



**University of Stuttgart**

Stuttgart Research Center Systems Biology



## Systems Biology Seminar Talk

# From Code to Force: An Evolutionary Perspective on Fly Embryo Building

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**Thursday, 13.11.2025**

**13:30 CET**

**Host:**

**Dr. Andrew Clark**

**Room 1.177, UG**

**Allmandring 31**

**Stuttgart**

### Abstract:

Morphogenesis arises from the coordinated dynamics of genetic, cellular, and mechanical systems. During gastrulation, gene regulatory networks specify cell fates and orchestrate the forces that shape tissue architecture. Yet, how the structure of these networks and their coupling to mechanical feedback evolve to generate new morphogenetic strategies remains unclear.

Using comparative in toto live imaging across a phylogenetically broad panel of insect species, our groups quantitatively links regulatory architecture, gene innovation, and tissue mechanics during the establishment of the embryonic body plan. We find that rewiring of gene regulatory networks can drive fundamental transitions in the mode of morphogenesis, revealing direct transcriptional control over tissue mechanics. The emergence of lineage-specific genes further expands the mechanical state space of the embryo by introducing new structural and biochemical modules that modulate material behavior. Finally, comparative perturbation experiments indicate that feedback from tissue mechanics can bias regulatory trajectories, suggesting that internal physical constraints act as self-organizing drivers of evolutionary innovation.

These findings position the early embryo as a coupled genetic-mechanical system in which fate specification and force generation operate within an integrated feedback network. Such coupling provides a systems-level framework through which developmental and evolutionary dynamics jointly shape the emergence of animal form.

### CV:

Steffen Lemke heads the Department of Zoology at the University of Hohenheim. His research focuses on the innovation and optimization of epithelial morphogenesis, using gastrulation in insects and vertebrates as an experimentally tractable system to study how developmental and evolutionary dynamics interact to shape animal form. His group combines comparative embryology, quantitative imaging, and evolutionary genetics, and has established a broad panel of experimentally accessible insect species representing key nodes in the phylogeny. Steffen Lemke obtained his PhD from the University of Göttingen, conducted postdoctoral research in the Schmidt-Ott lab at the University of Chicago, and established his first group in Heidelberg before moving to Hohenheim in 2023.