

# Ciona Notochord Morphogenesis: Fate Mapping



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## Stochasticity and stereotypy in the *Ciona* notochord

Maia Carlson, Wendy Reeves, Michael Veeman

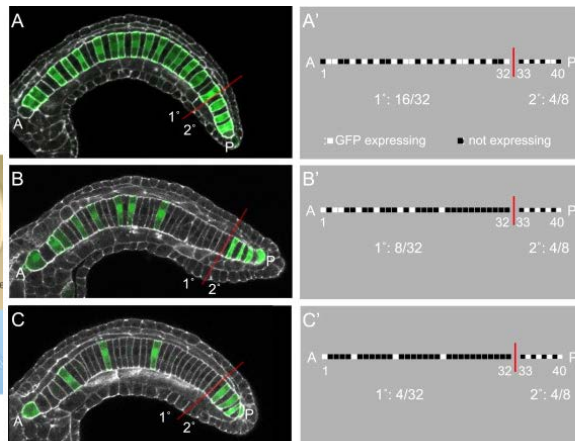
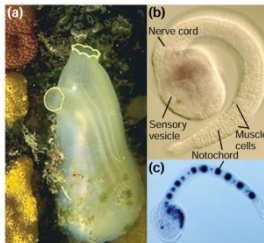


Fig. 1.

Quantifying mosaic transgene expression patterns. (A–C) Confocal images of different mosaic expression patterns of an electroporated *Bra1*-GFP expression plasmid in *Ciona* embryos (green). Phalloidin staining of the actin cytoskeleton is shown in white. The anterior tip of the intercalated notochord is to the left and indicated with an 'A'. The posterior tip of the intercalated is to the right and indicated with a 'P'. The boundary between the primary and secondary notochord lineages between cell 32 and 33 is indicated with a red line. (A'–C') Schematic representation of the expression patterns seen in (A–C). Each notochord cell is scored as being expressing or not expressing. This is represented as a binary string for each embryo. All three embryos have 4 of the 8 secondary notochord cells expressing GFP. The embryo in (A and A') shows transgene expression in 16 of the 32 primary notochord cells, whereas the embryo in (B and B') has only 8 expressing primary notochord cells and the embryo in (C and C') has only 4 expressing primary notochord cells.

- *Ciona* notochord, possesses a transient embryonic and larval structure, is an original system because it is a specialized tubular organ, not a body cavity.
- Defects in mediolateral intercalation underlie several major birth defects, and a newly quantitative understanding of *Ciona* notochord intercalation is a major step towards our long-term goal of building quantitative, multiscale models of how organ shape is controlled in this experimentally tractable model chordate.
- Development of a genetic fate mapping strategy based on the mosaic expression of an electroporated transgene that facilitated the quantification of intercalatory behaviors of the 40 *Ciona* notochord cells on a very large scale.
- *Ciona* notochord intercalation is much more stereotyped than previously believed, and data suggests that the balance between stereotyped and stochastic behaviors is heavily constrained by the geometry of the intercalating tissue.
- This highly quantitative analysis of intercalatory behaviors in wildtype embryos will act as an important baseline for the future analysis of genetically perturbed embryos.