

Achievement Report 2009

This is the third year of the Global COE Program entitled “Frontier Biosciences: Strategies for survival and adaptation in a changing global environment,” led by Professor Ko Shimamoto. The program has continued successfully from last year. Its aims, which are being accomplished under close international cooperation, are 1) to promote scientific activities which will contribute to our understanding of how organisms survive and adapt in a changing global environment, 2) to train young scientists who will make internationally recognized achievements in the future, and 3) to contribute to society’s quest for solutions to global food and environmental problems. Since this is the third year of the program, there was a mid-term evaluation by the Global COE Committee(led by Prof. Ryoji Noyori, President of RIKEN). Our COE program received a high evaluation.

An interim evaluation hearing was held on June 29, 2009 by the Global COE Program Committee. The evaluation result in September showed that NAIST should be able to achieve the project’s original objectives by sustaining our current effort. We also received high evaluations for establishing research and educational bases, for our effective administrative structure, and for fostering highly creative young researchers.

Prior to the Program Committee hearing, we also asked three influential individuals (Profs. Kozo Kaibuchi of Nagoya University and Takayuki Kohchi of Kyoto University, and Dr. Takaharu Tanaka of Suntory Holdings Limited) to assess our progress. Our educational and research achievements were highly evaluated, as exemplified by the comment: “NAIST is achieving good results and is expected to continue to do so”.

These evaluations showed that competency and internationalization are improving steadily among our students and young researchers, and gave us the confidence that our achievements to date provide a strong basis for our future development.

I Research Programs

GCOE International Symposium

The 4th Global COE International Symposium, on the theme of Environmental Adaptation, was held on November 12-13, 2009 in Millennium Hall, NAIST. Professors Hiroshi Takagi and Kenji Kohno organized this Symposium, and we introduced hot research topics on the wide range of molecular strategies that are used by various organisms (bacteria, yeasts and other fungi, plants and mammals) for their survival and adaptation under environmental stress conditions.

These strategies include programmed cell death, the hypoxia response, NO synthesis, the

proteotoxic response, ER quality control, redox homeostasis, deep water adaptation, photosynthetic supercomplex remodeling, innate immunity, the heat response, cold adaptation, genomic stability, and translesion DNA synthesis. Through this Symposium, we could



understand in depth both common and different features between organisms, and discuss the global contribution of future biotechnology in terms of food, environmental and medical issues. A total of 481 participants attended the Symposium, including 34 students from the preceding GCOE International Student Workshop and four exchange students from the University of Minnesota who presented their work in a poster session. At the mixer in the evening of the first day, the participants enjoyed lively cross-cultural interactions with each other.

In the context of the GCOE program, this 4th Symposium turned out to be a great success - particularly the students' poster session, in which the younger participants could receive valuable suggestions for their own research and initiate potential collaborations. Professors Masayori Inouye (Robert Wood Johnson Medical School, U.S.A.) and Robert Fuchs (CNRS Marseille, France) also gave us important personal messages, concerning scientific attitude, enthusiasm and philosophy, that should strongly encourage young scientists to conduct their research.

We hope that this Symposium will lead to new research concepts and directions across the broad field of environmental response and adaptation, and that the NAIST participants will enhance their own motivation to expand their international outlook, activity and collaboration to a higher level.



Speakers of the 4th Global COE International Symposium

Hosting GCOE Seminars

A total of 91 seminars were held this year. Forty-nine researchers from Japan and 42 researchers from abroad (including 31 Japanese) presented their work.

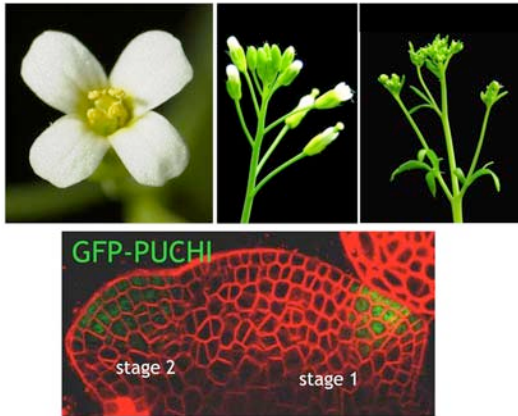
Establishing GCOE Special Research Groups

Developmental Morphology Research Group:

Associate Professor Mitsuhiro Aida, Assistant Professor Seiji Takeda

Our group focuses on the function of the shoot meristem, a small group of dividing cells located at the tip of the plant body. Cells in the shoot meristem are multipotent, giving rise to primordia for new organs such as stems, leaves and floral organs. This remarkable ability of the meristem is a key to understanding how plants grow. This year, we reported that the three genes *PUCHI*, *BOP1* and *BOP2*, which are expressed in the shoot tip of *Arabidopsis thaliana*, play essential roles in specifying cells in the meristem to give rise to flowers (Plant Cell 21: 1360-1372, 2009). Further analysis of the function of these genes will deepen our

understanding of plant morphogenesis.



(top, from left to right) Flower of *Arabidopsis thaliana*, normal inflorescence, and inflorescence of a plant mutated for *PUCHI*, *BOP1* and *BOP2*, which forms branches instead of flowers.

(bottom) Image of the shoot meristem, with green indicating cells where the *PUCHI* gene functions.

Plant Reproductive Genetics Group:

Associate Professor Tetsu Kinoshita, Assistant Professor Yoko Ikeda

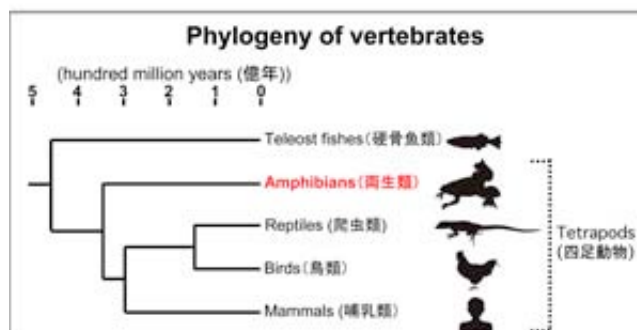
Our group aims to elucidate epigenetic phenomena during sexual reproduction and subsequent seed development in rice and *Arabidopsis*. In particular, we focus on the mechanism of genomic imprinting that is established by DNA demethylation before fertilization. As a result of differential epigenetic modification of parental genomes, the set of imprinted genes are unequally expressed between the maternally and paternally derived alleles after fertilization in the endosperm. Recently, we found that a mutation in the *ALAC1* gene, a conserved histone chaperone gene, controls maternally expressed imprinted genes and affects DNA demethylation of those genes. This year, we reported these observations at several symposia of the Japanese Society for Epigenetics, Gordon Research Conference on Epigenetics and International Plant Molecular Biology. Yoko Ikeda received a young scientist award from JSE, a poster award from GRC, and was selected as to give an oral presentation by IPMB.



Developmental Genomics Research Group:


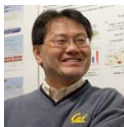



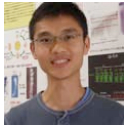

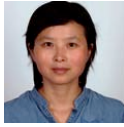
Associate Professor Hajime Ogino, Assistant Professor Haruki Ochi

The aim of our research is to reveal evolutionary changes in genome structures that have contributed to species differentiation in vertebrates. This year, an international joint research team including our group reported the draft genome sequence assembly of the African clawed frog *Xenopus tropicalis*, the first whole-genome sequencing analysis of an amphibian (Science 328: 633-636, 2010). Prior to this work, fish and mammalian genome sequences had often been compared in studies of vertebrate evolution. However, because of their ancient evolutionary divergence, it was not easy to identify genomic differences that account for their anatomical differences, such as that between fin and limb. Since the frog fills the gap between fish and higher tetrapods, its genome sequence information will help us to understand how our ancient ancestor had developed specialized organs, such as limb and lung, to adapt to terrestrial life, from the view of gene evolution.



Employing Young Researchers from Overseas

Two new overseas researchers were hired, so that a total of eight International Research Fellows were pursuing their projects during this year. As well as conducting their own research, the Fellows also participated in the Summer Camp (see section II, Summer Camp) where they helped to assess the students' performance and progress. Three of the eight have now ended their terms.

International Research Fellows			
Henri Claver Jimbo Biodynamics and Integrative Biology (Prof. Sato) 2009.08 –		Susumu Morigasaki Cell Biotechnology (Prof. Takagki) 2008.04 -	
Tetsuji Mutoh Molecular Neuroscience (Prof. Nakashima) 2009.04 –		Ke Yin Plant Cell Biology and Organogenesis (Prof. Umeda) 2007.09 – 2010.03	
Kaoru Yoshiyama Microbial Molecular Genetics (Prof. Maki) 2008.08 –		Siripong Thitamadee Gene Regulation Research (Prof. Bessho) 2007.09 – 2010.03	
Hiroshi Kadokura Molecular and Cell Genetics (Prof. Kohno) 2008.07 –		Su Jing Plant Molecular Genetics (Prof. Shimamoto) 2007.09 – 2010.	

Papers by International Research Fellows

The level of expression of thioredoxin is linked to fundamental properties and applications of wheat seeds. Li YC, Ren JP, Cho MJ, Zhou SM, Kim YB, Guo HX, Wong JH, Niu HB, Kim HK, Morigasaki S, Lemaux PG, Frick OL, Yin J, Buchanan BB. *Molecular Plant* 2: 430-441, 2009.

Detecting folding intermediates of a protein as it passes through the bacterial translocation channel. Kadokura H, Beckwith J. *Cell* 138: 1164-1173, 2009.

Suppressor of gamma response 1 (SOG1) encodes a putative transcription factor governing multiple responses to DNA damage. Yoshiyama K, Conklin PA, Huefner ND, Britt AB. *Proc Natl Acad Sci U S A* 106: 12843-12848, 2009.

Hosting GCOE Colloquia

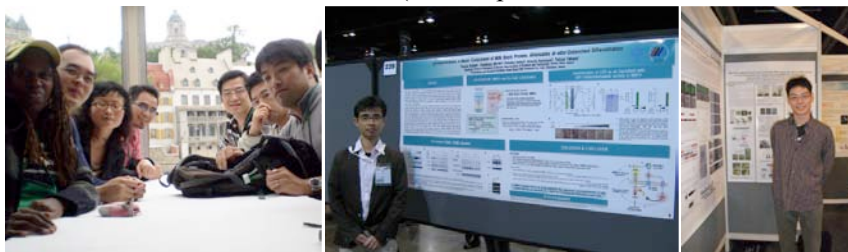
The colloquia are important seminars in the Global COE program. Four colloquia were held during this year, including three by the International Bio Seminar lecturers (see section II, International Bio Seminars). Students listened to a colloquium after taking three preparatory Bio Seminar classes.

Funding for Young Researchers

Grants of JPY500,000 each were awarded to 20 out of 39 assistant professors and International Research Fellows after their research projects had been evaluated.

Supporting Presentations by Young Researchers at International Conferences

Fourteen assistant professors and postdoctoral fellows were awarded financial support to participate in international conferences in five countries (U.K., Spain, Canada, U.S.A. and Korea).



II Education Programs

Funding Young Researchers and Students

Eighty-eight doctoral course students were employed as GCOE research assistants (RAs) this year. Twenty outstanding students, who were selected after an evaluation of their research projects, were employed as GCOE Special RAs. A total of eleven GCOE postdoctoral fellows (PDs) were employed this year. In addition, two outstanding post-docs were employed as GCOE Special PDs. The two GCOE Special PDs, Masayoshi Nakamura and Kota Yanagitani, presented their posters at the GCOE Network Forum in February.

International Student Workshop

The third International Student Workshop was held at I&I Land in Shijonawate from November 8 to 11, 2009. A total of 34 graduate students (10 from the College Biological Sciences, university of California, Davis (UCD-CBS, USA) 10 from the Institute of Genetics and Developmental Biology, Chinese Academy of Sciences (CAS-IGDB, China) and 14 from NAIST's Graduate Scholl of Biological Sciences (NAIST-BS, Japan) participated in the Workshop. Students presented their studies in English and discussed each other's research results. The three groups interacted strongly with each other, both academically and culturally. Students from the US, China, and Japan shared communal Japanese-style bedrooms, ate meals together and bathed together in public baths. During these four days in a secluded environment, the students were able to establish close and friendly relationships and to enjoy stimulating cultural exchanges.



Summer Camp

The annual Summer Camp took place from August 26 to 28, 2009 at the Awaji Yumebutai International Conference Center, where research presentations and discussions were held with



86 doctoral students, 24 pre-doctoral master's students, and 61 faculty members. Once again, all oral and poster presentations were in English. Lectures given by an invited speaker, Prof. Kazuhiro Shiozaki of UC Davis, three associate professors and two assistant professors from NAIST-BS were also given in English, so that the entire Camp resembled an overseas international conference. At the end of the Camp, a high-rating review was given by an external evaluation committee comprising Profs. Kentaro Inoue of UCD-CBS, Xiangdong Fu of CAS-IGDB, Takayuki Kohchi of Kyoto University, and Hideki Nishitoh of Tokyo University. This was the third Summer Camp in which all of the proceedings were conducted in English. It is becoming an important event of the GCOE Program.

International Bio Seminars

During the year, three lecturers were invited from UCD-CBS (Drs. Peggy Farnham and Kenneth Kaplan) and CNRS, France (Dr. Robert Fuchs), and they each gave a series of three intensive seminars over two days to small groups of doctoral students. The seminars were held in a small room with a relaxed atmosphere and an interactive teaching style, which proved stimulating for the participants.

International Seminar (Overseas Studies for Students)

Four students received financial support to perform research for about 10 days, one month and three months in overseas laboratories. They achieved substantial results in communicating in English, contributing to joint research and learning experimental techniques.

International Seminar (English for Science and Technology)

Thirty students went to UCD-CBS and UCD's English Training Center in January and February to develop their speaking and writing skills in scientific English. As well as taking intensive classes in the Center, they received and participated in seminars at UCD-CBS, and gave presentations and joined discussions in host laboratories.

Supporting Presentations at International Conferences

Thirty-two doctoral students were given financial support to participate in international conferences in nine countries. Three of them gave oral presentations.

III International Network

Through the Global COE Program, NAIST-BS is developing strong interactions with UCD-BS and CAS-IGDB. In the International Student Workshop (section II, above), for example, 20 Chinese and US students presented their research, participated in discussions and exchanged their ideas with NAIST-BS students. Many internationally recognized researchers were invited to participate in workshops, colloquia, seminars and lectures at NAIST, all of which has laid a strong foundation for further international cooperation in the future. NAIST-BS faculty members also visited both Institutes to experience our partners' educational and research

environments.

IV Achievements

Publications

A total of 154 papers were published from NAIST-BS this year, of which 131 were in English-language journals. Of the 154, 134 were published in peer-reviewed journals; several were published in very high-quality journals such as *Cell* and *Science*, and 13 were published in journals having impact factors above 9.0. Some of these papers received wider coverage in newspapers and television programs. Doctoral students were the first authors of 36 papers.

