Division of Natural System	Research field	Differentiation and Developmental Biology	Lab. ID NS06-2
Laboratory web site			

Research subjects

Our research subjects are as follows.
1. Evolution of the echinoderm's body plan (Yamaguchi)
Echinoderms and hemichordates form a clade named Ambulacraria. Ambulacrarians typically have a larva with tripartite coeloms. Hemichordate adults inherit the body plan form from larvae, whereas echinoderm larvae metamorphose into pentaradial juveniles. We are investigating molecular mechanisms underlying the adult rudiment formation in echinoderms. Our aim is to understand the evolutionary transformation of echinoderms through a comparison of the mechanisms between echinoderms and hemichordates.
2. Gene regulatory network for micromere specification in sea urchin embryos (Yamaguchi)
Sea urchin micromeres that form at the vegetal pole of the 16-cell stage embryo function as an organizer/signaling center. In the 21st century, molecular mechanisms that control micromere specification have been rapidly elucidated, and now the respective genes are integrated into a gene regulatory network. However, we obtained unexpected results in a primitive urchin, which suggest that the network may not be used in micromere/vegetal pole specification. Our target is to construct the ancestral network.
3. Molecular and Cellular Mechanisms of Hematopoietic Stem Cell Specification (Kobayashi)
Hematopoietic stem cells (HSCs) are capable of supplying all mature blood cells, and they are developed from the ventral floor of the dorsal aorta during embryogenesis. It is still unclear, however, how this event is regulated by cellular and molecular networks. Utilizing the zebrafish model, we will examine cell-cell interactions based on live-imaging to elucidate cellular networks and identify the molecular cues that regulate HSC specification.
4. Identification of Hematopoietic Stem Cell Niches in The Zebrafish Kidney (Kobayashi)
It is necessary to understand the microenviroment of HSCs (HSC niche) in order to expand HSCs ex vivo. HSCs in teleost fish are maintained in the kidney, whereas those in mammals are in the bone marrow. We will utilize comparative approaches between the zebrafish kidney and mammalian bone marrow to identify the universal molecular mechanisms of HSC maintenance and proliferation.
5. Molecular mechanisms regulating catch-up growth (Kamei)
Most animals retard growth in response to adverse conditions; however, upon the removal of unfavorable factors, they often show quick growth restoration, which is known as "catch-up" growth. Albeit the catch-up growth is important for the accidentally stunted wild animal to regain its size and renew competition with non-stunted one, the molecular mechanism of such unique growth spurt remains largely unknown. In this project, by using zebrafish model, we wants to know when, where, and how the embryonic growth signal changes to facilitate the catch-up growth.
6. Effects of anomalistic growth pattern on the neural crest cell development (Kamei)
It has been known that severe embryonic growth retardation and subsequent catch-up growth often associates with adult-onset disorders such as hypertension, diabetes, and mental retardation. Though the changes during such an anomalistic growth pattern seem to be a key for deciphering the cause of future pathogenesis of stunted animals, the cellular basis of the phenomenon remains to be elucidated. We tackle this issue by exploring the effect of the embryonic growth retardation and the catch-up growth on the development of neural crest cells, multi-potent embryonic stem cells, in zebrafish embryos.

Master/Doctor course: Education policy, curriculum, typical activity in the laboratory

Students determine their research theme at the start of their graduate studies. Lab meeting is held weekly, where students introduce and discuss recent papers in their field (Journal Club) or present their recent results (Progress Report). It is hoped that students attend scientific meetings to present their results once a year.
Yamaguchi lab makes trips to collect the sand dollar *Peronella japonica* at Notojima island in summer and the sea urchin *Hemicentrotus pulccherimus* around the Noto Marine Station in winter. Also, it is an important job to keep sea urchins in aquariums of our lab.
In the Kobayashi's Lab, since many transgenic and mutant zebrafish lines are maintained, all students have a duty to work for the maintenance of the fish facility (e.g. feeding, changing filters). It may be a precious experience to keep and culture your own fish.
The Kamei Lab is located in Noto Marine Station. We have own zebrafish facility and numbers of experimental equipments so that students can develop their research projects by using molecular, cellular, and developmental biology techniques.

Daily life in the laboratory, etc.

We have an open and free lab environment, which facilitates a smooth relationship among all lab members. Please note that we sometimes work for experiments and/or animal care even outside of normal core time, which can only be conducted if a reasonable plan was set.

Message or comments by the laboratory faculty staffs

We welcome students who are interested in research on animal evolution, growth and development. Our interdisciplinary research will be of basic literacy/skill for a variety of careers after graduation. Graduates of our lab take occupation as researchers at universities, research staffs in private companies, high school teachers, public employees, etc. We do hope the lab life offers you a wonderful opportunity to grow and develop immensely as a human being.

Recent Master theses in these 3 years (+ more if appropriate)

year.month	Thesis title (including English translation of Japanese thesis title)
2016.3	The interaction between germ layers in the adult rudiment of the sand dollar Peronella japonica
2012.3	Functional analysis of dermatan sulfate epimerase in the sea urchin embryo

Recent Doctoral theses in these 3 years (+ more if appropriate)

year.month	Thesis title (including English translation of Japanese thesis title)
2012.3	Expression patterns of Hox genes in the direct-type developing sand dollar Peronella japonica: insights into the evolution of echinoderms

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