

Seminario Especial

Departamento de Fisiología, Biofísica y Neurociencias

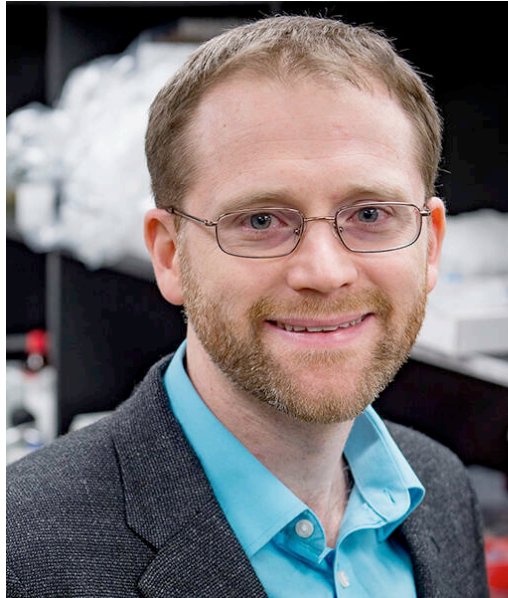


Reverse engineering morphogenesis through the integration of quantitative experiments and multi-scale computational modeling

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**NUEVO Auditorio de
Fisiología (edificio de
Neurociencias)**

**Miércoles
12-marzo-2025
12:00 hrs**

Predicting how an organ's size and shape emerge from complex biomolecular interactions remains one of the most significant challenges in systems biology and tissue engineering. Our research integrates experimental and computational approaches to elucidate the underlying principles of morphogenesis. To do so, we use the larval wing disc of the fruit fly as a powerful model system for discovering the mechanisms regulating a growing organ's shape and size. In the first part of the talk highlighting interdisciplinary collaborations, I describe the formulation and experimental validation of a multi-scale computational model that has generated new mechanistic insights into the control logic of morphogenesis. Using tools that create spatially defined perturbations to growth or mechanotransduction pathways, we demonstrated that increasing cell proliferation through different growth-promoting pathways leads to distinct outcomes. For example, increased insulin signaling enhances the tissue's basal curvature while stimulating growth through Bone morphogenetic protein (BMP/Dpp) signaling, or elevated Myc expression has the opposite effect and flattens the central tissue region. These variations in outcomes arise from differences in how each growth pathway regulates contractility, cell-ECM adhesion, and ECM stiffness. In the second part of the seminar, I discuss efforts to reverse-engineer how the mechanosensitive ion channel Piezo impacts cellular processes in multicellular systems. Here, we discovered that Piezo promotes robustness in regulating epithelial topology and is necessary for maintaining precision in organ size control. In summary, our interdisciplinary work has revealed a fundamental strategy of orchestrating tissue morphogenesis through the balanced interplay of growth and cell mechanics. This seminar explores organ growth and morphogenesis to identify new fundamental principles that impact developmental biology, tissue engineering, and regenerative medicine.