• *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.