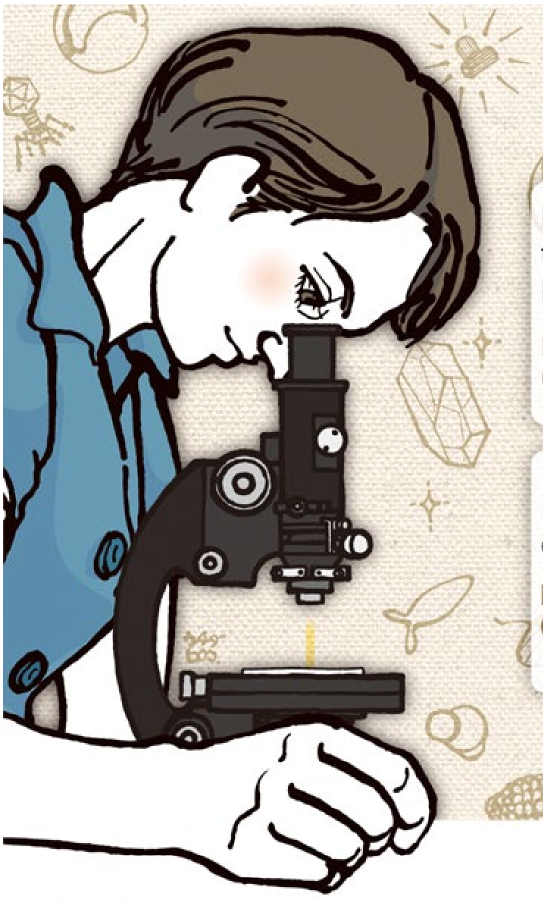
RIKEN BDR

Women and Future in Science Seminar



Molecular Mechanisms Underlying the Evolution of Reproductive Diversity

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Left-right asymmetry by bilateral cellular flows in amniote gastrulation

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2025.2.27 (Thu)

13:00-14:00 JST

← via Zoom Register here

https://riken-jp.zoom.us/meeting/register/tJYsd--qqDspGtdFYCxVG78T9r8kSu0Nyb1s

Molecular Mechanisms Underlying the Evolution of Reproductive Diversity

Reproductive modes in nature are highly diverse, encompassing gonochorism, hermaphroditism, and parthenogenesis. Despite this diversity, these reproductive modes share a common foundation in gametogenesis, the process that governs the formation of gametes. Recent studies in medaka fish have revealed that gametogenesis is controlled by independent genetic pathways, or "modules", which regulate key processes such as meiosis and folliculogenesis. Evolutionary modifications to these modular switches may alter the regulation of key processes of gametogenesis, leading to the emergence of diverse reproductive modes. For instance, such modifications could enable the formation of diploid oocytes in parthenogenetic species.

This study focuses on the Amazon molly (Poecilia formosa), a parthenogenetic fish that evolved approximately 100,000 years ago from an interspecific hybridization event involving its gonochoristic ancestor, Poecilia mexicana, which still exists today. By exploring how the "meiotic module" is bypassed during oogenesis, this study aims to elucidate the molecular mechanisms underlying the transition from gonochorism to parthenogenesis. Single-cell RNA-seq was performed on ovaries from Amazon molly and Poecilia mexicana. Transcriptomic comparisons identified developmental timepoints and pathways specifically associated with diploid oocyte formation. This study sheds light on the evolutionary rewiring of modular switches driving reproductive mode diversification.

Left-right asymmetry by bilateral cellular flows in amniote gastrulation

Various human disorders demonstrate the paramount significance of laterality in proper development. In vertebrates, midline morphogenesis and large-scale cellular flows are striking characteristics of the onset of bilaterality, and then laterality (i.e. left-right asymmetry) is assigned into the left-right compartmentalized embryonic field by asymmetric gene regulation of the laterality signals. In amniotes, the primitive streak is the earliest midline structure and serves as an organizing center of gastrulation. In avian embryo, a bilateral counter-rotating cellular flow, termed ‘polonaise movements’, occurs along the midline axis during primitive streak development. Using the primitive streak in chick embryos as a model system, our recent study revealed that midline morphogenesis and the large-scale cellular flows are coincident, but not co-dependent, during early avian gastrulation (Asai et al., eLife, 2024). Further, our experimental system combined with PIV analysis characterized left-right-asymmetric features in the polonaise movements (Asai and Sinha et al., biorXiv, 2024). These results suggest that laterality in avian is patterned earlier than suggested by current models, which assume that the asymmetric regulation of the laterality signals at the node leads to the left-right patterning.

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