Internship Proposal

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Project Title:
Uncovering the inter-tissue mechanical interactions that drive epithelial rotation
Level:

Master Student

Project Summary:

Collective cell migration is crucial for morphogenesis, tissue repair, and cancer dissemination. While most instances of collective cell migration require the establishment of follower and leader cells, epithelial tissue rotation emerges as a novel mode that contributes to tissue morphogenesis and organ shaping. At larger scales, tissue behavior can influence neighboring tissues' motion through inter-tissue boundaries. However, there is limited understanding of the underlying mechanisms and whether forces at tissue boundaries contribute to this process in the complex mechanical environment of organ formation.

The Drosophila egg chamber is an ideal model to study how epithelial rotation is mechanically coupled between tissues. Egg chamber rotation is driven by the collective movement of the follicular epithelium, which relies on the basal planar polarized organization of

the actin cytoskeleton. Using high-resolution imaging, tissue-specific genetic manipulation, and optogenetic perturbation of contractility, we obtained preliminary data suggesting strong inter-tissue coupling that allows concerted movement. By exposing the egg chamber to blue light for varying durations to manipulate contractility at the interface between tissues, we observed different behaviors in follicular epithelium migration. These observations suggest that mechanical interactions between the two tissues could rely on inter-tissue cell-cell adhesion and mechanical forces at the germline cortex.

Work to be developed by the student:

The student will combine advanced protein perturbation tools with high-resolution imaging to

characterize the potential impact of inter-tissue mechanical coupling at the tissue boundaries

in

epithelial collective cell migration, through a number of specific tasks such as:

1) By perturbing contractility at the germline-epithelium interface, we will determine if mechanical

perturbation has an impact on the dynamic of focal adhesion and components of planar cell polarity implicated in FE rotation.

2) We will use quantitative imaging analysis to determine if the impact of mechanical perturbation

in the germline is correlated with defective cell migration.

References:

1. Friedl P, et al., 2009. Collective cell migration in morphogenesis, regeneration, and cancer.

2. Espina JA, et al., 2022. Durotaxis: the mechanical control of directed cell migration.

3. Barlan K, et al., 2017. Fat2 and Lar Define a Basally Localized Planar Signaling System Controlling

collective Cell migration.

4. Haigo SL, et al., 2011. Global tissue revolutions in a morphogenetic movement controlling elongation.

5. Coban B, et al., 2021. Metastasis: crosstalk between tissue mechanics and tumor cell plasticity.

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