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Abstracts

Concurrent session 5: Pattern formation

Program/Abstract # 36
Generation and interpretation of segmentation clock pattern during zebrafish somitogenesis
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Somites are the most prominent segments in the vertebrate embryo and give rise to skeletal muscle, dermis and vertebral column. The size of each somite, as well as the rate of somite formation, is thought to be governed by a mechanism described by the clock and wavefront model. The wavefront represents the anterior to posterior development of the body axis while the clock gates the activity of the wavefront such that a somite boundary only forms when the wavefront reaches cells in the permissive phase of the clock. In zebrafish, the clock is thought to be constituted by an unstable negative feedback loop of Hairy/Enhancer of Split related genes (Her). This negative feedback loop causes each cell to go through repeated cycles of gene expression and repression that manifest as stripes of gene expression. These stripes presage morphological segmentation, and the clock and somite morphogenesis are linked by the transcription factor fused somites (fss)/tbx24. Downstream of fss, somite boundary formation involves signaling by the receptor tyrosine kinase EphA4 and its Ephrin ligands. Integrin $\alpha5\beta1$, the primary receptor for Fibronectin, establishes an extracellular matrix along the somite boundary. Here, we address the connection between segmentation clock patterning and somite boundary formation.

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Program/Abstract # 37
FoxH1 and nodal signaling during zebrafish development
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The Nodal signaling pathway is important for a variety of steps during vertebrate development, including germ layer specification, axial structure formation, and asymmetric organ positioning. I have identified a novel zebrafish allele of *FoxH1*, the transcriptional effector of the Nodal pathway, called *midway* (*mid*). The *mid* mutation truncates the FoxH1 protein, removing its SMAD-interaction domain and presumably preventing it from transducing Nodal signals. Maternalzygotic (MZ) *mid* embryos completely lack notochords and exhibit fused somites, similar to loss of FoxH1 function in other species. The loss of a notochord is preceded by an absence of axial mesoderm markers during early development, and can be restored by injection of mRNA encoding *schmalspur* (*sur*), the previously characterized allele of *zFoxH1*. Early endoderm markers are largely unaffected in both MZ mutants, suggesting that signaling through FoxH1 is required only for axial mesoderm fates and not for endoderm. Both zygotic mutants lack asymmetric Nodal signaling in the lateral plate mesoderm, but *mid* exhibits subtly stronger effects on gut laterality. These phenotypic discrepancies, and the ability of *sur* to partially rescue MZ*mid*, implicate *mid* as a stronger allele of *zFoxH1* and explain why the MZ*sur* phenotype is not as severe as loss of FoxH1 in other organisms. While *mid* may retain some transcriptional repressor function, it likely represents a true loss of transcriptional activation by FoxH1.

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Program/Abstract # 38
Pattern and polarity in the plant epidermis
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During development, multicellular organisms must create a diverse set of specialized cell types and organize these cells into functional tissues. Asymmetric cell division is an important mechanism for solving these challenges. We use stomata (epidermal structures that regulate CO_2 and H_2O exchange in plants) as a model to understand asymmetric divisions during pattern formation; stomata guard cells are created via a stereotyped set of asymmetric cell divisions whose number and orientation are dictated by local cellcell interactions. We are interested in the nature of the positive and negative inputs into this system and how they are integrated. Our focus is on three major elements: (1) a set of related bHLH transcription factors that regulate the cell divisions associated with establishing, maintaining and terminating the stomatal lineage, (2) a negative regulatory circuit previously defined by receptor-like proteins and a Mitogen Activated Protein Kinase (MAPK) cascade, and (3) novel proteins that carry out the asymmetric division process. We have established direct regulatory relationships between the MAPK kinases and bHLHs and will discuss how stomatal development provides a test system for deciphering complex regulatory networks. We will also introduce the novel and asymmetrically localized protein BASL and a model for its activity in differentiation and self-renewing cell divisions.

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