Title: Cell organisation and 3D shape formation in a posterior neuruloid system

Development requires high co-ordination between cells in time and space, for example, in decisions on whether to divide or die. Substantial work has focused on cell behaviour within specific tissues (e.g., Drosophila wing), but how cells interact between tissues during development to ensure robust morphogenesis is comparatively poorly understood. Self-organisation requires a symmetry-breaking event that causes gene expression changes in a subpopulation of cells, resulting in changes in molecular and mechanical properties that shape the form and function of tissues. Here, we use the neuruloid, an organoid system that mimics the caudal end of the embryo during neurulation and axial elongation in vertebrates, to understand the mechanisms that drives cell differentiation and organisation within this tissue.

At 24 hours following neuruloid induction, we observe two distinct domains within the organoid with different protein expressions, even without a substantial development of 3D shape. Meanwhile, between 27- and 33-hours post induction, we observe a strong apical actin reorganisation, with a formation of a ring of actin alongside the two 'domains' developing a robust pattern with TBXT+ cells on the periphery of the organoid, and SOX2+ cells in the centre. After 36 hours of development, 3D shape emerges where the organoid develops into a doughnut-like shape. By 72 hours, lobes of TBXT+ cells develop and initial data at this time point indicates presence of a population of SNAI1 positive cells migrating towards them in a seemingly directed manner.

Through quantitative analysis of this symmetry breaking event and subsequent emergence of 3D shape within neuruloids, we will obtain a better understanding of the mechanisms which underpin patterning and other morphological changes that occur during organ development.