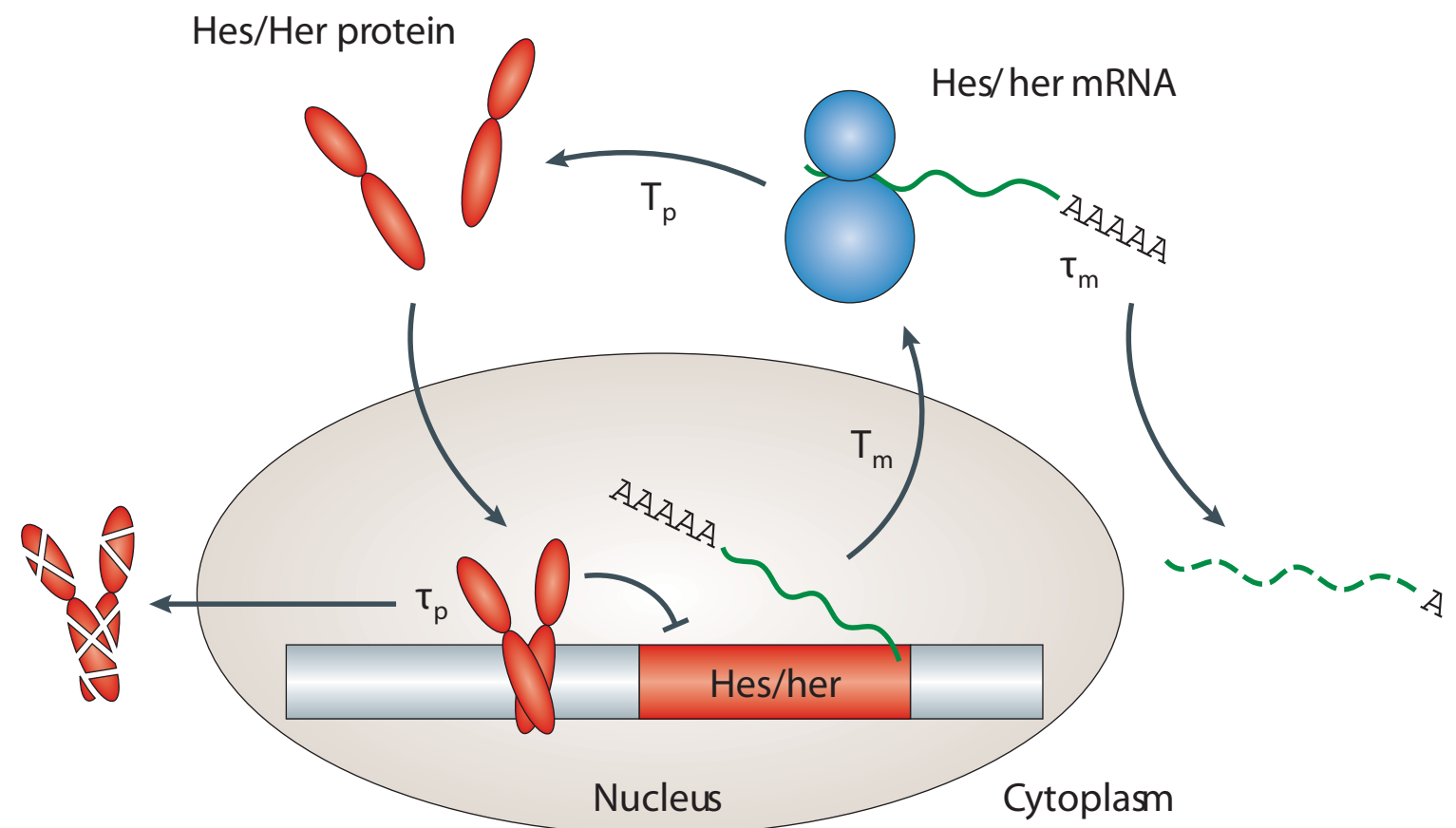


bHLH - DNA crystal

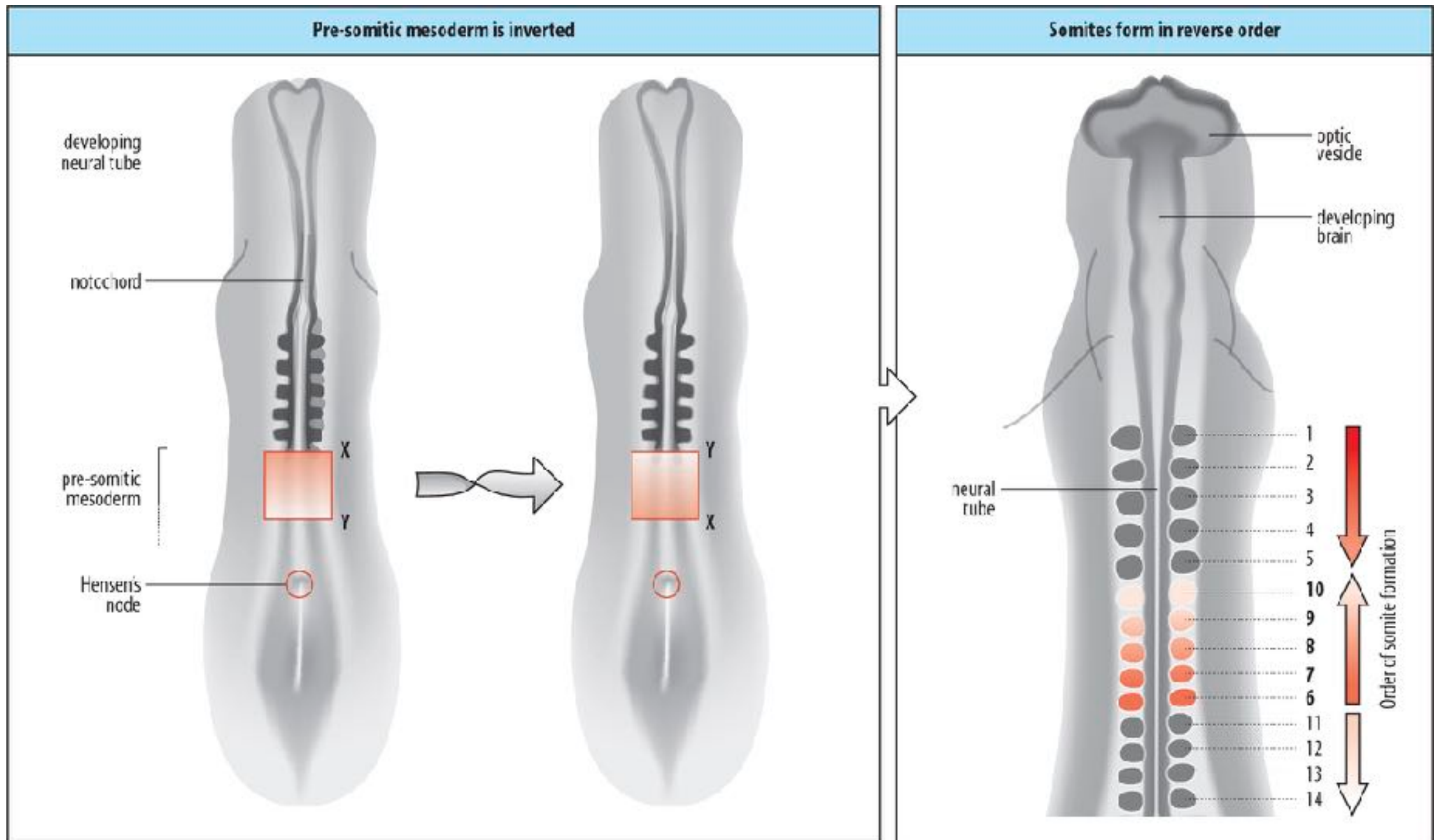
Chick - *c-hairy1*

Mouse - *hes7*

Zebrafish - *her1*

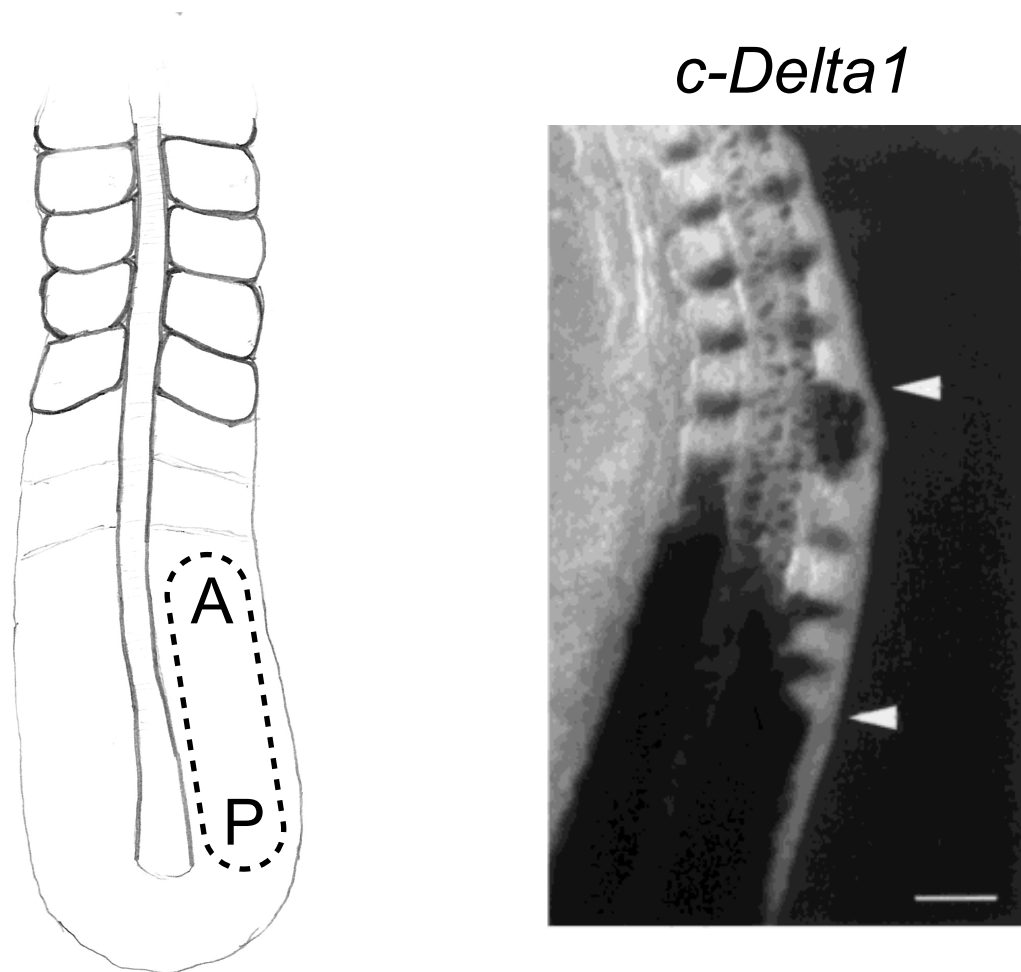


PSM inversion - prior orientation is retained



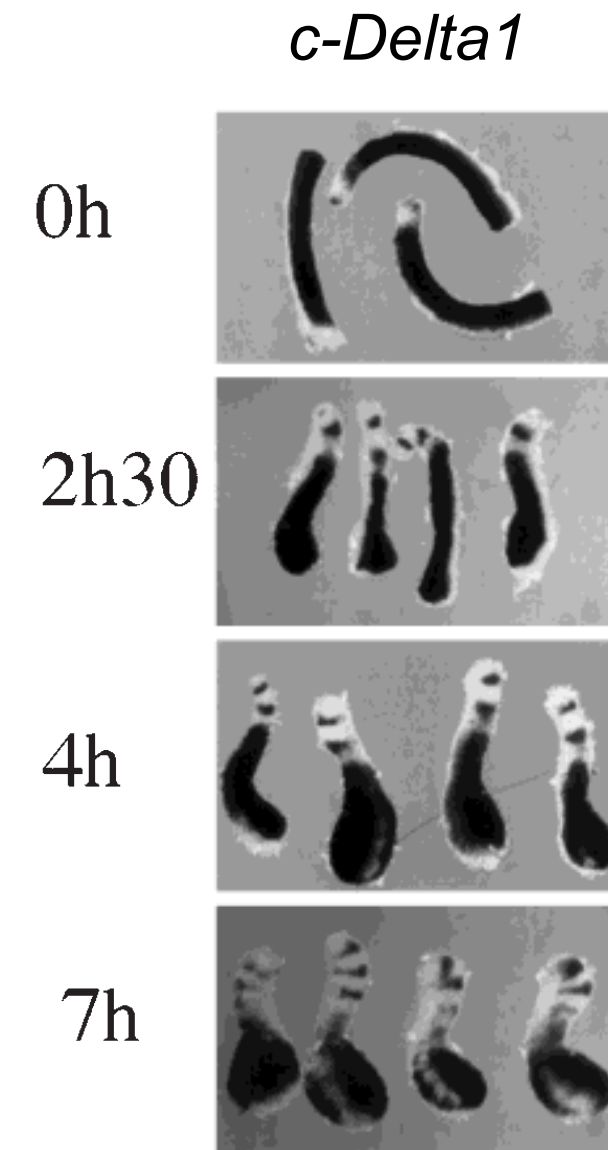
PSM inversion and explant - prior orientation is retained

PSM reversal graft



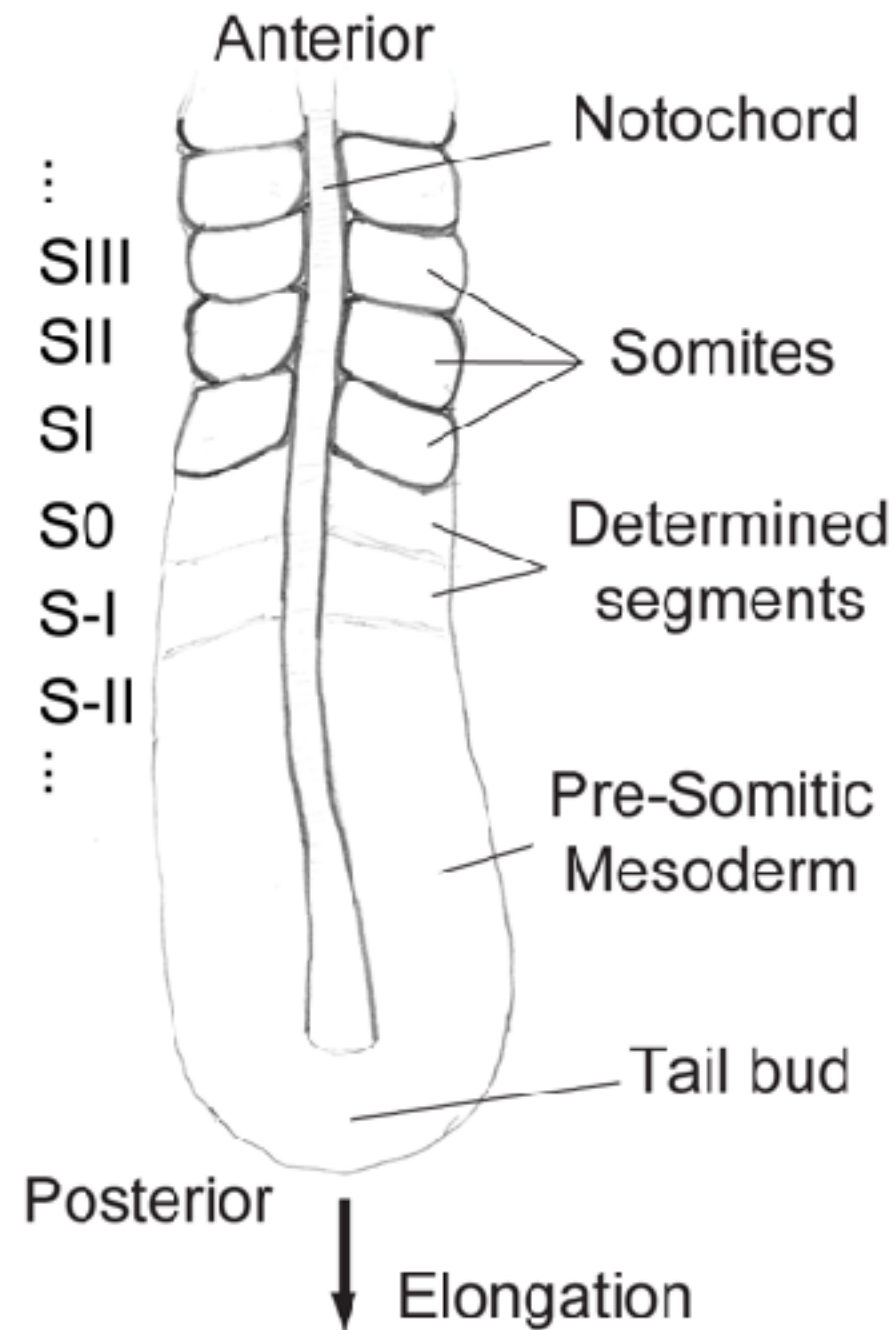
Menkes et al., 1968; ; Menkes and Sandor, 1969;
Christ et al., 1974; Palmeirim et al., 1998

PSM explant

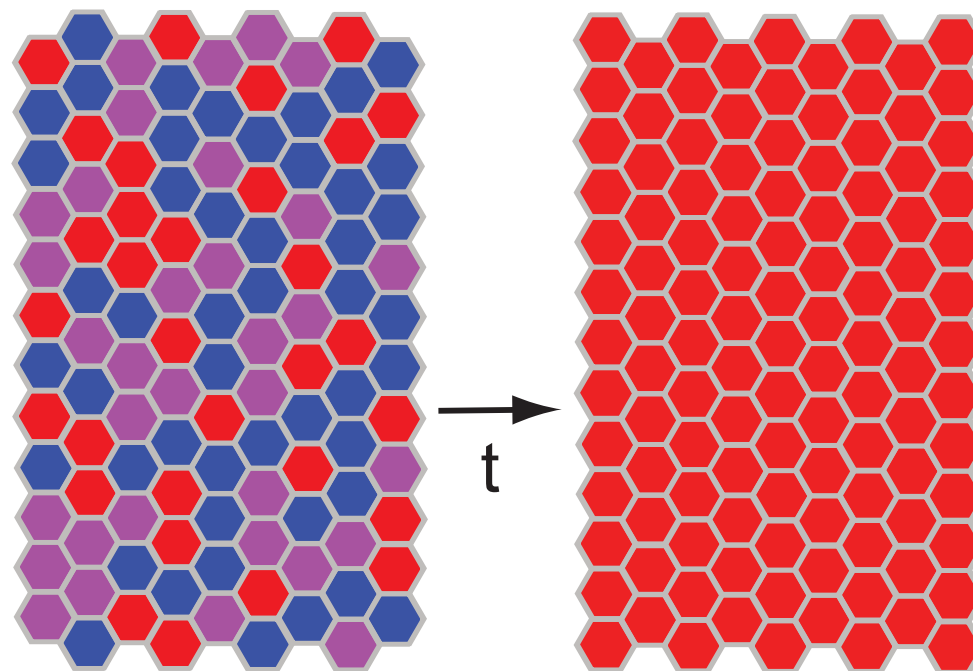
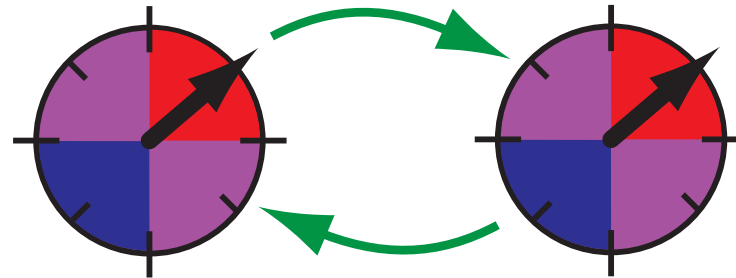


Palmeirim et al., 1997; Palmeirim et al., 1998

What is happening in the PSM? Is there a clock?



Genetic oscillators



unsynchronized
oscillators

synchronized
oscillators

coherent, tissue-level oscillation