Biology 1 (Cell biology 1)

Day 2, July 14, 10:30am-12pm

Regulatory mechanisms of plant development

Tatsuo Kakimoto

Department of Biological Sciences, Graduate School of Science, Osaka University

Plant morphogenesis depends on intercellular communication, intracellular signaling, and cell-type determination. I will introduce some of our work, including the mechanisms of how the stemness-like features of pericycle is given, and how interplay of intercellular communication and transcriptional regulation creates proper vascular pattern.

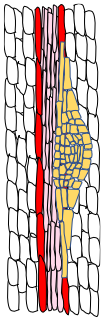


Figure. Only pericycle cells (red) can produce lateral root primordia in Arabidopsis. We recently found transcriptional regulators that govern the competency of pericycle to produce lateral root primordia.

Biology 1 (Cell biology 1)

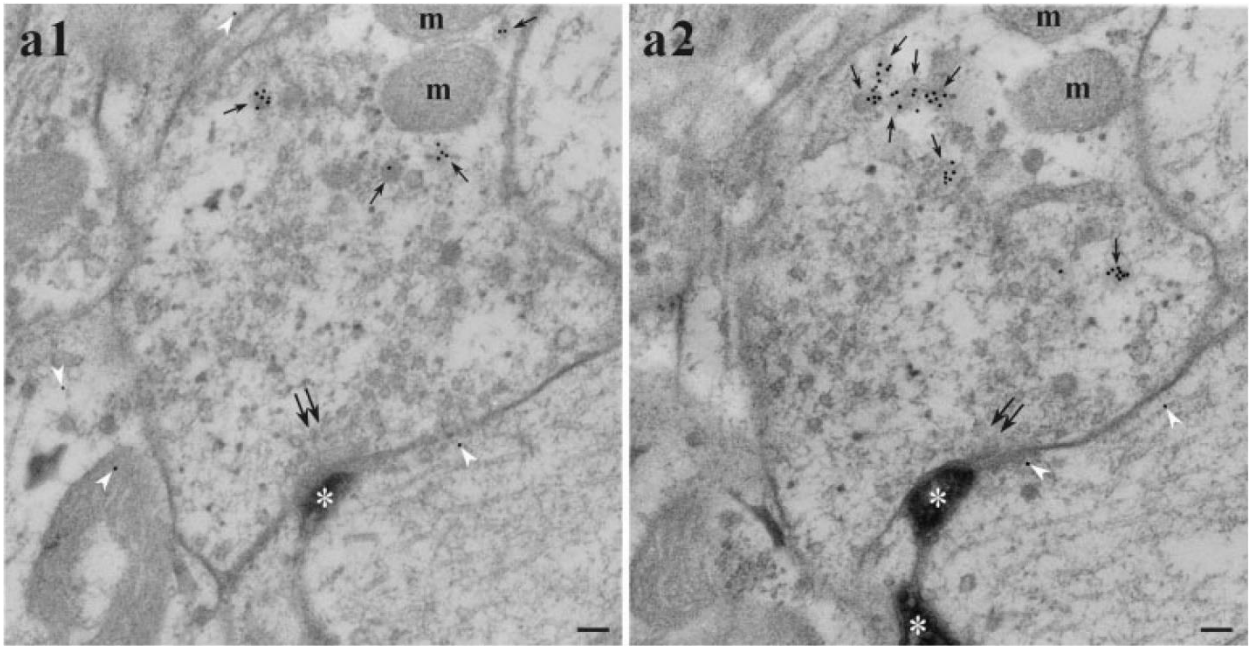
Day 2, July 14, 10:30am-12pm

What neuroanatomy tells us about the functional principle of brains: a study in insect microbrains

Yoshitaka Hamanaka

Laboratory of Comparative Neurology, Graduate School of Science, Osaka University

The brain is a network formed by many neurons, the shape and chemical nature of which dictate the function often via establishment of its synaptic connection. Besides, its internal ultrastructure enables us to see its mode of neurotransmission and polarity of information flow. Thus, neuroanatomical study is fundamental to understand where and how information is processed. Among animals, insect microbrains are especially suitable to understand its functional principle because it consists of a relatively small number of neurons (~100,000 to 1,000,000). In a seminar, I will give a talk that shows great potency of neuroanatomy and also a technique to find out functional connection between two particular sets of neurons.



Hamanaka et al. (2005) *J Comp Neurol*

Biology 1 (Cell biology 1)

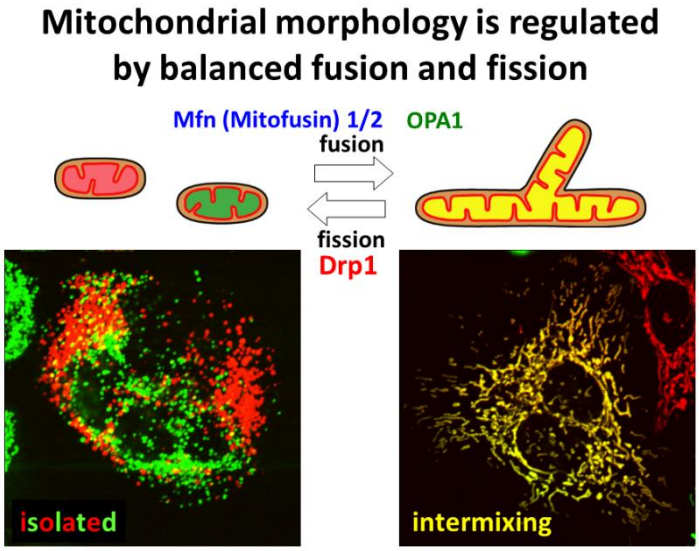
Day 2, July 14, 10:30am-12pm

Biological Sciences

Mitochondrial fusion and fission factors regulating cellular signaling and function.

Naotada Ishihara (Department of Biological Sciences, Graduate School of Science, Osaka University)

Mitochondria are multifunctional organelles that have critical roles not only in energy production by oxidative phosphorylation but also in various cellular signaling pathways. Mitochondrial morphology changes dynamically under the mitochondrial stress, energetic condition, and cellular signaling such as differentiation, apoptosis and antiviral response. In mammalian cells, dynamin-related GTPase Drp1 plays a key role in mitochondrial fission, and several GTPase proteins are essential for the mitochondrial fusion. Mitochondrial fusion and fission factors should have multiple regulatory functions in differentiated cells and in vivo. Recently we also found that distribution of mitochondrial DNA is dynamically regulated by the mitochondrial membrane dynamics, which should be required for maintenance of active mitochondria.



Biology 2 (Cell biology 2)

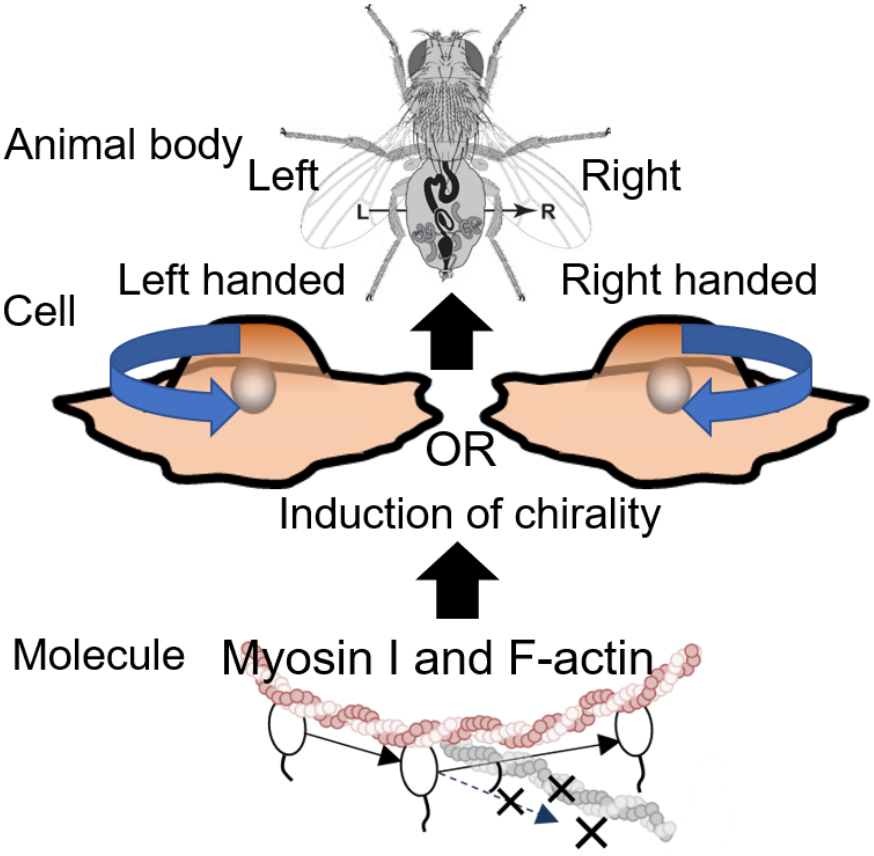
Day 2, July 14, 3:10-4:40pm

Cells with handedness: molecular bases and functions

Kenji Matsuno

Department of Biological Sciences, Graduate School of Science, Osaka University

Chirality is a fundamental element in biology, from the molecular to the organismal level. An object is chiral if it is distinguishable from its mirror image. Most macromolecules found in cells are chiral. An animal also has chirality in the left-right (LR) asymmetric structures and functions of its body. In general, chirality occurring at the molecular and organ/organism scales has been studied separately. However, recently, chirality at the cellular level, designated as cell chirality, was found in various species. We found cell chirality for the first time in vivo. In this presentation, we will show the mechanism how cell chirality is formed. We also propose that cell chirality can serve as a link between molecular chirality and LR asymmetry of animal body.



Induction of chirality from molecule to whole body

Transport toward the center of the cell: structure & mechanism of microtubule-based systems

Ryosuke Yamamoto, Hiroshi Imai, Takahide Kon

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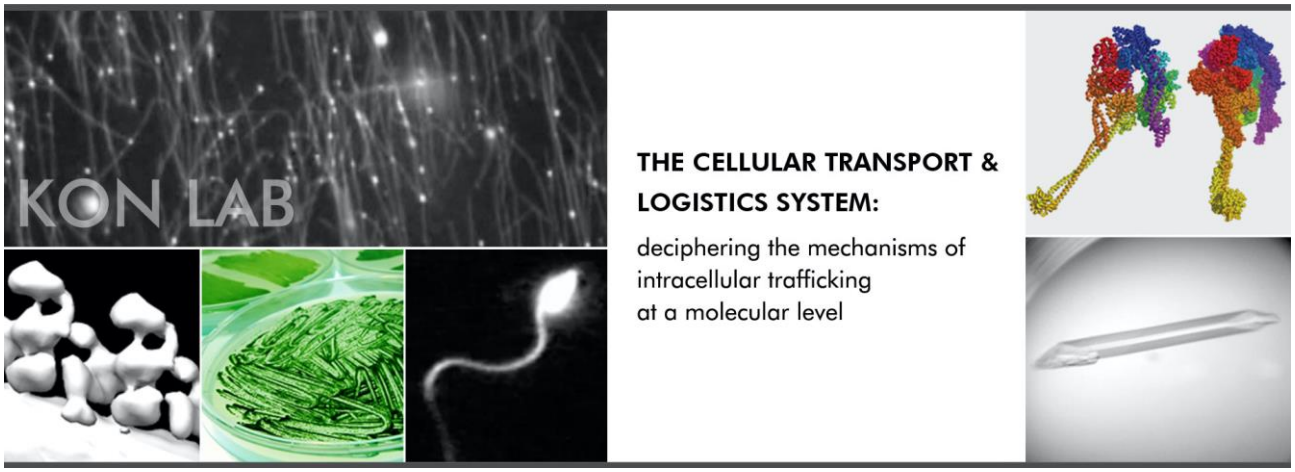
Eukaryotic cells are equipped with efficient intracellular transport systems, which are critical for diverse cellular activities including cell motility, cell division, intracellular trafficking and positioning of numerous biological cargoes [e.g. protein complexes, mRNAs, organelles and viruses]. Underscoring the importance of the transport systems, it is now clear that serious human diseases are associated with dysfunction of these machineries. Our laboratory aims to elucidate the molecular mechanism(s) underlying the intracellular transport systems by means of near-atomic-level structural analysis and single-molecule functional analysis. In this lecture, we will present our latest research results on the microtubule-based transport systems.

References

(1) Ayukawa, R. et al. *J Cell Biol* (2021) 220 (4): e202007033.
(2) Kutomi, O. et al. *Science Advances* (2021) 7 (9): eabf3621.



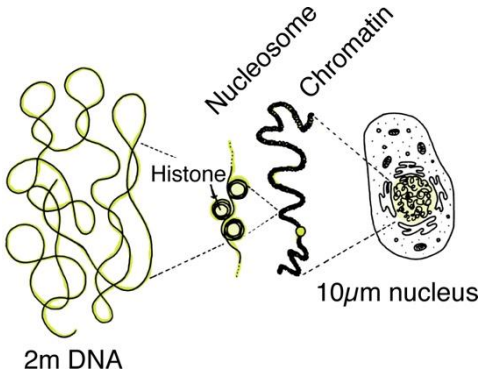
Biology 4 (Molecular genetics)

Day 3, July 15, 3:10-4:40pm

How does the epigenetics impact on gene regulation?

Chikashi Obuse

Department of Biological Sciences, Graduate School of Science, Osaka University



The genetic information of mammalian cells is preserved in the nucleus, in which DNA together with proteins and RNA form a complex called chromatin. Our body consists of various types of cells, and their cellular identities are determined by each cell-type specific gene expression. This cell-type specific gene expression is controlled by epigenetic information including DNA methylation and histone. These epigenetic information can be altered during development or by environmental factors, but are also able to maintained and inherited by the next generation if necesarry. We are interested in epigenetic mechanisms to utilize genetic information properly. In this lecture, I would like to talk about short introduction of molecular mechanism of epigenetics, as well as our study related to this issues.

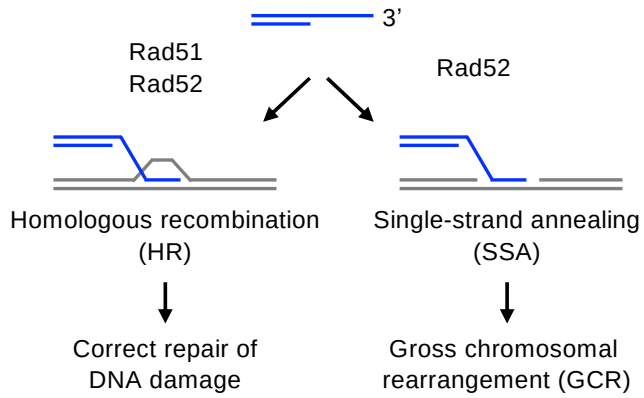
Biology 4 (Molecular genetics)

Day 3, July 15, 3:10-4:40pm

Molecular mechanisms of gross chromosomal rearrangements

Takuro Nakagawa
Department of Biological Sciences, Graduate School of Science, Osaka University

Our genome keeps suffering spontaneous damages, such as DNA breaks and stalled replication forks. Homologous recombination plays an essential role in repairing the damage. In humans, defects in homologous recombination cause hereditary breast and ovarian cancer (HBOC) or Fanconi anemia (FA) syndromes, which exhibit high levels of chromosomal rearrangements and are predisposed to cancer. However, it remains unclear how gross chromosomal rearrangements occur, although its understanding helps finding the way to cure the patients. Using fission yeast as a model organism, we are studying the mechanism of gross chromosomal rearrangements. I want to discuss our recent work showing that Rad52-mediated single-strand annealing (SSA) facilitates gross chromosomal rearrangements.



Onaka, A.T., Su, J., Katahira, Y., Tang, C., Zafar, F., Aoki, K., Kagawa, W., Niki, H., Iwasaki, H. and Nakagawa, T. (2020) DNA replication machinery prevents Rad52-dependent single-strand annealing that leads to gross chromosomal rearrangements at centromeres. *Commun Biol*, **3**, 202.

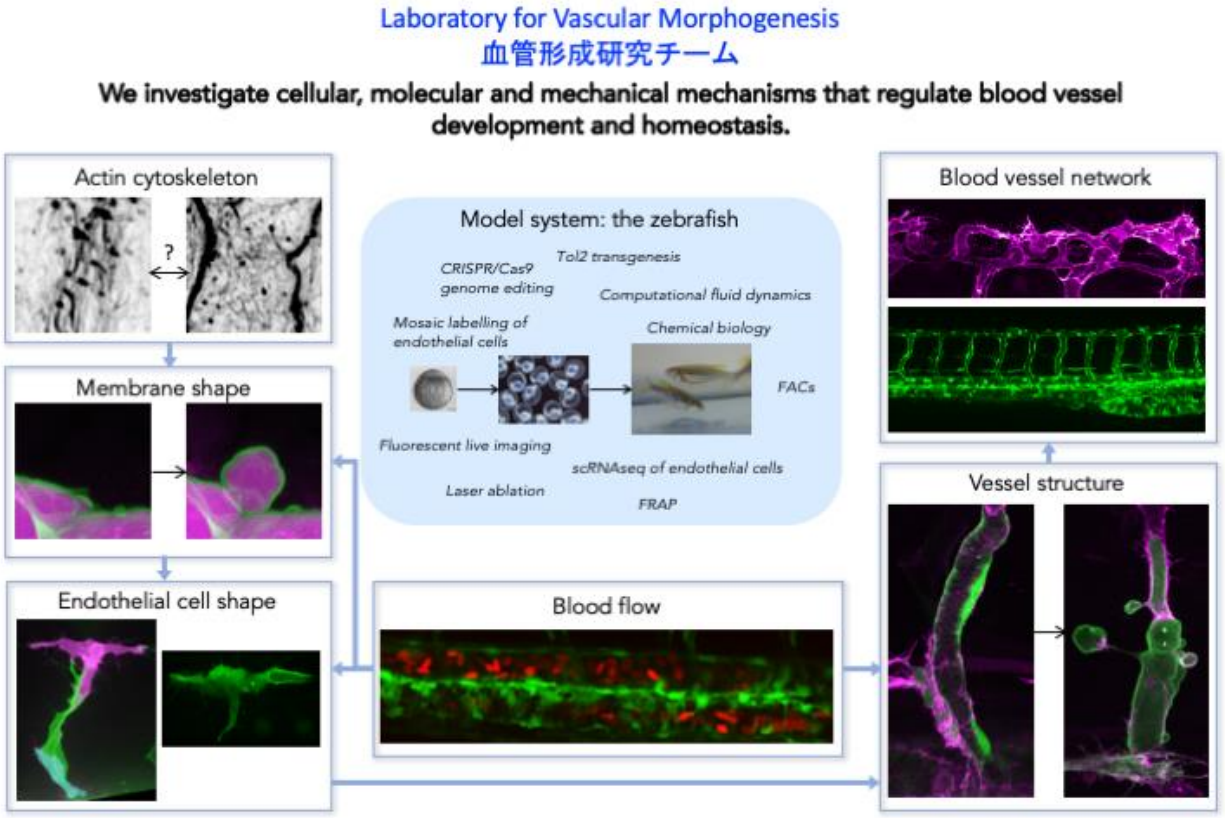
Biology 7 (Developmental biology)

Day 6, July 20, 10:30am-12pm

Understanding blood vessel development using the zebrafish

Li-Kun Phng

Blood vessels supply oxygen and nutrients to meet the metabolic demands of tissues across our body. Therefore, the establishment and maintenance of a network of interconnected blood vessels is crucial throughout our lifetime. In our lab, we investigate the fundamental principles of how new blood vessels are generated through sprouting angiogenesis. Because of its optical transparency, it is possible to capture the dynamic processes of sprouting angiogenesis live in the zebrafish embryo. In this lecture, I will describe how we investigate and visualize endothelial cell behaviour by combining genetic and chemical perturbations with high-resolution fluorescent time-lapse confocal imaging.



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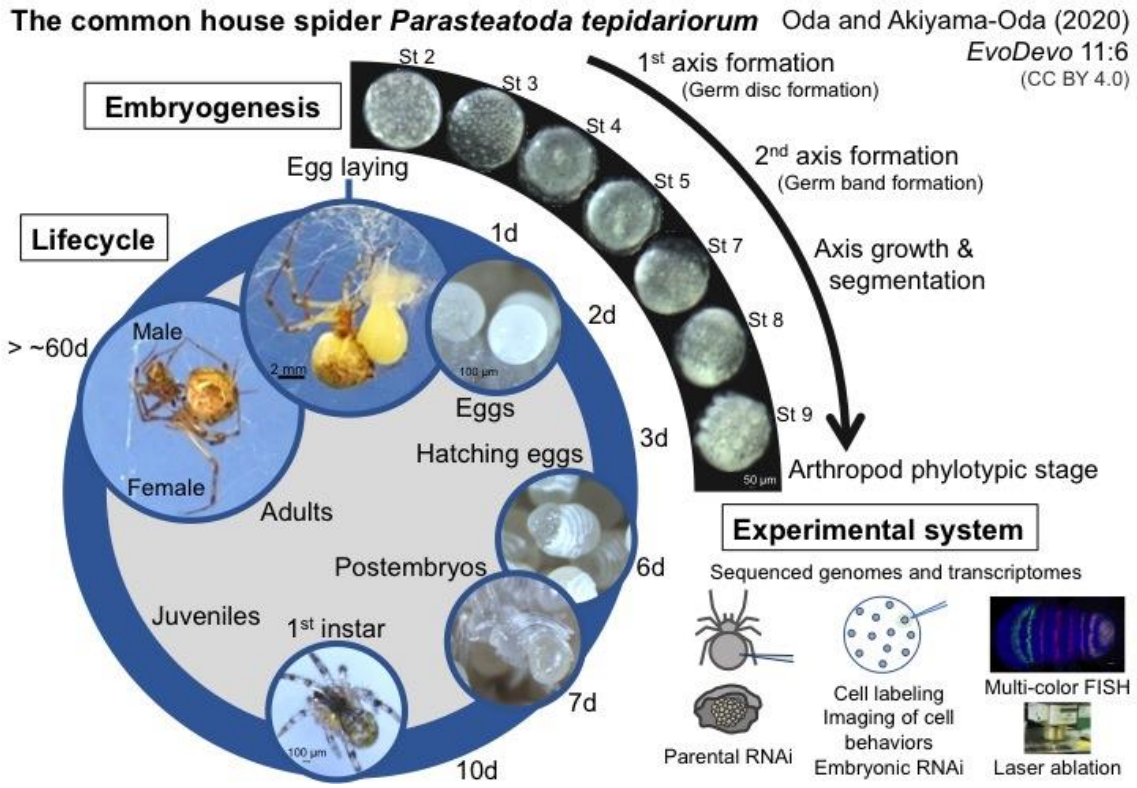
Biology 7 (Developmental biology)

Day 6, July 20, 10:30am-12pm

Development of a new model system for studying basic principles of animal development

Hiroki Oda (Laboratory of Biohistory)

Several decades of studies using the classical model invertebrates, such as *Drosophila melanogaster* and *C. elegans*, have contributed to deepening our knowledge on cellular, molecular, and genetic mechanisms of animal development, as described in textbooks. However, as the nature of each model system restricts what we can find, model system developments depending on the focus of research are continuing challenges. Regulative capacity for body axis formation and wave-like behaviors of gene expression for body axis segmentation are characteristics of spider embryos, but these aspects are not evident in *Drosophila* embryos. I will give a lecture on two decades of our efforts to develop the common house spider *Parasteatoda tepidariorum* as a new arthropod model system for studying basic principles of animal development.



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