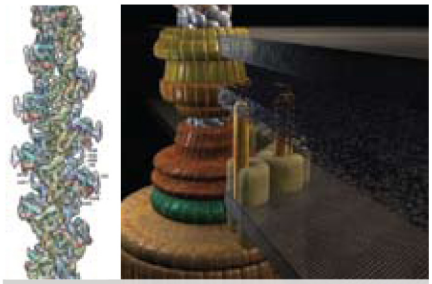
# Excellence in Interdisciplinary Research and Education

Osaka University's Graduate School of Frontier Biosciences offers a stimulating environment for cutting-edge interdisciplinary research on biological system dynamics.

Keiichi Namba



Structure of F-actin and Flagellar Motor

The Graduate School of Frontier Biosciences (FBS) at Osaka University was established in 2002. "Our mission is to educate graduate students in an interdisciplinary environment," says **Keiichi Namba,** dean of FBS. "Our 70 or so faculty members are from diverse backgrounds including mathematics, physics, chemistry, medicine, and information science. And our approximately 250 graduate students interact with these specialists. It's a unique graduate school, and very popular with students from both Japan and overseas."

Doctoral students at FBS receive support from the prestigious Global Center of Excellence (GCOE) program running from 2007 to 2011. As part of this program, students spend one month doing their research in the laboratory of another research group. "This enables students to gain firsthand experience in interdisciplinary research," says Namba.

The graduate school entrance examination at FBS is flexible, offering applicants the choice of sitting exams in physics/mathematics, biology, or chemistry. "We welcome students from overseas with appropriate TOEFL [test of English as a foreign language] and GRE [Graduate Record Examination] scores," says Namba.

In addition, the FBS holds annual symposia, biannual summer schools, and annual retreats—which are open to overseas participants—and supports collaborative visits of students and postdocs to universities and research institutes in the United States, Europe, and Asia.

Namba is a biophysicist specializing in biological nanomachines. "We analyze the structure and dynamics of macromolecular assemblies using techniques including electron cryomicroscopy and X-ray diffraction," says Namba. "Recently, we used cryomicroscopy to successfully visualize the structure of F-actin in a few days." F-actin is the helical polymer of a protein, actin, which is an essential component of muscle fibers and cell cytoskeletons. These results offer a deeper understanding of the cellular mechanisms governing life. Namba is also investigating the source of energy for the torque of the bacterial 'flagellar motor'—a rotary nanomachine composed of assemblies of proteins—and how the tiny helical propellers connected to the rotary motor propel bacteria through liquids.

**Toshio Yanagida,** who is the leader of the Soft Biosystems Group at Osaka University and a pioneer of single molecule imaging, is now focused on the dynamics of living cells. "Molecular machines use fluctuations such as Brownian motion," says Yanagida. "A deeper understanding of how living cells use such fluctuations—or *yuragi*—to process enormous amounts of information will enable the design of more energy-efficient and robust machines."

In 2011 and 2012, Yanagida is launching two major interdisciplinary projects. One is the Quantitative and Computational Biology Center (QBiC), which begins in April 2011 and aims to develop a comprehensive understanding of biological system dynamics. "This is a multi-institute project with Osaka University and RIKEN," says Yanagida. "We will focus on the basic elements regulating biological systems while developing new experimental and theoretical techniques. The infrastructure for the project includes a new 7000 square meter building, 15 principle investigators, 60 postdoctoral researchers, 20 technicians, and more than 20 graduate students. We aim to double this manpower by 2013," says Yanagida.

Toshio Yanagida

The other initiative is the Brain Information Transmission Interdisciplinary Research Center, to be launched in 2012 in collaboration with the National Institute for Communication Technology (NICT, in Hyogo) and the Advanced Telecommunications Research Laboratory (ATR, in Kyoto). "This project focuses on how the brain processes internal and external information, and how to transmit this data to a computer. This could revolutionize human-machine communication and network system technologies," emphasizes Yanagida. The project is based on three main pillars: heart-to-heart science (HHS), brain–machine interface (BMI), and brain-function installed information network (BFI).

The aim of these collaborations is to analyze the flow of information, energy, and materials within living organisms and interface them with an external control system. "We will start with single molecules and work up towards the whole brain," explains Yanagida. "Ultimately, such studies are expected to lead to the construction of highly energy-efficient machines and advanced medical diagnostics."

MORE INFO

**Graduate School of Frontier Biosciences, Osaka University**
www.fbs.osaka-u.ac.jp

CREDIT: (TOP RIGHT) PROFESSOR KEIICHI NAMBA, OSAKA UNIVERSITY