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ChemSites: Institute of Transformative Bio-Molecules (ITbM) (Nagoya University, Japan)



What is the institute's background and history?

Changing the World with Molecules

The Institute of Transformative Bio-Molecules (ITbM), established in April 2013 at Nagoya University (Japan), aims to create molecules that affect biological systems through extensive collaboration between chemistry and biology. These molecules, which address significant societal issues related to

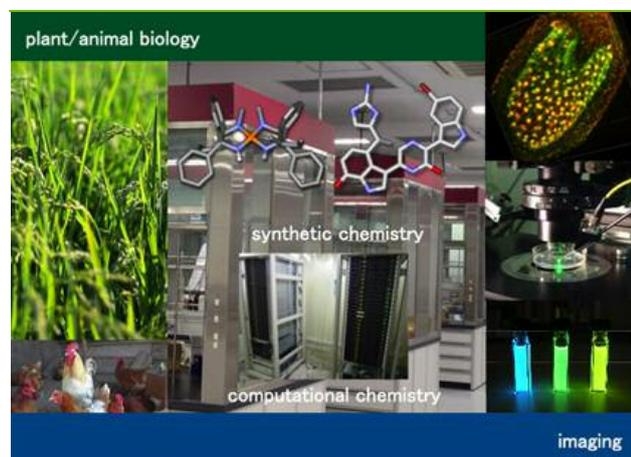


Figure 1 ITbM's main research fields

the environment, food production and medical technology, are defined as 'transformative bio-molecules', i.e., molecules that can change the world. Led by Center Director Professor Kenichiro Itami of Nagoya University, ITbM merges the strengths of Nagoya University, such as synthetic/catalytic/theoretical chemistry and animal/plant biology to create an interdisciplinary research environment, using molecules as the common language between chemists and biologists. Funded by the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT), ITbM is one of nine international research centers selected by the World

Premier International Research Center Initiative (WPI) program (<http://www.jsps.go.jp/english/e-toplevel/index.html>) to advance cutting-edge scientific research by fusing fields and creating new disciplines.

How is the institute structured and organized?

ITbM consists of a young team of 11 Principal Investigators (PIs) with seven Professors from Nagoya University (NU) and four Professors from overseas institutes, who are world-leading researchers in the fields of synthetic chemistry, animal/plant biology and theoretical science. Synthetic chemists, Professors Kenichiro Itami (NU; Center Director), Shigehiro Yamaguchi (NU; Vice-Director), Takashi Ooi (NU), Cathleen M. Crudden (Queen's University, Canada) and Jeffrey W. Bode (ETH Zurich, Switzerland) collaborate extensively with plant biologists Professors Tetsuya Higashiyama (NU; Vice-Director), Toshinori Kinoshita (NU), and Keiko Torii (University of Washington, USA), animal biologists Professors Takashi Yoshimura (NU) and Steve A. Kay (University of Southern California, USA) along with theoretical scientist



Figure 2 ITbM's 11 PIs and 4 Co-PIs

Professor Stephan Irle (NU) to develop molecules that enable us to ‘understand’, ‘see’ and ‘regulate’ living organisms. ITbM has adopted a Cooperative-PI (Co-PI) system for overseas PIs where the Co-PIs conduct the research at ITbM whilst the overseas PIs are at their host institute. The labs at ITbM are organized in a ‘Mix-Lab’ fashion, where chemists, biologists and theoreticians work side by side in the lab, which breaks the conventional barriers between research groups/fields, and enables interactive discussions on a daily basis to promote interdisciplinary research.



Figure 3 ‘Mix-Labs’ – chemists and biologists working in the same lab

ITbM’s new building is to be finished in spring 2015, and will reflect the ‘Mix-Lab’ concept throughout.

The institute has three sub-centers that support ITbM’s interdisciplinary research:

- (i) Molecular Structure Center with analytical devices to analyze the structure of molecules;
- (ii) Chemical Library Center to create a databank of synthesized/commercial molecules for bioassay studies; and
- (iii) Live-Imaging Center with leading-edge laser microscopes to enable bio-imaging of molecules in live cells.

These sub-centers are equipped with the latest measurement/analysis techniques managed by specialized staff.



Figure 4 ITbM’s new building (expected in Spring 2015)



Figure 5 ITbM’s annual international symposium (ISTbM-2)

Many of the postdoctoral researchers at ITbM are from overseas and the institute has English/Japanese-speaking administrative staff members, who organize international symposia, build global networks and provide local support for daily life including housing, medical care and children’s education – all aimed at making sure the overseas researchers are comfortable living and carrying out research in Nagoya.

ITbM has partnerships with overseas institutions, including the overseas PI’s host institutes, ETH Zurich, Queen’s University, the University of Washington and the University of Southern California. In addition, ITbM is working closely with the National Science Foundation’s Center for Selective C–H Functionalization (Center Director: Professor Huw Davies, Emory University, USA) (<http://www.nsf-cchf.com>), which brings together leading experts in a range of chemical disciplines, by carrying out collaborative projects through active exchange of personnel (students/researchers/faculty) and ideas between the institutions.

What are the institute’s research focus and scientific aims?

ITbM’s main research focus is to develop new catalysts and reaction systems in order to generate molecules that enable visualization of biological activities and control of biological systems, such as molecules that dramatically enhance plant growth and improve animal reproduction.

The four core projects running at ITbM are the development of: (i) molecule-controlled plant reproduction; (ii) molecular tools to combat the parasitic *Striga* plant issue in agriculture; (iii) molecular control of circadian rhythm in animals; and (iv) molecular innovation for bio-imaging and bio-sensing. Each project is based on the collaboration between chemistry and biology to deliver bio-molecules that can have significant societal impact.

ITbM also has an internal grant system, known as the ITbM Research Award, where young researchers from different disciplines have the opportunity to make their original research proposals in order to accelerate interdisciplinary research. Through the ‘Mix-Lab’ system, synthetic chemists, animal/plant biologists and theoreticians work in the same

lab, making it possible for molecules designed by theoreticians to be synthesized by chemists and subjected to biological assays with almost immediate feedback.

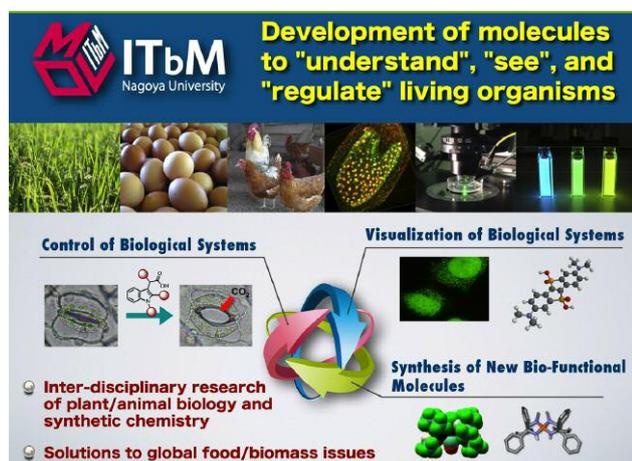


Figure 6 Research aims of ITbM

Center Director Professor Kenichiro Itami's message

“Molecules are small but are essential to all life on earth. It is my strong belief that molecules have the power to change the way we do science and the way we live. The main target of ITbM is to develop transformative bio-molecules that will be the key to solving urgent problems at the interface of chemistry and biology. The identity of ITbM is its capability to develop completely new bioactive molecules with carefully designed functions. With biologists knowing what functions they need in molecules and chemists knowing how to install these functions, we hope to make unprecedented scientific advances at ITbM. We are looking forward to working with

ambitious researchers worldwide and nurturing the next generation of cutting-edge research, unrestricted by the bounds of traditional disciplines. Located in central Japan, Nagoya University's ITbM provides an enthusiastic research environment for people from all over the world wanting to connect molecules, create value, and change the world.”

Matteo Zanda

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Figure 7 ITbM Center Director Kenichiro Itami (middle)