From genes to shape: Molecular control of mechanical forces during tissue morphogenesis

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The shaping of tissues is crucial for establishing functional organs during animal development. One fundamental shape change of epithelial tissues is folding whereby a quasi 2-dimensional sheet of cells acquires a precise 3-dimensional form. Epithelial folding is important, e.g. during embryonic gastrulation, neural tube, eye, gut and brain development, and defects in epithelial folding can give rise to human disease. The folding of epithelia requires the generation of mechanical forces to alter the shape or arrangement of cells within the tissue. Mechanical forces are generated by the cell's cytoskeleton, however, how force generation is controlled within cells and across tissues to give rise to precise changes in epithelial shape is poorly understood.

The *Drosophila* wing disc, the precursor of the adult wing, serves as a well-established model system to study signaling pathways and tissue morphogenesis. We showed that the Wnt and Hedgehog signaling pathways control force generation during the folding of the wing disc. However, the downstream targets of these signaling pathways that alter mechanical forces and drive folding are unknown.

This project will use a combination of molecular genetics, live imaging, quantitative image analysis, biophysics and RNA sequencing to identify the downstream targets of the Wnt and Hedgehog signaling pathways and to elucidate their functions.

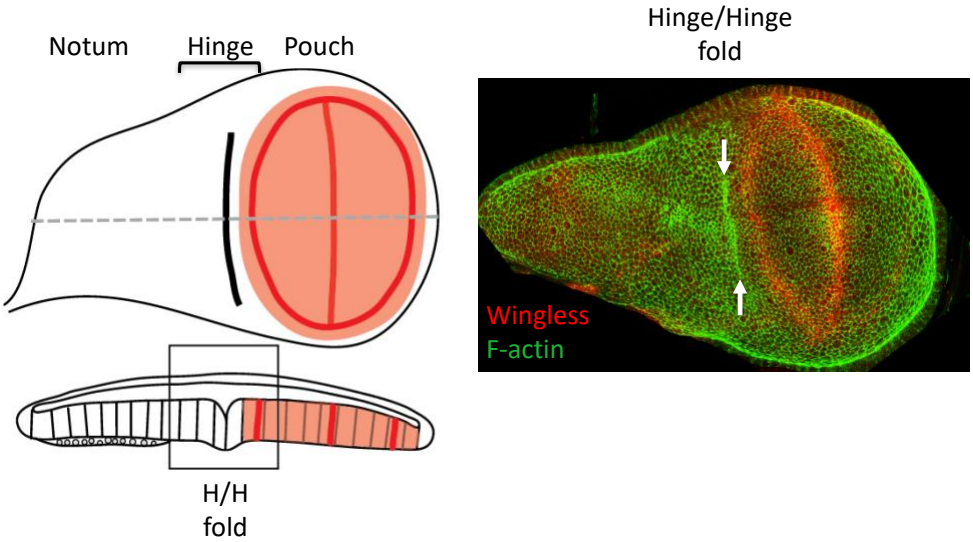

Figure: Wnt/Wingless controls fold formation in the *Drosophila* wing disc.

Further reading:

Sui, L. and Dahmann, C.
A cellular tilting mechanism important for dynamic tissue shape changes and cell differentiation in *Drosophila*.
Developmental Cell, 59, 1-15 (2024)ScienceDirect

Sui, L. and Dahmann C.
Wingless counteracts epithelial folding by increasing mechanical tension at basal cell edges in *Drosophila*.
Development, 147 (2020). Pubmed

Sui L., Alt S., Weigert M., Dye N., Eaton S., Jug F., Myers E.W., Jülicher F., Salbreux G., Dahmann C.
Differential lateral and basal tension drive folding of *Drosophila* wing discs through two distinct mechanisms
Nature Communications, 9, 4620 (2018) [Pubmed]