

# Invitation to Life Science and Technology



Tokyo Institute of Technology  
School of Life Science and Technology

Tokyo Institute of Technology (Tokyo Tech) will merge with Tokyo Medical and Dental University (TMDU) in October 2024. The name of the new university is "Institute of Science Tokyo". Please note that up to the day before integration, all students currently studying at and newly enrolling at Tokyo Tech or TMDU will belong to the university at which they enrolled. As of the integration day, they will become students of the new university.



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# Message from the Dean

Professor KAJIWARA, Susumu, Dean



In the 21st century, our society has moved from an era of only economic growth to an era in which people are pursuing the realization of a healthy, prosperous, and sustainable society; or well-being, in other words. In addition, recent years, we have been confronted with global social issues – such as global warming, the UN Sustainable Development Goals (SDGs) and infectious disease pandemics –, and life science and technology has become an indispensable discipline in solving these large-scale problems.

In 1990, Tokyo Institute of Technology (Tokyo Tech) established the School of Bioscience and Biotechnology as the third undergraduate school, after the School of Science and the School of Engineering, to lead in the development of science and technology in the 20th century and to fully supplement the life element that is essential in the 21st century. The Graduate School of Bioscience and Biotechnology was established in 1992. In 2016, the reform of Tokyo Tech's education system generated the School of Life Science and Technology by combining undergraduate and graduate schools for Bioscience and Biotechnology. Our faculty has already produced more than 5,000 graduates, and many of them are now working in domestic and international companies, research institutes, universities, government agencies, and international organizations.

The School of Life Science and Technology has established the faculty's core facility systems within the School and promotes a wide breadth of research and development in the field by using them. The School also promotes joint research with other universities and companies in Japan and overseas, and conducts interdisciplinary research and industry-academia collaboration to solve global social issues.

In addition to the more than 100 academic members affiliated with this faculty, members from the Laboratory for Chemistry and Life Science, the Cell Biology Center, and the Earth and Life Science Institute of the Institute of Innovative Research are also involved in providing specialized education.

The undergraduate curriculum allows students to systematically acquire knowledge in a wide range of specialized fields related to life science and technology, and to acquire specialized knowledge in interdisciplinary fields by taking a multidisciplinary course offered by a consortium of four universities: Tokyo Tech, Tokyo Medical and Dental University (TMDU), Hitotsubashi University, and Tokyo University of Foreign Studies. In addition, Tokyo Tech offers a variety of study-abroad programs, allowing students to experience studying abroad from the undergraduate level.

The Graduate Major of Life Science and Technology of our graduate education program gives students the opportunity to acquire knowledge and skills in highly specialized fields of Life Science and Technology and training needed to become global experts in the field through a combination of special lectures, by invited world-class professors. The Graduate Major of Human-Centered Science and Biomedical Engineering is a multidisciplinary course jointly administered by the departments of Mechanical Engineering, Electrical and Electronic Engineering, Information and Communication Engineering, Information Technology, Materials Science, and Applied Chemistry, and it fosters global leaders who can promote cross-disciplinary research and development that integrates with other specialized fields. (The Graduate Major of Human-Centered Science and Biomedical Engineering is scheduled to cease accepting students in AY 2024.) The Graduate Major of Earth-Life Science fosters students who wish to tackle global issues humanity is facing, the origin of life, and extraterrestrial life. It also provides the entrepreneurship education necessary to create new industries and develop new businesses.

Tokyo Tech and TMDU will merge to form a new university, Institute of Science Tokyo, on October 1, 2024. Since the School of Life Science and Technology has many specialized fields common to medical education and research, including dentistry, we will be launching and taking a leading role in interdisciplinary graduate majors that will include medical field to many science and engineering fields from next April. We are also considering launching multi-disciplinary undergraduate courses such as those in science, engineering and medicine at an early stage after the integration.

Through these efforts, The School of Life Science and Technology aims to nurture global leading experts who can promote the well-being of people around the world by conducting research with a strong sense of curiosity and inquisitiveness, with flexible thinking that can respond to the needs of a diversifying society, and by utilizing a wealth of knowledge.

Associate  
Deans

Planning

Prof. YAMAGUCHI, Yuki

Education

Prof. ITOH, Takehiko

Research

Prof. KUME, Shoen

Social Cooperation

Prof. KOBATAKE, Eiry

Admission DEI

Prof. TANAKA, Mikiko

Councilor

Prof. HIROTA, Junji

# Blending Life Science and Technology to Create Infinite Possibilities

Can you imagine how our society will change in the coming years?

We can foresee the future as life science and technology progress together.

Extensive research is being conducted at the School of Life Science and Technology, from exploring the principles of life to technological applications.

Collective knowledge and skills in life science and technology offer infinite possibilities for our future society.

## History of the School



|             |  |
|-------------|--|
| 1929        | Foundation of the Tokyo Institute of Technology  |
| June 1990   | Foundation of the School of Bioscience and Biotechnology   |
| April 1992  | Foundation of the Graduate School of Bioscience and Biotechnology  |
| Autumn 1993 | Establishment of the Gene Research Center  |
| March 1997  | Establishment of the Research Center for Experimental Biology  |
| 1999        | Reorganization of the Graduate School<br>Three new departments were opened in the graduate school: Department of Life Science, Department of Biological Information, and Department of Biomolecular Engineering. The undergraduate school was restructured into two departments: Department of Bioscience and Department of Biotechnology. |
| 2000        | The Department of Bioscience and the Department of Biotechnology in the graduate school were reorganized and renamed as the Department of Biological Sciences and the Department of Bioengineering, respectively.  |
| 2001        | Construction of the Radioisotope Research Center   |
| 2003        | Three research centers were merged to create the Center for Biological Resources and Informatics.  |
| 2016        | Reorganization of the undergraduate and graduate schools as the School of Life Science and Technology  |

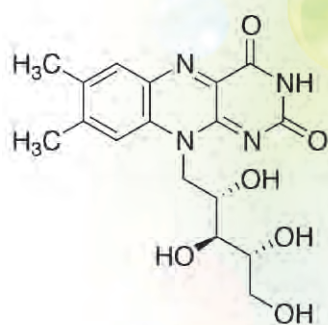


## Roots of the School

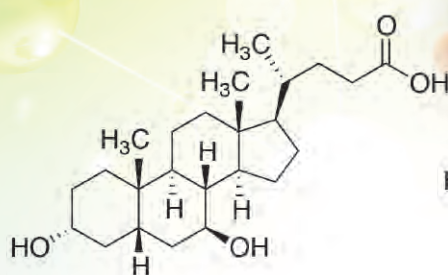


Tokyo Tech successfully created vitamin B2 by hand for the first time, thereby making industrial production possible. In addition, a drug for improving liver function, Urso, and an antiviral drug, Aracena, were also synthesized at Tokyo Tech.

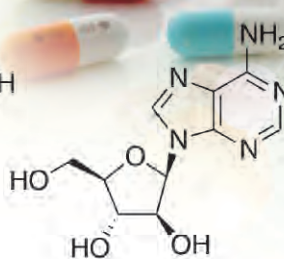
Furthermore, a group of Tokyo Tech researchers discovered alkaline enzymes, which led to the development of enzyme-containing detergents. Based on this pioneering research, Tokyo Tech established the School of Bioscience and Biotechnology, which was Japan's first interdisciplinary school of life science and technology.



Vitamin B2



Urso



Aracena

**The School of Life Science and Technology is advancing world-class research, developing various fields related to the life sciences, and delivering excellent results.**

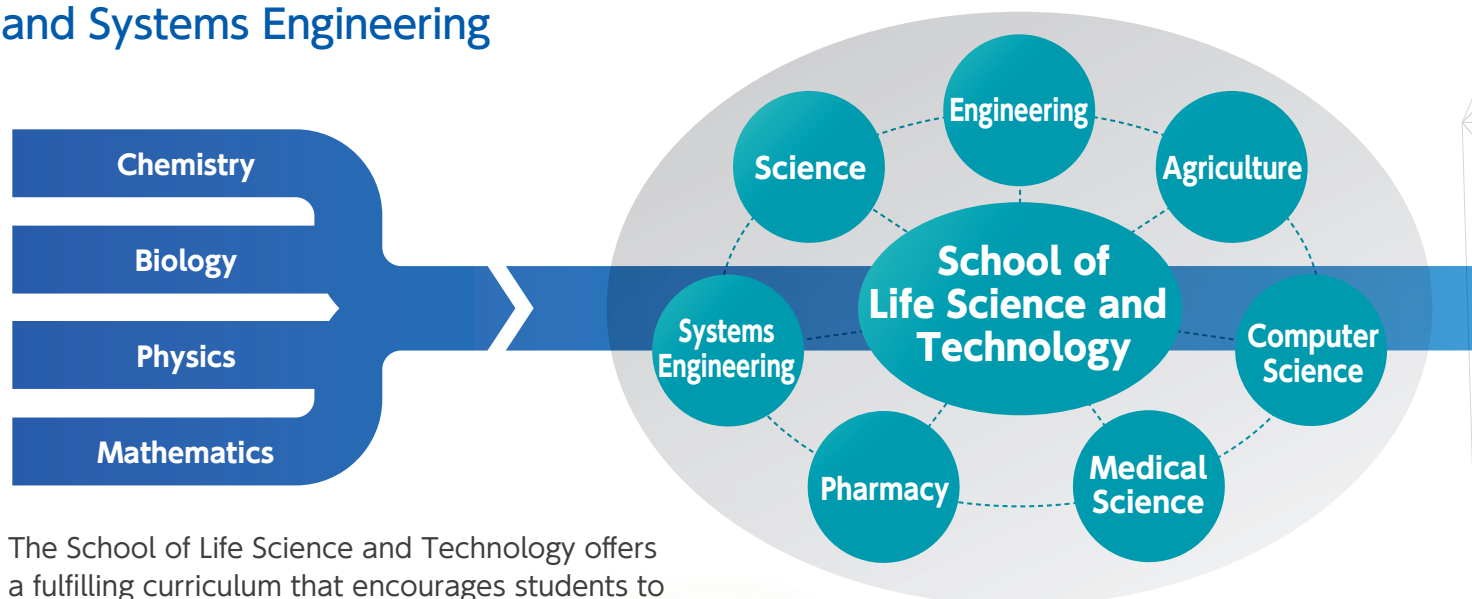
### A Message from OHSUMI, Yoshinori Honorary Professor and 2016 Nobel Laureate in Physiology or Medicine



Science is a human activity that is built on a body of knowledge obtained over many generations. Therefore, it is impossible to separate the activities of scientists from the times in which they live. One example of this is when I became interested in the biological phenomenon called autophagy and began researching it using yeast. Although our understanding of the structure and laws of the natural world continues to accelerate rapidly, many mysteries remain beyond our reach. Even when you think you have it figured out, it's actually just the beginning of the next step. I believe it is more important than ever for the future of humanity to have a broad perspective, to think long-term, and to be able to make scientific judgement in diverse areas without being preoccupied with the achievements brought about by science and technology. My message for today's youth is to always be mindful of the future. If there seems to be some great authority in front of you, it merely indicates academic stagnation. The spirit of young people to surpass their predecessors is a driving force for progress. Do not be afraid to be different, and have the courage to embrace and develop your curiosity and interests without fear of the relentless volume of information that characterizes the modern age. Make sure you live a life that is truly satisfying, and find your own way with passion and resilience.

# Fostering Global Leaders

Interdisciplinary Interactions Encompassing Science, Engineering, Pharmacology, Agriculture, Medical Science, Computer Science, and Systems Engineering



The School of Life Science and Technology offers a fulfilling curriculum that encourages students to become leaders in a variety of fields. The curriculum enables students to systematically acquire the foundational knowledge and expertise in life science and technology. Furthermore, students can obtain an advanced education in a cutting-edge research environment. Our variety of international programs and internships is also emphasized.

## Undergraduate study

### The largest education and research organization for life science and technology in Japan

The School of Life Science and Technology is one of the largest undergraduate life science programs in Japan. Students can study the life sciences from polyphenic perspectives, including science, engineering, pharmacology, medicine, and agriculture.

### Creative experiences from the first year

In their first year, students take part in a challenging active learning program in which they create educational materials related to the life sciences. Critical thinking and problem-solving skills are developed through collaborative work.

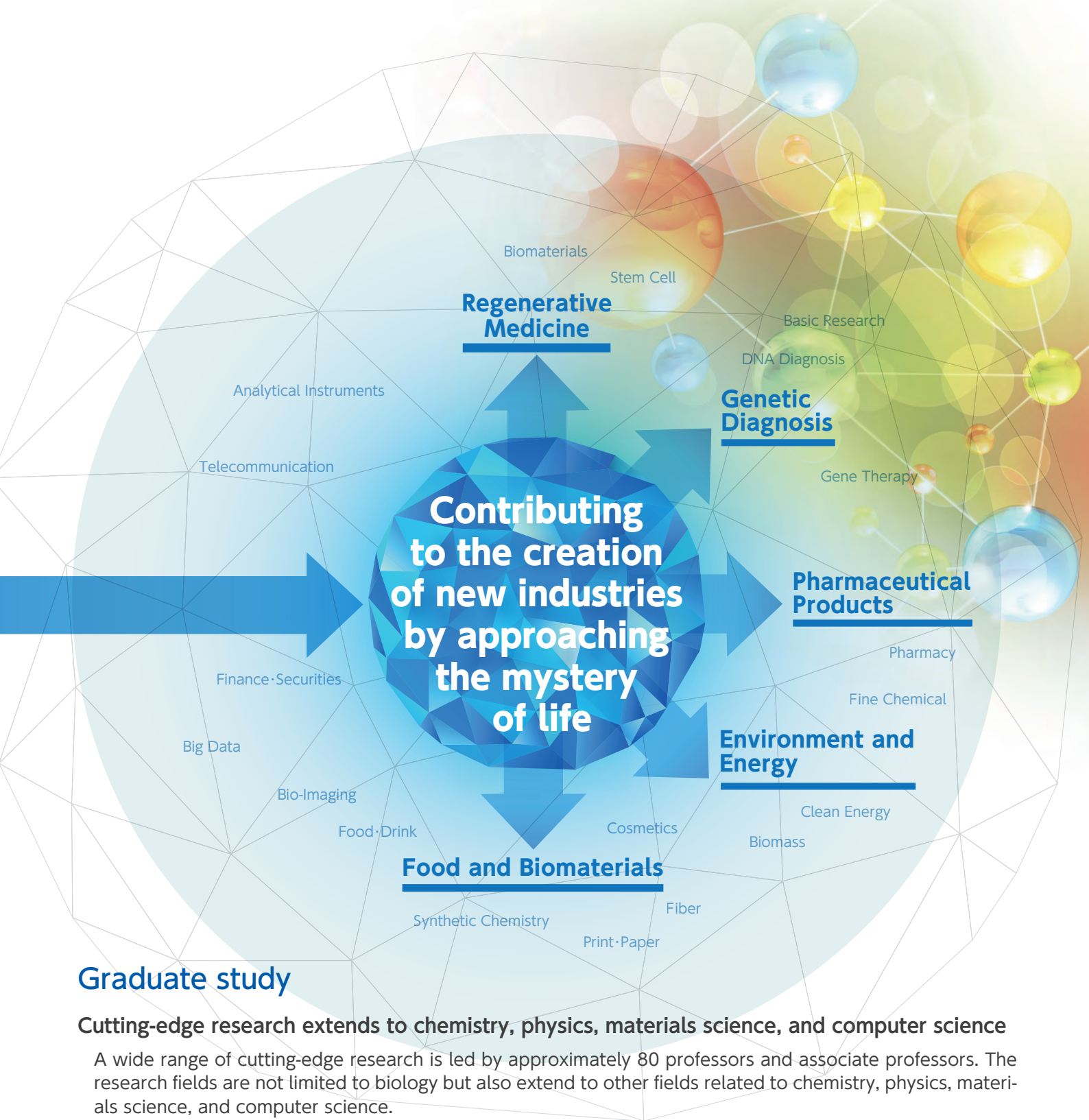
### Study abroad and internship opportunities

A set of well-established international exchange programs and short-term study programs are available, and undergraduate students are encouraged to use these programs to study overseas. Internships at companies are also encouraged, and credit is given for these activities.

### Early enrollment in graduate-level classes

Because most students continue their studies at the graduate level, the School allows students to take graduate-level classes while they are undergraduates. Talented eligible students can also graduate early.





## Graduate study

### Cutting-edge research extends to chemistry, physics, materials science, and computer science

A wide range of cutting-edge research is led by approximately 80 professors and associate professors. The research fields are not limited to biology but also extend to other fields related to chemistry, physics, materials science, and computer science.

### Research in an international environment

We welcome many outstanding researchers from abroad to visit and participate in research initiatives and seminars. Many of our laboratories have international students. There is an international atmosphere across the campus. Students are encouraged to attend conferences and internships abroad using the school's study abroad programs. Credit is also given for these activities.

### Broad and diverse studies lead to employment in a variety of fields

Studies at the School of Life Science and Technology are related not only to scientific fields such as biology, chemistry, and physics but also engineering fields such as applied chemistry, materials, mechanical engineering, and computer science. Our alumni work in a variety of companies in different fields.

# Pursuing New Forms of

Our new curriculum allows smooth transitions between degree programs. At the undergraduate level, students acquire basic knowledge in life science and technology by their third year and prepare themselves to participate in cutting-edge research by conducting the Independent Research Project (graduation research) in their final year.



## Bachelor's Degree Program

| 1st Year   | 2nd Year   | 3rd ~ 4th Year  |   |
|--|--|---|---|
| Fundamental Life Science<br>Basic Chemical Thermodynamics<br>Basic Quantum Chemistry<br>Basic Organic Chemistry<br>Basic Inorganic Chemistry<br>Linear Algebra /Recitation<br>Calculus /Recitation<br>Fundamentals of Mechanics<br>Fundamentals of Electromagnetism<br>Fundamental Life Science Laboratory<br>Introduction to Bio-Frontier Research<br>Processes for Creation in Science and Technology<br>School of Life Science and Technology Literacy<br>International Bio-Creative Design | Physical Chemistry<br>Organic Chemistry<br>Biochemistry<br>Molecular Biology<br>Basic bioinorganic chemistry<br>Molecular Genetics<br>Biochemical Engineering<br>Bioinformatics<br>Biostatistics<br>Instrumental Analysis in Bioscience<br>Developmental Biology<br>Fundamentals of Innovation Creation<br>Basic Laboratory and Exercise<br>Advanced Bio-Creative Design | Biophysical Chemistry<br>Structural Biology<br>Genome Informatics<br>Bioorganic Chemistry<br>Biomaterials Science<br>Polymer Science (LST)<br>Advanced biological inorganic chemistry<br>Pharmaceutical Chemistry<br>Plant Physiology<br>Photosynthesis and photobiology<br>Animal Physiology<br>Evolutionary Biology<br>Biological Science | Microbiology<br>Cell Engineering<br>Environmental Bioengineering<br>Genetic Engineering<br>Basic Neuroscience<br>Enzyme Engineering<br>Synthetic Biology<br>Cell Biology<br>Bioethics and Law<br>Scientific discussions in English<br>LST Seminar<br>Graduation Thesis<br>Internship<br>Overseas Training |

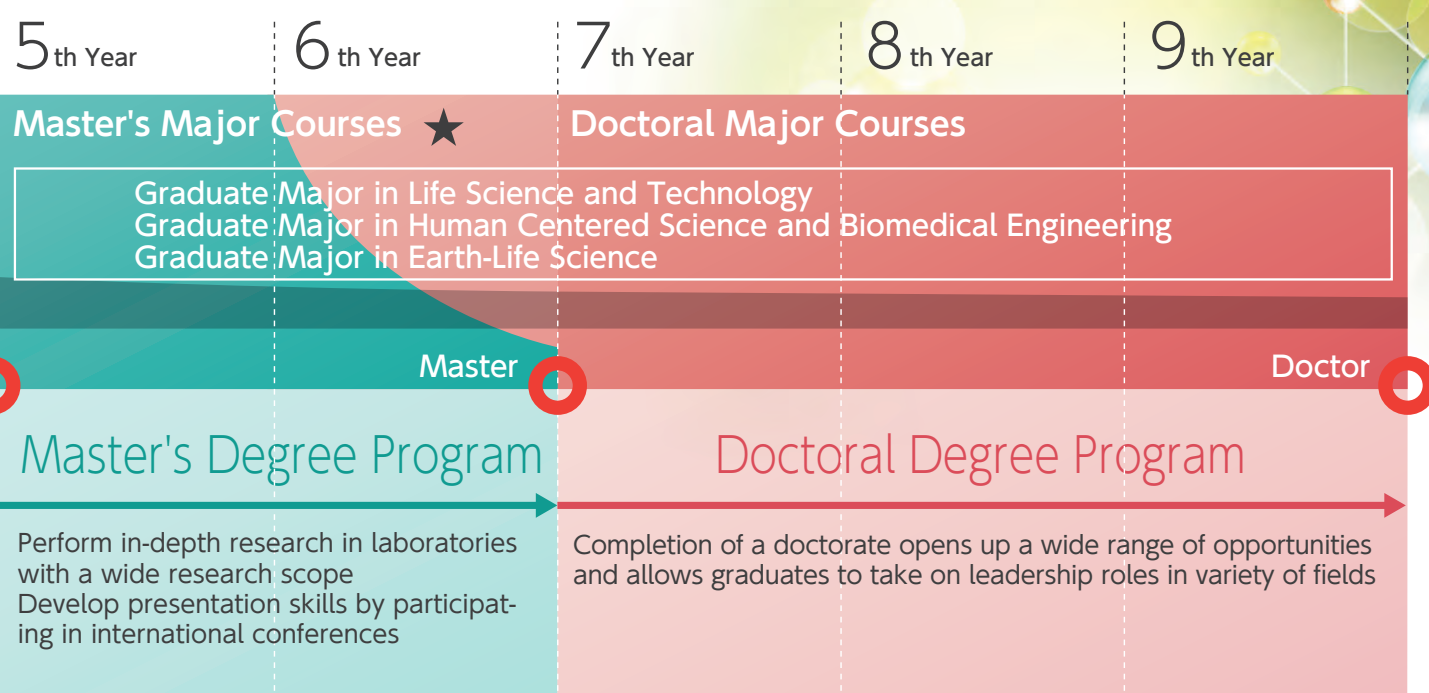
List of lectures (partial list)



# Learning

## ■ Academic quarter system

Our curriculum uses a quarter system in which each year is divided into quarters. The system allows flexible course planning and makes it easier for students to study abroad and complete internships.



★ Progress is measured by the student's level of achievement. Those who have attained a sufficiently high level may take more-advanced courses.

## Master's Degree Program

### Learn by engaging in cutting-edge research

By joining a laboratory and conducting cutting-edge research, students gain a deeper understanding of their field and develop scientific skills.



## Doctoral Degree Program

### Make an impact in the future of the life sciences

Advanced doctoral research provides opportunities for students to take an active part in the fields of life science and technology both inside and outside of Japan.



For additional details of the support options available to students at Tokyo Tech (tuition fee exemptions, scholarships, dormitory options, employment opportunities, etc.), please visit our website at <https://www.titech.ac.jp/english/prospective-students>

# Student Work and Activities

The fast-growing fields of life science and biotechnology seek internationally active individuals who are able to open up a new era. By creating an independent study environment, the School of Life Science and Technology supports a variety of activities in which students take initiative and proactively communicate with other students and researchers around the world.

**Learn by yourself, think actively, and materialize the idea with originality and ingenuity**



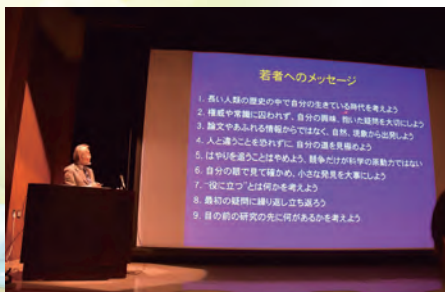
Students at School of Life Science and Technology are trained to materialize the idea with originality and ingenuity from the first year of the bachelor's degree program in courses such as Processes for Creation in Science and Technology, International Bio-Creative Design, and Advanced Bio-Creative Design. There are also opportunities to participate in presentation contests and give a speech on their achievements.

**Tokyo Tech Team wins another gold medal at iGEM**



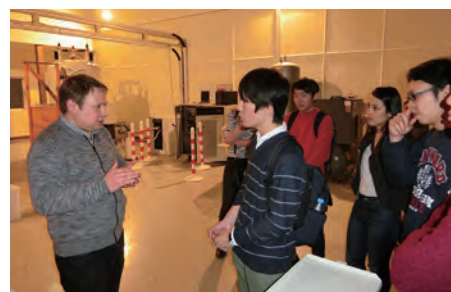
Approximately 200 teams of students from around the world participate in International Genetically Engineered Machine (iGEM), an international competition in synthesis biology. Tokyo Tech Team, which mainly consisted of students from the School of Life Science and Technology, is famous for its record by winning the 11th consecutive gold medal.

**Looking to the future of life science with world-famous researchers**



With the hope of becoming world-class investigators, undergraduate and graduate students as well as young researchers can enrich their perspectives through participation in Bioscience and Biotechnology International Symposia and Top Leaders Forums where they can meet superb academics from home and abroad.

**Join workshops and training seminars abroad**



Tokyo Tech offers students the opportunity to attend overseas workshops and training seminars in order to foster global leadership.



## Exposure to cross-cultural environments while studying abroad

International internships are among the many ways in which students have the opportunity to visit universities and research institutes abroad. These programs aim to develop human resources in the field of life science and individuals capable of playing an active role in the world.



Massachusetts  
Institute of  
Technology



Heinrich-Heine-  
Universität  
Düsseldorf



University of  
Connecticut Health  
Center

## Study abroad experiences

### KAWAURA, Hinata

The three months I spent at the Gilestro Laboratory at Imperial College London was a hugely valuable experience. In the long-established academic culture of the UK, I observed that anything essential to the pursuit of academic excellence was respected above everything else. This meant that, unlike in Japan where students seldom counter the opinions of faculty members, students in the UK did not hesitate to engage in a battle of logic with their instructors. I found this setting extremely powerful, as it enables discussions among groups of individuals to come up with answers that would otherwise not be possible. I learnt a lot from my internship and intend to build on this experience as I continue to pursue my research.

### IMADA, Takashi

I worked as an intern for five months at the Pamela Silver Laboratory at Harvard Medical School. During my stay, not only was I able to acquire new skills in imaging and analysis, but I was able to meet a diverse community of researchers and observe the different ways in which Japanese and American universities and laboratories are organized. This experience has impacted the way I view research as well. The pursuit of science should not be about following trends set by others. It should be about taking on unique and edgy research that explores new fields.

## Students talk about their life in the lab

### Mutawakil Al Muqadasi doctoral student

I am an Indonesian student at the School of Life Science and Technology. As a foreign student in Japan, the language barrier has been a great challenge. Even so, my fellow students here are very helpful thus making me enjoy every process of my research. Moreover, it is a blessing to have supervisors who are always there for me to give valuable insights and mental support, hence making my life as a student easier. Overall, it is an excellent opportunity to study at Tokyo Tech. I hope I can implement my knowledge and experience that I earn to help society in the future.



### KANESHITA, Minori master's student

I'm currently researching on the immune response function of an U1 snRNA. Although there are times my research does not go well, I enjoy with the guidance I receive from my professors and seniors. I'm able to conduct a wide range of experiments from organic synthesis to cell experiments, and I feel that I'm growing through my experiments.



### TAKEDA, Yota master's student

I am exploring the developmental mechanisms of the vertebrate limbs. At first, I did not know what to expect, but thanks to the kindness of my colleagues in the laboratory, I am enjoying my research every day. I would like to make use of my experiences at Tokyo Tech, and be a person who is active in a variety of situations.



## International Graduate Program (IGP)

<https://www.titech.ac.jp/english/admissions/prospective-students/graduate-programs/igp>

### International Graduate Program for Bioscience and Biotechnology

Since 2007, the School of Life Science and Technology (the former Graduate School of Bioscience and Biotechnology) has administered an international graduate course for foreign students from all over the world, especially excellent students from Asian countries.

In 2013, to further advance this graduate course, we launched new international education programs that include master's, doctoral, and integrated master's and doctoral education curricula designed to help students cultivate their creativity, learn practical working skills, and improve their English- and Japanese-language skills. In these International Graduate Programs, we foster international leaders who are able to develop leading-edge research and innovations in science and technology as a bridge between Japan and other countries.

Currently, our school has three Graduate Majors, Life Science and Technology, Human Centered Science and Bio-medical Engineering and Earth-Life Science. A student selects one of these majors after discussion with his or her supervisor.

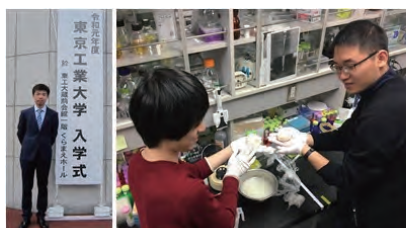


## Tokyo Tech - Tsinghua University Joint Graduate Program

[http://www.ipo.titech.ac.jp/tsinghua/index\\_en.html](http://www.ipo.titech.ac.jp/tsinghua/index_en.html)

Tokyo Tech and Tsinghua University (China) jointly operate a double degree program for students at the master's levels. In addition to cultivating students' specialized scientific knowledge and research experience, the program strategically develops students with linguistic proficiency in Japanese, Chinese and English, and familiarity with the culture and customs of both Japan and China. Of the program's three courses — Bioscience and Biotechnology, Nanotechnology, and Decision Science & Technology — the "bio course" has historically played a central role. Managed jointly by each country's leading university in science and technology fields, the program is a model for international academic collaboration at the highest level of education and research. Industry-academia collaborative research symposia are held twice a year in Beijing and Tokyo to foster development of human resources who can respond to a wide range of interdisciplinary issues and promote industrial development and cultural exchange based on international cooperation between Japan and China. Professors, students, and business people participate in these symposia, thereby deepening bilateral exchanges. The program is recognized for nurturing talented individuals with the ability to contribute to the international community.

Members of the 15<sup>th</sup> cohort from Tsinghua University



Member of the 19<sup>th</sup> cohort from Tokyo Tech

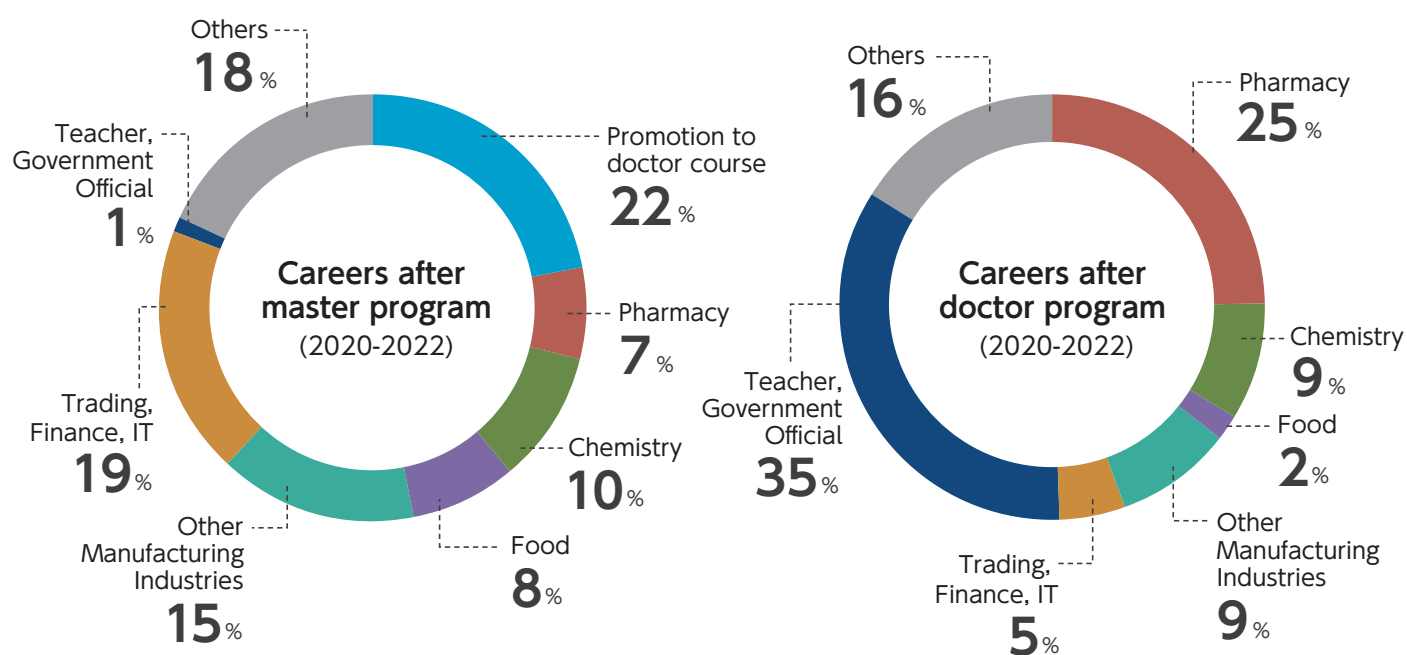


15<sup>th</sup> anniversary\_ceremony, October 21, 2019, Tokyo Tech



# Working Globally

90% of the undergraduate students will proceed to the graduate school of Tokyo Tech.



## Places of employment

### Pharmacy

Astellas Pharma, AstraZeneca, Chugai Pharmaceutical, Kyowa Kirin, Mochida Pharmaceutical, Pfizer Japan, Takeda Pharmaceutical, Daiichi Sankyo Propharma, etc.

### Chemistry

Asahi Kasei, Fujifilm, JSR, Kao, Lion, Mitsubishi Chemical, Mitsui Chemicals, P&G, Sumitomo Chemical, Teijin, Toray Industries, AGC, Dow Chemical, DIC, Unilever, etc.

### Food

Asahi Breweries, Kewpie, Kirin Holdings, Lotte, Morinaga Milk Industry, Mizkan, Kikkoman, Suntory Holdings, Nisshin Seifun, S&B Foods, J-OIL MILLS, etc.

### Other Manufacturing Industries

Dai Nippon Printing, Fujitsu, Hitachi, Kioxia, Micron Memory Japan, Nippon Paper, Terumo, Toppan Printing, Olympus, Sony, Toshiba, Keyence, Panasonic, etc.

### Trading, Finance, IT

Itochu, Mizuho Bank, Microsoft Co, MUFG Bank, NS Solutions, NTT, NTT Date, Softbank, Sumitomo Mitsui Banking, Rakuten, KDDI, etc.

### Teacher, Government Official

Tokyo Tech., Kyushu Univ., UC Berkeley, Zhejiang Univ., RIKEN, KEK, Tokyo Regional Taxation Bureau, MEXT, AIST, etc.

### Others

Accenture, The Japan Research Institute, Tokyo Gas, The Japan Research Institute, Odakyu Electric Railway, IBM Japan, Kadokawa, Mitsui Fudosan, Mitsubishi Estate, etc.

# Faculty Members List (Alphabetical order)

## 〈Life Science and Technology〉

| NAME              | FIELD | Facility Name      | PAGE |
|-------------------|-------|--------------------|------|
| Professor         |       |                    |      |
| FUKUI, Toshiaki   | C S   | B1 Bldg.           | 19   |
| HAYASHI, Nobuhiro | M M   | Midorigaoka Bldg.6 | 15   |
| HIROTA, Junji     | T S   | B-C                | 24   |
| HONGO, Yuichi     | T S   | West Bldg.3        | 24   |
| ICHINOSE, Hiroshi | T S   | B2 Bldg.           | 24   |
| IGARASHI, Ryuji   | C M   | Midorigaoka Bldg.6 | 20   |
| ISHII, Yoshitaka  | M S   | J3 Bldg.           | 15   |
| ITOH, Takehiko    | C M   | Midorigaoka Bldg.6 | 20   |
| IWASAKI, Hiroshi  | C S   | S2 Bldg.           | 20   |
| KAMACHI, Toshiaki | C M   | Midorigaoka Bldg.6 | 20   |
| KAMIYA, Mako      | M S   | B1 Bldg.           | 15   |
| KANO, Fumi        | C S   | S2 Bldg.           | 20   |
| KAWAI, Kiyohiko   | M S   | B2 Bldg.           | 15   |
| KIMURA, Hiroshi   | C S   | S2 Bldg.           | 21   |
| KINBARA, Kazushi  | M S   | B2 Bldg.           | 15   |
| KITAO, Akio       | M M   | Midorigaoka Bldg.6 | 16   |
| KOBATAKE, Eiry    | M S   | G1 Bldg.           | 16   |
| KOMADA, Masayuki  | C S   | S2 Bldg.           | 21   |
| KUME, Shoen       | T S   | B1 Bldg.           | 24   |
| MARUYAMA, Atsushi | M S   | B2 Bldg.           | 16   |
| MASUDA, Shinji    | T S   | B-B                | 24   |
| MURAKAMI, Satoshi | M S   | J2 Bldg.           | 16   |
| OSAKABE, Yuriko   | T S   | J2 Bldg.           | 21   |
| SEIO, Kohji       | M S   | J2 Bldg.           | 16   |
| TAGUCHI, Hideki   | M S   | S2 Bldg.           | 17   |
| TANAKA, Mikiko    | T S   | B1 Bldg.           | 25   |
| TOKUNAGA, Makio   | C S   | B1 Bldg.           | 21   |
| UENO, Takafumi    | M S   | B2 Bldg.           | 17   |
| WACHI, Masaaki    | C S   | J2 Bldg.           | 21   |

## 〈Human Centered Science and Biomedical Engineering〉

| NAME                       | FIELD | Facility Name      | PAGE |
|----------------------------|-------|--------------------|------|
| Professor                  |       |                    |      |
| KAJIWARA, Susumu           | C S   | J3 Bldg.           | 28   |
| KOSHIKAWA, Naohiko         | T S   | B1 Bldg.           | 30   |
| KURODA, Kumi               | T S   | B1 Bldg.           | 30   |
| NAKAMURA, Hiroyuki         | M S   | R1 Bldg.           | 27   |
| NAKATOGAWA, Hitoshi        | C S   | S2 Bldg.           | 29   |
| NISHIYAMA, Nobuhiro        | M S   | R1 Bldg.           | 27   |
| SANEYOSHI, Takeo           | T     |                    | 30   |
| TANAKA, Kan                | C S   | R1 Bldg.           | 29   |
| YAMAYOSHI, Asako           | M S   | B2 Bldg.           | 27   |
| (Appointed on May 1, 2024) |       |                    |      |
| Associate Professor        |       |                    |      |
| KADONOSONO, Tetsuya        | M S   | B2 Bldg.           | 27   |
| KITAGUCHI, Tetsuya         | C S   | R1 Bldg.           | 29   |
| MASAKI, Yoshiaki           | M S   | B2 Bldg.           | 27   |
| MIURA, Yutaka              | M S   | R1 Bldg.           | 28   |
| MIYASHITA, Eizo            | T S   | G3 Bldg.           | 30   |
| MORI, Toshiaki             | M S   | B2 Bldg.           | 28   |
| OGURA, Shun-ichiro         | M S   | B1 Bldg.           | 28   |
| OKADA, Satoshi             | M S   | R1 Bldg.           | 28   |
| ORIHARA, Kanami            | C S   | J3 Bldg.           | 29   |
| URIU, Koichiro             | C M   | Midorigaoka Bldg.6 | 29   |
| YOSHIDA, Keisuke           | C S   | R1 Bldg.           | 30   |

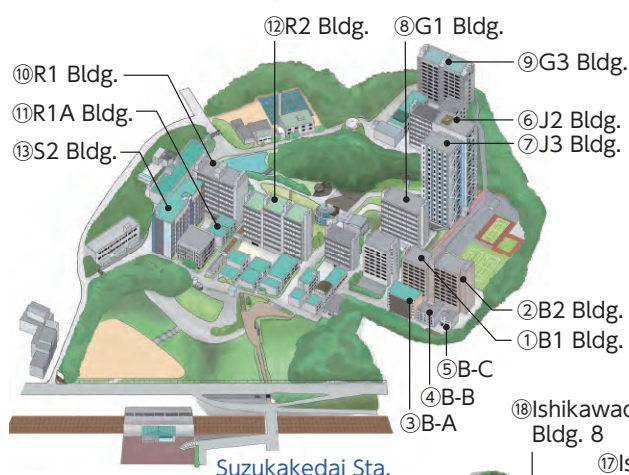
## 〈Earth-Life Science〉

| NAME                | FIELD | Facility Name      | PAGE |
|---------------------|-------|--------------------|------|
| Professor           |       |                    |      |
| MATSUURA, Tomoaki   | C     | Ishikawadai Bldg.7 | 31   |
| Associate Professor |       |                    |      |
| FUJISHIMA, Kosuke   | M     | Ishikawadai Bldg.8 | 31   |
| MCGLYNN, Shawn      | M     | Ishikawadai Bldg.7 | 31   |

### Research Field

M : Molecule C : Cell T : Tissue, Organism

## Suzukakedai Campus



### Facility Name

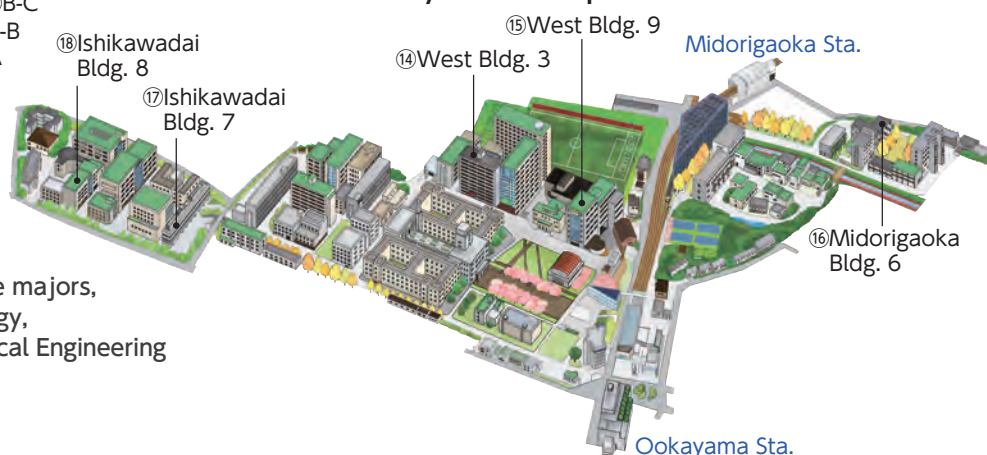
S Suzukakedai Campus

- ① B1 Bldg.
- ② B2 Bldg.
- ③ B-A (B1B2 Annex A)
- ④ B-B (B1B2 Annex B)
- ⑤ B-C (B1B2 Annex C)
- ⑥ J2 Bldg.
- ⑦ J3 Bldg.
- ⑧ G1 Bldg.
- ⑨ G3 Bldg.
- ⑩ R1 Bldg.
- ⑪ R1A Bldg.
- ⑫ R2 Bldg.
- ⑬ S2 Bldg.

○ Ookayama Campus

- ⑭ West Bldg. 3
- ⑮ West Bldg. 9
- ⑯ Midorigaoka Area
- ⑰ Midorigaoka Bldg. 6
- ⑱ Ishikawadai Area
- ⑲ Ishikawadai Bldg. 7
- ⑳ Ishikawadai Bldg. 8

## Ookayama Campus



The School is composed of three majors,  
Life Science and Technology,  
Human Centered Science and Biomedical Engineering  
and Earth-Life Science.





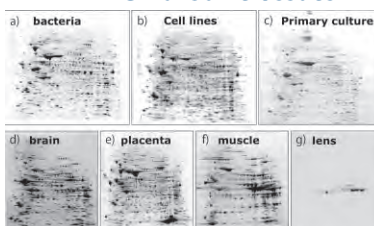
Professor  
**HAYASHI, Nobuhiro** | Assistant Professor  
**WONG, Sing Ying**

### Elucidation of something unknown of the life through high performance proteomics

Using AI proteomics technique developed by combination of original high-performance 2D-PAGE with AI, we are studying various subjects including basic, clinical and healthcare science.

**Keywords** healthcare science, clinical proteomics, artificial intelligence (AI)

#### 2D-PAGE of some tissues



#### Protein

#### Image of future healthcare society



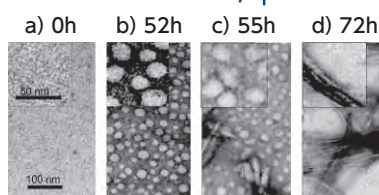
Professor  
**ISHII, Yoshitaka** | Assistant Professor  
**MATSUNAGA, Tatsuya**

### Structural biology of amyloid and molecular mechanism of Alzheimer's

Our team is revealing functions and structures of misfolded amyloid proteins associated with Alzheimer's and other diseases by solid-state NMR (SSNMR). Our research scope also includes NMR-based analysis of advanced nanomaterials such as modified graphenes.

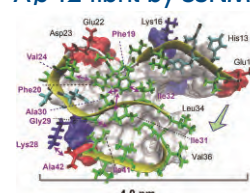
**Keywords** Amyloid, structural biology, solid-state NMR, carbon nanomaterials

#### Time-resolved electron micrograph of Alzheimer's A $\beta$ protein



#### Protein

#### First atomic model of A $\beta$ 42 fibril by SSNMR



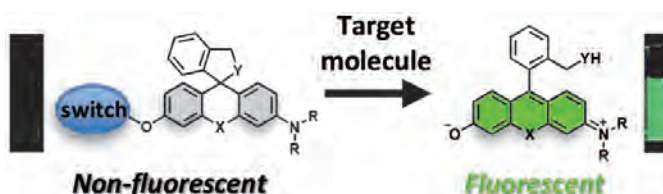
Professor  
**KAMIYA, Mako** | Assistant Professor  
**FUJIOKA, Hiroyoshi**

### Development and biological applications of original chemical probes

We are developing original chemical probes (fluorescent probes, Raman probes, photosensitizers, etc.) to visualize or control biological phenomena and disease.

**Keywords** Organic chemistry, photochemistry, fluorescent probes, bioimaging

#### Activatable fluorescent probes for bio-molecules



#### Chemical biology



Professor  
**KAWAI, Kiyohiko** | Assistant Professor  
**KONDO, Yohei**

### Detect a single molecule Learn from a single molecule

We use bioorganic chemistry to control photochemical reactions. Our research focuses on "dynamics" such as rate constants of chemical reactions and motions of biomolecules.

**Keywords** single molecule chemistry, bioorganic chemistry

#### Fluorescence blinking



#### In situ mutation detection



#### Photochemistry



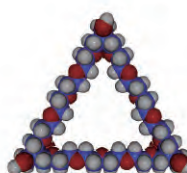
Professor  
**KINBARA, Kazushi** | Assistant Professor  
**KOHATA, Ai**

### Developing functional molecules inspired by biological systems

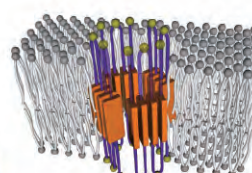
Inspired by the sophisticated biological systems, we are developing synthetic functional molecules which mimic or control biomacromolecules.

**Keywords** organic chemistry, molecular devices, self assembly, biomimetics

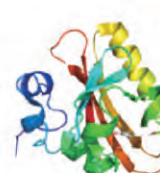
#### Structured PEG



#### Ion channel



#### Photoactive protein



#### Biomaterials



Professor  
**KITAO, Akio**

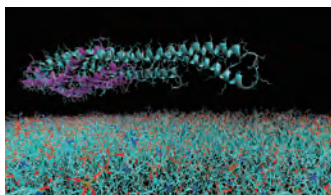
Assistant Professor  
**TRAN, Phuoc Duy**

## Observing Biological Phenomena by Computer

We investigate molecular mechanisms of biological systems (proteins, nucleic acids, membrane, etc) by cutting-edge computer simulation.

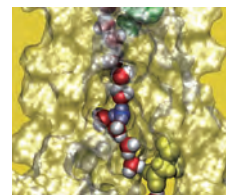
**Keywords** Protein Dynamics, Computational Biology, Biophysics, Computational Chemistry

## Membrane deformation simulation induced by I-BAR



## Computational Biology

## Proton transfer through flagellar motor



Professor  
**KOBATAKE, Eiry**

Assistant Professor  
**NISHIDA, Kei**

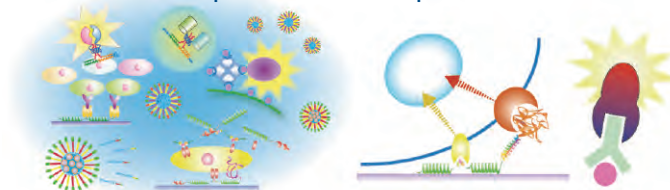
## Construction of super biofunctional protein materials

We have created various super biofunctional protein materials for controlling cellular functions and biosensing.

**Keywords** protein engineering, cellular and tissue engineering, biomaterial, biosensing

## Biomaterials

## Construction and application of super biofunctional proteins



Professor  
**MARUYAMA, Atsushi**

Assistant Professor  
**SHIMADA, Naohiko**

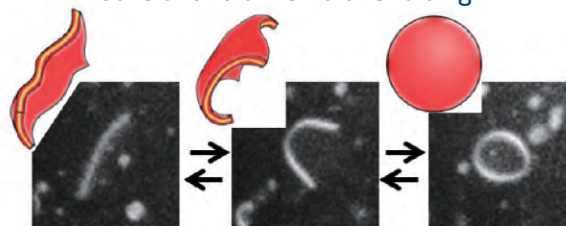
## Design of bio-functional and bio-conjugate materials

Our research interests involve design of biofunctional materials capable of enhancing function of biopolymers and cells for nanomedicines, tissue engineering and diagnosis.

**Keywords** drug delivery/ nucleic acids, proteins, lipids/ stimuli responsive polymers

## Biomaterials

## Control of bio-membrane folding



Professor  
**MURAKAMI, Satoshi**

Assistant Professor  
**OKADA, Ui**

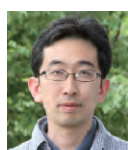
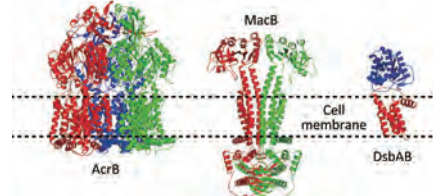
## Structure and molecular mechanism of membrane protein complex

We seek to understand the molecular mechanism of key biological processes on the cell membrane and membrane proteins at the level of protein structure, dynamics and molecular biology.

**Keywords** membrane protein, structural biology, protein crystallography, membrane transport

## Protein

## Crystal structures of membrane protein solved in our laboratory



Professor  
**SEIO, Kohji**

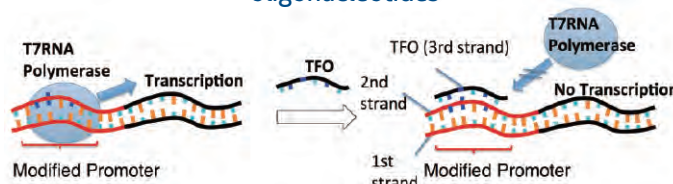
## Nucleic acids chemistry for regulation of genetic information

We are trying to establish novel methodologies to regulate nucleic acids related phenomenon, using organic chemistry, physical chemistry, biochemistry, and computational chemistry.

**Keywords** organic chemistry of nucleic acids, transcription regulation, nucleic acid drugs

## Nucleic acids

## Transcription regulation by triplex forming oligonucleotides







Professor  
**TAGUCHI, Hideki**

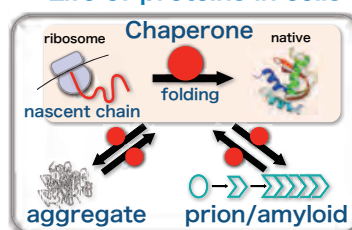
Assistant Professor  
**NIWA, Tatsuya**

### Life of proteins in cells: Translation, chaperone, prion

We are pursuing the expanding world of proteins in the cell, focusing on how proteins are synthesized and folded in cells (non-canonical ribosome dynamics, chaperones that assist protein folding, prions and so on).

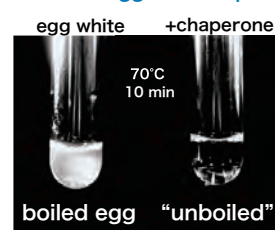
**Keywords** Proteins, non-canonical ribosome dynamics, chaperone, prion, amyloid

#### Life of proteins in cells



#### Protein

#### "unboiled" egg with chaperone



Professor  
**UENO, Takafumi**

Assistant Professor  
**KIKUCHI, Kosuke**

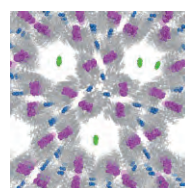
### Development of artificial enzymes and biosupramolecular materials

Our interests are chemistry of protein assembly based on synthetic chemistry and structural biology to elucidate chemical reactions in living cells and develop biomaterials.

**Keywords** protein engineering, bioinorganic chemistry, chemical biology

#### Biomaterials

#### Functionalized protein crystal and artificial needle protein



Professor  
**YASUI, Takao**

Assistant Professor  
**AJIRI, Taiga**

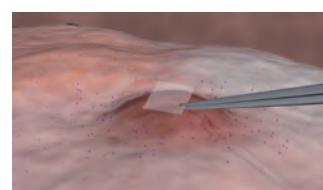
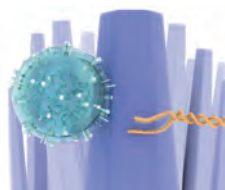
### Innovation of biomolecular analysis using nano-intelligence platforms

We aim to revolutionize life sciences and medicine by developing groundbreaking, cross-disciplinary technologies, turning the impossible into reality.

**Keywords** Biomolecular analysis, nano-intelligence platform, Liquid biopsy, Quantum life science

#### Bioanalysis

#### Platforms for analyzing and collecting biomolecules



Professor  
**YUASA, Hideya**

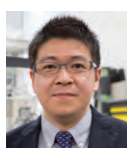
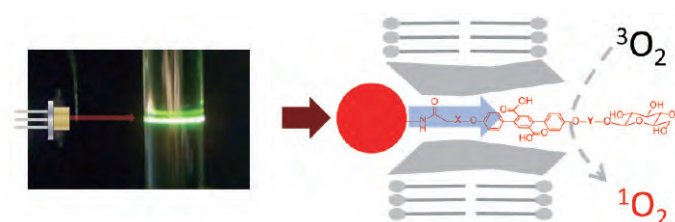
Assistant Professor  
**KANAMORI, Takashi**

### Photosensitizers and photodynamic therapy of cancer

We are studying photodynamic therapy of cancer using up-conversion nanoparticles and photosensitizers we developed on our own.

**Keywords** photodynamic therapy, photosensitizer, lanthanide nanoparticle

#### Bioactive compounds



Associate Professor  
**ASAKURA, Noriyuki**

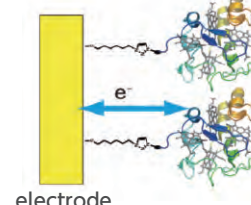
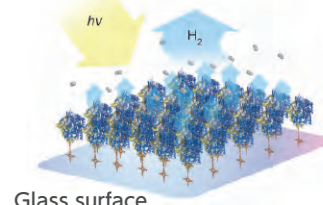
### Bioelectrochemistry of proteins and hydrogen generation by photoinduced biological electron transfer

We are interested in understanding details of the important biological electron transfer. This provides precise control over enzyme reactions in direct electrochemical and photochemical studies.

**Keywords** electrochemistry, photochemistry, biological electron transfer, redox proteins

#### Protein

#### Photoinduced hydrogen evolution





Associate Professor  
**FUJIE, Toshinori**

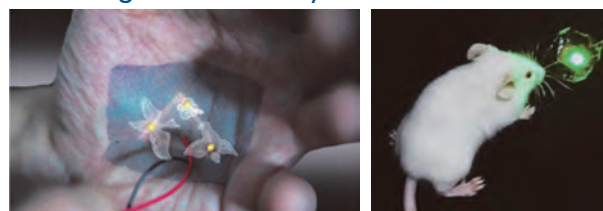
## Nano-biodevice based on dimensional control for biomedical applications

We envision the smart biodevice with integrated nano, bio and electronic systems towards minimally invasive medicine, expected for human healthcare and biomedicine.

**Keywords** biomaterials, polymer, tissue engineering, bioelectronics

## Biomaterials

### Bio-integrated devices by nanosheet electronics



Associate Professor  
**HATA, Takeshi**

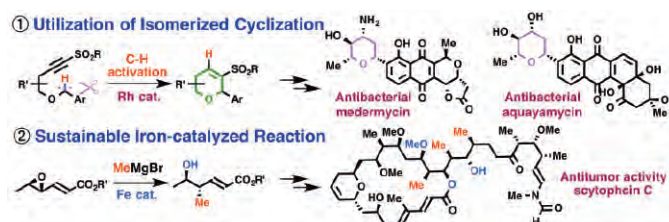
## Synthesis of bioactive compounds by sustainable molecular transformation

We are developing new sustainable synthetic methods for manipulation of organic molecules and also making natural products and pharmaceuticals by those methods.

**Keywords** organic chemistry, synthetic chemistry, pharmaceutical chemistry, natural products chemistry

## Bioactive compounds

### Sustainable synthesis of bioactive compounds



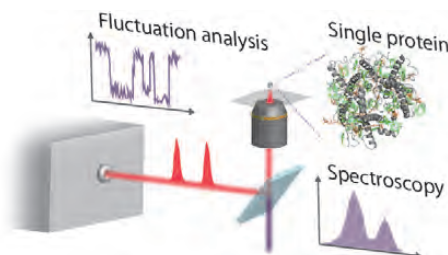
Associate Professor  
**KONDO, Toru**

## Nanoscale photophysics in biological system using advanced microspectroscopy

Photoreceptor protein achieves efficiency, multifunctionality, and robustness. We develop advanced microspectroscopy to understand photoreaction mechanism at the molecular level, leading to the design of bio-inspired materials.

**Keywords** ultrafast microscopy, single-protein, photosynthesis, biological quantum effect

## Biophotophysics



Single-protein spectroscopy by femto-second laser microscope



Associate Professor  
**MATSUDA, Tomoko**

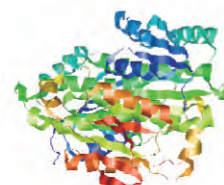
## Organic synthesis by enzymes

We have been using enzymes as a catalyst and CO<sub>2</sub> as a solvent for organic synthesis to promote green chemistry.

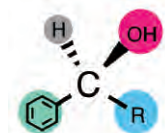
**Keywords** enzyme, organic synthesis, CO<sub>2</sub>, green chemistry

## Biocatalysis

### Microorganism with useful enzymes as catalysts



Optically pure compounds for intermediates of pharmaceuticals



Associate Professor  
**MIE, Masayasu**

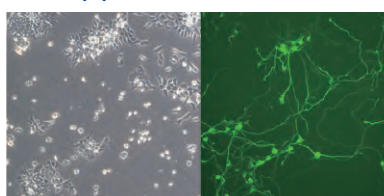
## Development of biomolecular tools

We are trying to develop molecular tools consist of biomolecules such as proteins and DNA for bioimaging, biosensing and regulation of cellular functions.

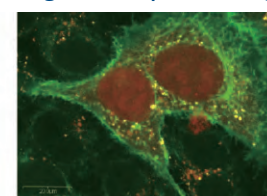
**Keywords** biomaterials, protein engineering, cellular engineering

## Biomaterials

### Induction of neural differentiation by protein transduction



### Bioimaging with engineered protein tag





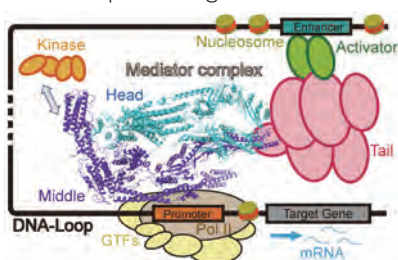


Associate Professor  
**NOZAWA, Kayo**

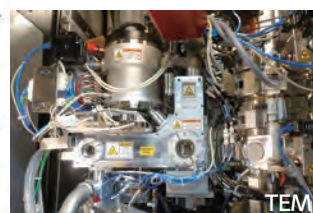
### Structural and biochemical analysis of gene regulation by 3D genome folding

To understand gene regulatory mechanism, we employ cryo-EM to visualize high-order genome architectures, and aim to design and characterize in-vitro reconstituted genomic architectures.

**Keywords** Structural biology, Cryo-EM, gene structure, transcriptional regulation



Chromatin, Gene expression



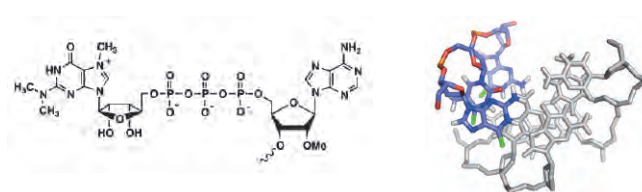
Associate Professor  
**OHKUBO, Akihiro**

### Development of new nucleic acid drugs for gene therapy

We develop new bioactive molecules including nucleic acids drugs for accurate regulation of biochemical reactions (transcription, splicing, translation) based on organic chemistry.

**Keywords** bioorganic chemistry, nucleic acid chemistry, nucleic acid drugs

### Nucleic acid drugs for accurate regulation of biochemical reactions



Bioactive compounds



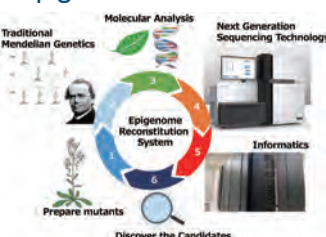
Associate Professor  
**TO, Taiko**

### Elucidating the epigenome establishment mechanism in plants and its applications

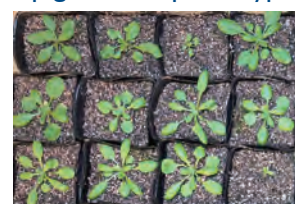
Living organisms identify harmful sequences in their genomes and suppress them through epigenetic modifications. We are studying the mechanism how plants establish epigenomic patterns properly, as well as developing new applications.

**Keywords** plants, epigenomics, molecular genetics, synthetic biology

### Epigenome reconstitution



### Association of variability (epigenome / phenotype)



Chromatin, Gene expression



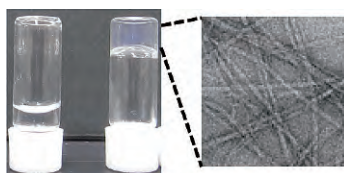
Associate Professor  
**TSUTSUMI, Hiroshi**

### Control and Analysis of Cell Environment based on Chemical Biology

We design and chemically synthesize supramolecular hydrogels and various fluorescent probes to control and analyze cellular function and cell environment.

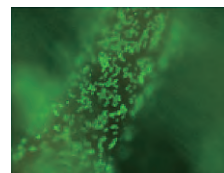
**Keywords** fluorescent probe, bioimaging, supramolecular chemistry, cell environment chemistry

### Supramolecular hydrogel



Biomaterials

### Cell culture using supramolecular hydrogels



Professor  
**FUKUI, Toshiaki**

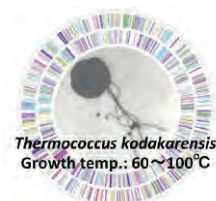
### Analyses and engineering of microbes for production of useful compounds

Our lab is studying on analyses and metabolic engineering of microbes (especially hyperthermophiles, bioplastic-producing bacteria, and methylotrophs) aiming efficient production of useful compounds.

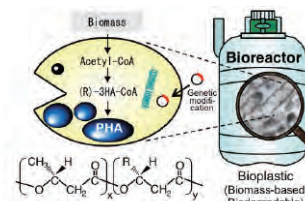
Assistant Professor  
**ORITA, Izumi**

**Keywords** bacteria/archaea, metabolic engineering, hyperthermophiles, bioplastic-producing bacteria

### Hyperthermophilic archaeon



### Bioplastic-producing bacterium



Microbiology



Professor  
**IGARASHI, Ryuji**

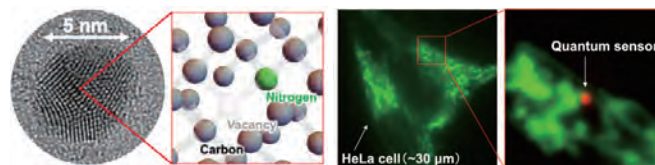
## Discovering the Essence of Life Beyond Classical Methodology

Quantum sensors are unveiling previously unseen minute biological changes and trace biomolecules, leading to a deeper understanding of life and pioneering ultra-early disease diagnostics.

**Keywords** diamond NV centers, single-cell/molecule, Liquid biopsy, Alzheimer's

Quantum Life

## 5 nm Quantum Sensor for Ultra-Sensitive Biometrics and Early Detection of Alzheimer's and Cancer.



Professor  
**ITO, Takehiko** Assistant Professor  
**TANAKA, Hiroyuki**

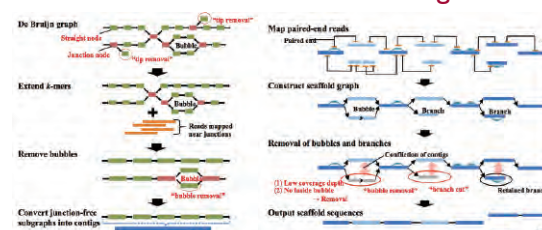
## Elucidation of biological phenomenon using NGS and bioinformatics

We are studying biological phenomenon, using next generation sequencer and various computational bioinformatics techniques.

**Keywords** genome informatics, chromosome dynamics

Bioinformatics

## Overview of Platanus assembler algorithm



Professor  
**IWASAKI, Hiroshi** Assistant Professor  
**TSUBOUCHI, Hideo**  
**KANAMARU, Shuji**

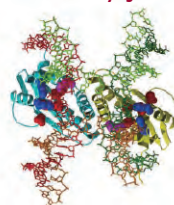
## Temporospatial regulation of chromosome dynamics

We are studying the molecular basis that underlies temporospatial regulation of chromosome dynamics through various techniques. In particular, we focus on the process of homologous recombination and mating type switching in fission yeast.

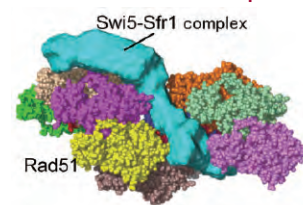
**Keywords** chromosome biology, homologous recombination, DNA repair, genome integrity

Chromatin, Gene expression

## A model for RuvC and Holliday junction



## A model for Rad51 filament and Swi5-Sfr1 complex



Professor  
**KAMACHI, Toshiaki** Assistant Professor  
**ITO, Hidehiro**

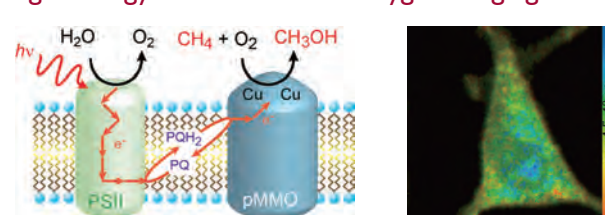
## Elucidation and application of metal ions in biological system

We are studying transduction of light energy into chemical energy by metalloenzyme and elucidation of oxygen dynamics inside a single cell.

**Keywords** metalloenzyme, oxygen imaging, energy transduction

Microbiology

## Light energy transduction and oxygen imaging of cell



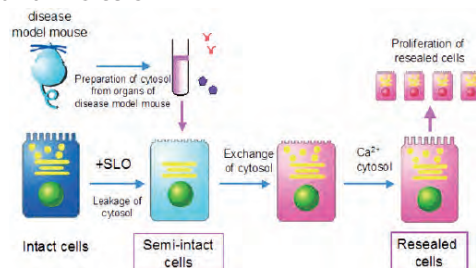
Professor  
**KANO, Fumi** Assistant Professor  
**NAKATSU, Daiki**

## Cell Editing and Cell Design

Kano lab is devoted to development of technologies for "Cell Editing and Cell Design". We use cell-resealing technique, a method for delivering molecules into cells, combined with a novel image-based analysis that creates covariation networks from immunostained cell images.

**Keywords** Cell-resealing technique, cell editing, covariation network analysis, human iPS cells

Cellular function



Scheme of cell-resealing technique





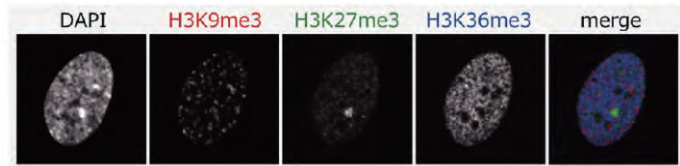
Professor  
**KIMURA, Hiroshi** Assistant Professor  
**SATO, Yuko**

### In vivo regulation of epigenetic dynamics

To understand the mechanism of gene expression, we are investigating histone modification dynamics in living cells and organisms.

**Keywords** epigenetics, cell nucleus, transcription, live cell imaging

**Chromatin, Gene expression**



Localization of various histone modifications



Professor  
**KOMADA, Masayuki** Assistant Professor  
**FUKUSHIMA, Toshiaki**

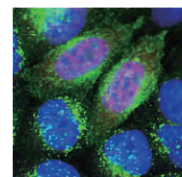
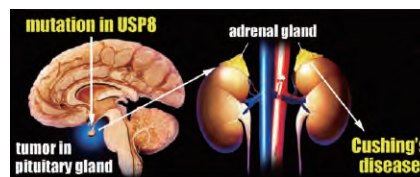
### Regulation of diverse cellular functions by the ubiquitin system

The ubiquitin system not only induces cellular protein degradation but also regulates their localization, complexation, and activation. We study molecular mechanisms underlying its diverse regulation and dysregulation in human diseases and senescence.

**Keywords** ubiquitin, proteostasis, tumor, senescence

**Cellular function**

#### USP8 mutation in pituitary tumor in Cushing's disease



Professor  
**OSAKABE, Yuriko** Assistant Professor  
**KIDOKORO, Satoshi**

### Molecular basis of genome editing and genetic engineering

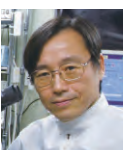
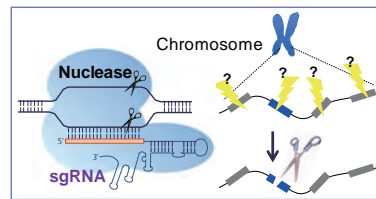
We are studying molecular basis of genome editing technology and its application, and genetic engineering to modify and improve gene function in various organisms.

**Keywords** genome editing, genetic engineering, molecular breeding

**Plant, Synthetic biology**

#### Genome modification and genetic mutations using genome editing

#### Applications in medical and plants



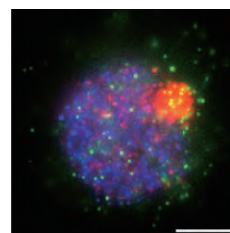
Professor  
**TOKUNAGA, Makio**

### Visualization and quantitation of cellular mechanisms

Our goal is the understanding of cellular spatio-temporal dynamics and mechanisms, based on development of techniques in molecular imaging and quantification.

**Keywords** single molecule, imaging and quantification, super-resolution, chromatin

**Cellular function**



Three-dimensional multi-color imaging of signaling and transcription factor molecules in the cell nucleus.

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Professor  
**WACHI, Masaaki** Assistant Professor  
**IWAI, Noritaka**

### Regulatory mechanism of bacterial cell growth and metabolism

We want to know how bacterial cells perform cellular metabolism, grow, and reproduce. Screening of new antibiotics is also carried out.

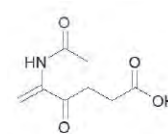
**Keywords** *E. coli*, cell division, metabolism, antibiotics, *Corynebacterium glutamicum*

**Microbiology**

#### SEM image of *C. glutamicum* cells



#### Alaremycin and its producer strain



Alaremycin



*Streptomyces* sp. A012304



Professor  
**YAMAGUCHI, Yuki**

Assistant Professor  
**SAKAMOTO, Satoshi**  
Assistant Professor  
**YAMAMOTO, Junichi**

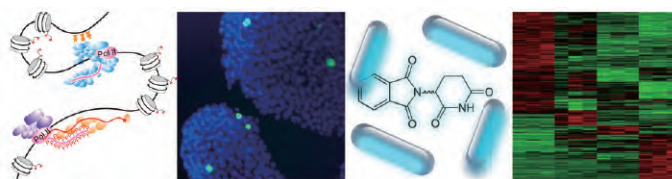
## Understanding and applying the machinery of life

We are promoting both basic and applied research, focusing on control mechanisms of genome expression and chemical biology using small molecules.

**Keywords** gene expression, genome, drug development, chemical biology

**Chromatin, Gene expression**

Collage showing diverse research in the lab. From left, transcription, ES cells, drugs, genome-wide analysis.



Associate Professor  
**AIZAWA, Yasunori**

Assistant Professor  
**KANEKO, Shinya**

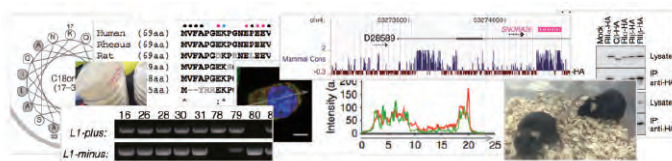
## Elucidation of sequence-function relationship in the human genome

We apply various approaches of molecular and synthetic biology to elucidate significance of (1) polycistronic translation of human mRNAs and (2) introns and retroelements in the human genomic functions.

**Keywords** gene, human genome, micro-protein, new proteome technologies

**Genomics**

Multidisciplinary approaches to identify and understand new types of human genes



Associate Professor  
**FUJITA, Naonobu**

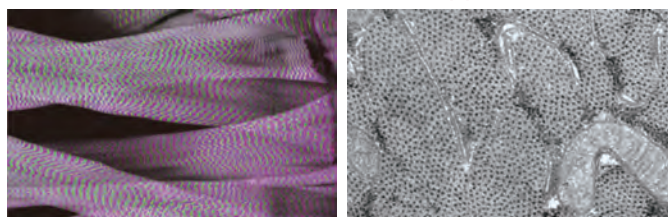
## Mechanisms of formation and remodeling of organelles in muscle cell

Muscle cells are multi-nucleated giant cells with highly organized organelles. Our study aims to elucidate the mechanisms to form and remodel the organelles in muscle cells.

**Keywords** muscle cell, organelles, T-tubule, fruit fly

**Cellular function**

Fluorescence and electron microscopy of muscle cells



Associate Professor  
**HIRASAWA, Takashi**

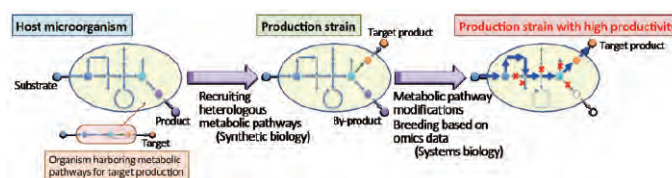
## Metabolic engineering toward bioproduction of useful materials

We are studying metabolic engineering of microorganisms for development of key technologies on rational design of microbial cell factories for production of useful materials.

**Keywords** applied microbiology, metabolic engineering, microbial cell factories, bioproduction

**Microbiology**

Metabolic engineering toward bioproduction



Associate Professor  
**KAJIKAWA, Masaki**

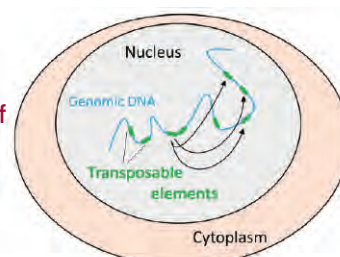
## Are transposable elements alive?

There are a huge number of transposable elements (TEs) in the genome of organisms. Our aim is to elucidate the amplification mechanism of TEs.

**Keywords** transposable element, retrotransposon, genome evolution, epigenetics

**Chromatin, Gene expression**

Amplification of transposable elements







Associate Professor  
**KATO, Akira**

Assistant Professor  
**NAGASHIMA, Ayumi**

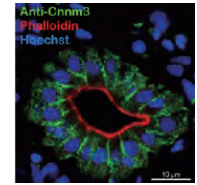
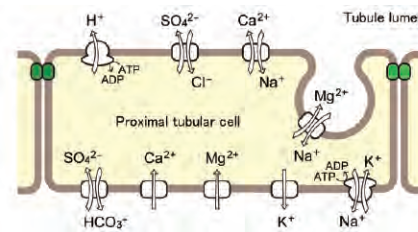
### Epithelial mechanisms responsible for environmental adaptation

We compare expressions and functions of transporters in various epithelial cell types (kidney, intestine, etc.) among freshwater fishes, seawater fishes, and terrestrial animals.

**Keywords** electrophysiology, molecular physiology, cell biology, comparative genomics

Cellular function

#### Renal excretion of divalent ions in marine teleost



Associate Professor  
**NAKAMURA, Nobuhiro**

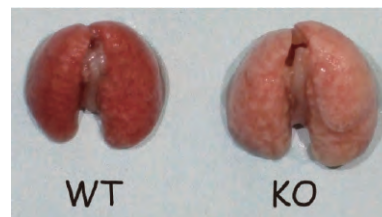
### Regulatory mechanism of cell and tissue shape and function

Our research is focusing on the signaling mediators, such as receptors, that regulate the cell and tissue architecture and function and the pathogenesis of related diseases.

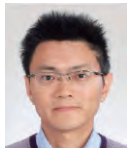
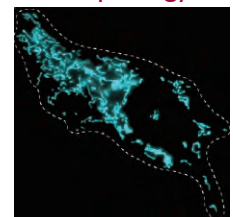
**Keywords** receptor, signal transduction, knockout mice, ubiquitin

Cellular function

#### Abnormal lung morphology in knockout mice



#### Mitochondrial morphology



Associate Professor  
**SHIRAKI, Nobuaki**

### Elucidation of the role of amino acid metabolism in stem cell differentiation

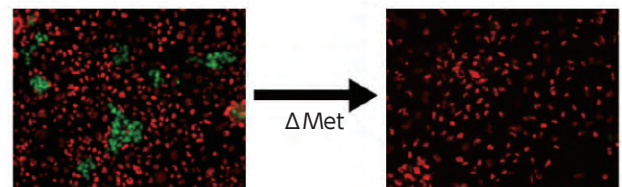
We are studying the role of amino acid metabolism in maintenance and differentiation of stem cells and its application for ES/iPS cell endoderm differentiation.

**Keywords** ES cells, iPS cells, amino acid metabolism, cell differentiation

Cellular function

#### Methionine deprivation induced cell death only in undifferentiated cells

(Green : undifferentiated stem cells, Red ; endoderm cells)



Associate Professor  
**YAMADA, Takuji**

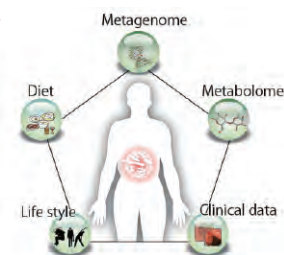
### Big data for human gut microbiome

We are studying molecular basis and metabolic functions of human gut or skin microbiome, using genomics, metagenomics and bioinformatics.

**Keywords** gut microbiome, metagenome, metabolic pathway, bioinformatics

Bioinformatics,  
Synthetic biology

#### Data for human gut microbiomes



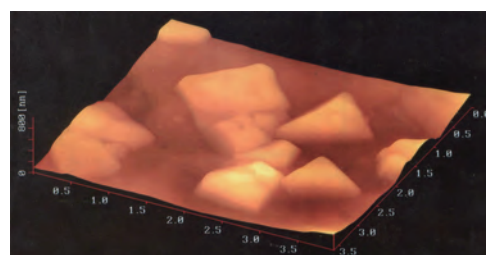
Associate Professor  
**YATSUNAMI, Rie**

### Extremophiles and extremozymes have limitless possibilities !

We are doing researches on protein engineering of extremozymes (enzymes produced by extremophiles) and metabolic engineering of extremophiles for production of useful materials.

**Keywords** protein engineering, metabolic engineering, extremophiles, extremozymes

Microbiology



AFM image of triangular disk-shaped halophilic archaeon



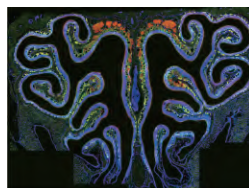
Professor  
**HIROTA, Junji**

## Molecular neuroscience of a sense of smell

Our laboratory studies on molecular mechanisms underlying the fate determination of olfactory sensory neurons, using mouse genetics and imaging techniques.

**Keywords** olfaction, chemical sense, neuronal differentiation, genome engineering

## Visualization of neurons in the main olfactory epithelium



Neuroscience

## Artificial chromosome & genome editing



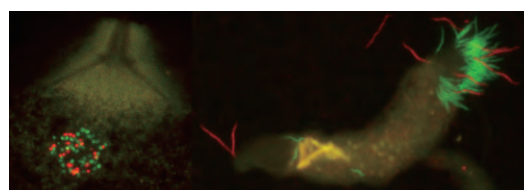
Professor  
**HONGO, Yuichi** Assistant Professor  
**MURAKAMI, Takumi**

## Molecular ecology and genome evolution of symbiotic systems

We are aiming to decipher symbiotic mechanisms between microbes and animals such as termites, and among the microbes. We use interdisciplinary approaches: from field studies to single-cell genomics.

**Keywords** symbiosis, insect, gut microbes, single-cell genomics, metagenomics

## Termite-gut protists and their symbiotic bacteria



Microbial Ecology



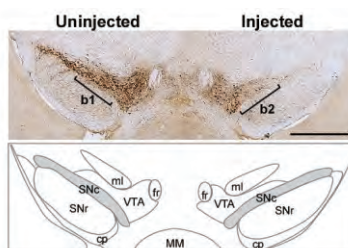
Professor  
**ICHINOSE, Hiroshi**

## Patho-physiology of neuro-psychiatric disorders in relation to monoamines

We are studying the regulatory mechanism of brain function by monoamines and by tetrahydrobiopterin in order to develop novel drugs and diagnostic tools against neuro-psychiatric disorders.

**Keywords** dopamine, Parkinson's disease, biomarker

Neurochemistry



## Conditional knock-out of the tyrosine hydroxylase gene by AAV-Cre



Professor  
**KUME, Shoen**

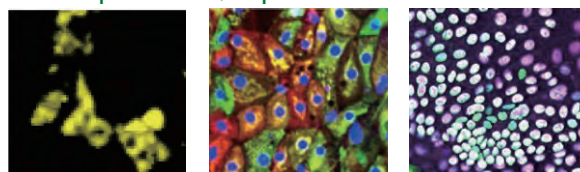
## Modeling organ development and homeostasis using human iPS cells

We are using human iPS cells to study the mechanism underlying organ development, differentiation, homeostasis, aiming for drug development and regenerative medicine.

**Keywords** stem cell, development & differentiation, drug development, regeneration

Development, Regeneration

## ES/iPS cell-derived differentiated cells of the pancreatic, hepatic and intestinal cells



Professor  
**MASUDA, Shinji** Assistant Professor  
**NONOYAMA, Shota**

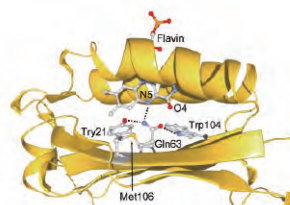
## Elucidation of regulatory mechanisms of photosynthesis, chloroplast, and photoreceptor functions

We are studying molecular mechanisms of how photosynthetic organisms sense and respond to light quality and quantity to control photosynthesis.

**Keywords** photoreceptor, chloroplast, photosynthesis, photo-oxidative stress

Photobiology

## Photoreceptor protein BLUF



## A photosynthesis regulatory mutant plant







Professor  
**TANAKA, Mikiko** Assistant Professor  
**KAWANISHI, Toru**

### Developmental basis of the evolution of vertebrate morphology

We are exploring the developmental and molecular mechanisms of how morphology of vertebrates have evolved.

**Keywords** evolutionary developmental biology

*MafB* is controlled by BMP in limb bud



**Development**

Control and "posteriorized" shark fin



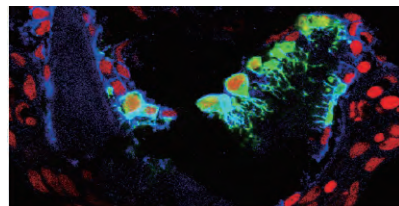
Associate Professor  
**KAWAKAMI, Atsushi**

### Cellular and molecular mechanism of tissue regeneration

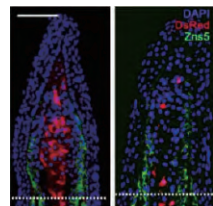
Multi-cellular organisms maintain their lives by regenerating damaged cells and tissues. In particular, fish retain high regeneration ability and regenerate fins, heart muscles, many internal organs, and even brain. We are tackling the mystery of tissues regeneration and homeostasis using zebrafish as a model.

**Keywords** regenerative biology, zebrafish, stem cell, tissue homeostasis

Analyses by transgenic imaging, cell lineage tracing, manipulation of molecular signals



**Development, Regeneration**



Associate Professor  
**NIKAIDO, Masato** Assistant Professor  
**NAGASAWA, Tatsuki**

### Understanding the molecular mechanism of adaptive and parallel evolution

We are comparing the genomes of various animals to understand molecular mechanisms that generate biological diversity. We mainly focus on cichlids, ancient fish and hedgehogs.

**Keywords** evolutionary biology, pheromone, cichlids, mammals

Parallel evolution from hairs to spines (hedgehogs and tenrecs)



**Evolution, Ecology**

Enlarged lip (cichlids)



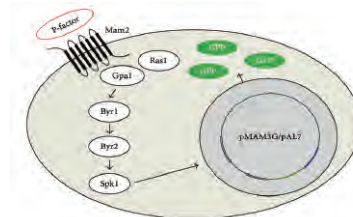
Associate Professor  
**OSADA, Toshiya**

### Development of olfactory receptors based chemical sensor

We have developed a chemical sensor using olfactory receptors that are expressed in fission yeast through the endogenous GPCR pathway.

**Keywords** olfactory receptor, pheromone, fission yeast, sensor

The ligand assay



**Neuroscience**



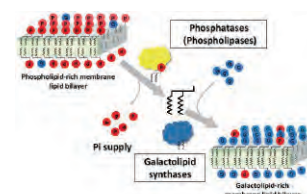
Associate Professor  
**SHIMOJIMA, Mie**

### Physiological role of lipid remodeling in plants

We are studying molecular mechanism and physiological function of plant lipid remodeling (membrane lipids, storage lipids, and surface lipids) in response to environmental stress.

**Keywords** plant, lipid, oil, stress response

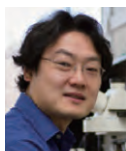
Lack of phosphate (Pi) starvation-induced lipid remodeling increases tolerance to drought stress



Wild type Mutant



**Plant**



Associate Professor  
**SUZUKI, Takashi**

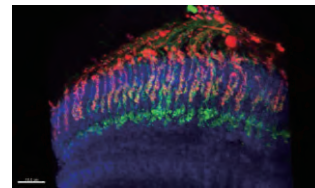
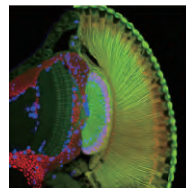
## Neuronal circuit formation and its plasticity

Our research goal is to elucidate the molecular mechanisms underlying neuronal circuit formation and function by means of molecular genetics.

**Keywords** brain, neuron, activity dependent plasticity, cell-cell communication

Neuroscience

## Fluorescence microscopy of the *Drosophila* visual system



Associate Professor  
**TACHIBANA, Kazunori**

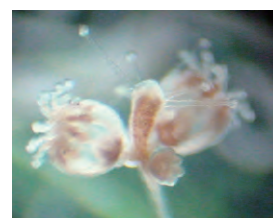
## Elucidation of molecular mechanisms of spawning in jellyfish

We are studying molecular basis and physiological regulations of jellyfish spawning in laboratory and field.

**Keywords** jellyfish, spawning, photoperiodism

Chronobiology

## Jellyfish (*Cladonema pacificum*) and its polyp



Associate Professor  
**TAGAWA, Yoh-ichi**

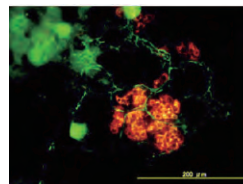
## *in vitro* living models for animal experiment alternatives and pre-clinical studies

We are developing culture systems of ES/iPS cell-derived tissues/organs on micro-fluidic devices closing livings (mouse or human).

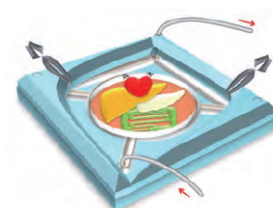
**Keywords** *in vitro* living model, synthetic biology, developmental engineering, regenerative medicine

Development, Regeneration

## Mouse ES-derived hepatic tissue



## *In vitro* living system







Professor  
**NAKAMURA, Hiroyuki**

Assistant Professor  
MIURA, Kazuki  
MORITA, Taiki

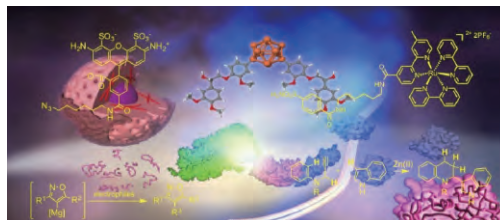
Elucidation of biological functions  
and drug development by organic  
synthesis

We are developing new drugs for cancer therapy and new methodology for chemical biology based on synthetic organic chemistry.

**Keywords** organic chemistry, medicinal chemistry, chemical biology, boron neutron capture therapy

## Bioactive compounds

## Control of target protein functions by small molecules



Professor  
**NISHIYAMA, Nobuhiro**

Assistant Professor  
**HONDA, Yuto**  
**MUGURUMA, Kyohei**

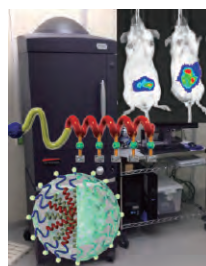
## Development of smart nanomedicine based on polymer nanotechnology

We are developing synthetic polymer-based nanomedicines towards realization of future medicine such as treatment of intractable diseases including cancers and diagnostic imaging.

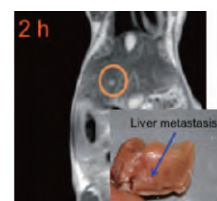
**Keywords** nanomedicine, DDS, polymer chemistry

## Biomaterials

## MR imaging of small metastatic tumors in liver



From polymer synthesis to *in vitro* & *in vivo* evaluations



Professor  
**YAMAYOSHI, Asako**

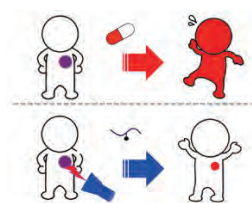
## Development of nucleic acid drugs to control life phenomena

I have been challenging myself every day, focusing on the development of novel nucleic acid drugs and the drug delivery system (DDS) using exosomes.

**Keywords** nucleic acid drugs, DDS, extracellular vesicles, light-triggered molecules

## Bioactive Molecules

## Novel nucleic acid drugs and DDS



Associate Professor  
**KADONOSONO, Tetsuya**

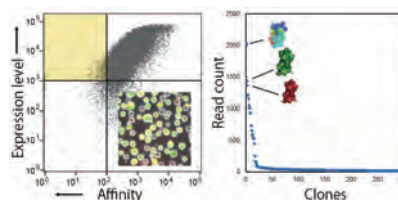
## Biopharmaceuticals developed by Smart Design technology

We are developing "smart design technology for molecules that mimic biological functions", by combining computational prediction and synthetic biological evaluation. Our aim is to create next-generation biopharmaceuticals.

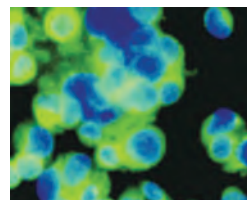
**Keywords** Smart design, biopharmaceuticals

## Protein

## Cell-based library screening and NGS analysis



## Detection of breast cancer cells



Associate Professor  
**MASAKI, Yoshiaki**

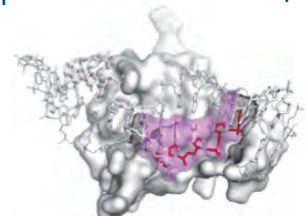
## Chemical approaches for resolving issues in nucleic acid therapeutics

Nucleic acid therapeutics have the potential to treat even genetic diseases, but there are still many challenges. We are working on the development of chemical approaches to resolve these challenges.

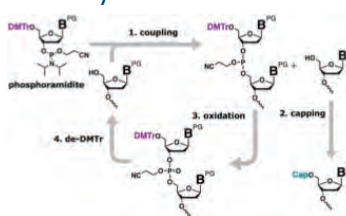
**Keywords** nucleic acid therapeutics, organic chemistry, chemoinformatics

## Nucleic acids

## Molecular design from protein-nucleic acid complex



## Accurate DNA/RNA synthetic method









Professor  
**NAKATOGAWA, Hitoshi**

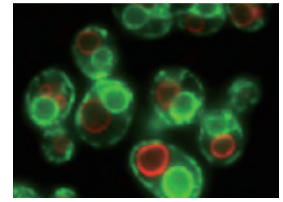
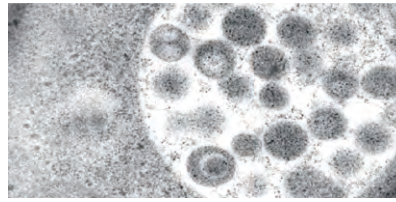
### Elucidation of molecular mechanisms and physiological roles of autophagy

We are studying molecular basis and physiological functions of autophagy (self-eating), an intracellular bulk degradation/recycling system, using various techniques.

**Keywords** yeast, organelles, membrane dynamics, starvation/stress response

Cellular function

### Electron and fluorescence microscopy of yeast cells



Professor  
**TANAKA, Kan**

### From understanding to design of cell systems

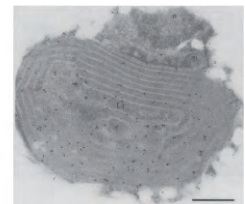
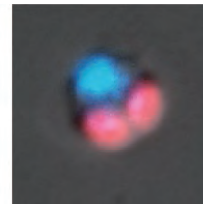
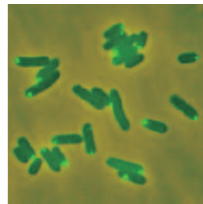
Our researches focus on fundamental architects of both prokaryotic and eukaryotic cells, destined for remodeling and design of cell systems.

Assistant Professor  
**MAEDA, Kaisei**  
**OSAKA, Natsuki**

**Keywords** photosynthesis, metabolism, gene expression, symbiosis/evolution

Microbiology

### Researches on unicellular model microorganisms



Associate Professor  
**KITAGUCHI, Tetsuya**

### Development of genetically-encoded biosensors

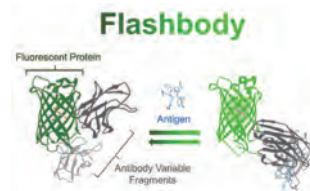
We are developing tools for an optical microscope to visualize the dynamics of intracellular molecules in living cells, tissues and whole animal bodies.

Assistant Professor  
**ZHU, Bo**  
**YASUDA, Takanobu**

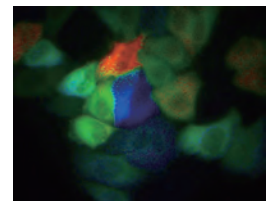
**Keywords** GFP, bioimaging, cell signaling

Cellular function

### Schematic diagram of genetically-encoded biosensor



### Fluorescence microscopy by biosensor



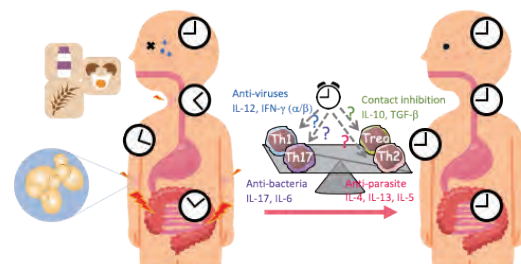
Associate Professor  
**ORIHARA, Kanami**

### Preventing severe immune diseases by regulating peripheral clock

We are studying about mechanisms of exacerbation of infectious / allergic diseases from the viewpoint of biological clocks. We are also trying to develop preventative methods for severe cases.

**Keywords** immunology, molecular biology, circadian rhythm, drug resistance

Bioactive Molecules



Associate Professor  
**URIU, Koichiro**

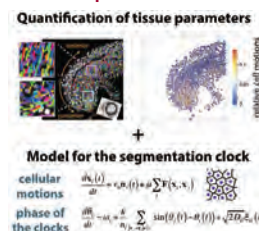
### Mathematical analysis in Life Science

We use mathematical models and simulations to understand biological phenomena. We study developmental clock and circadian clock.

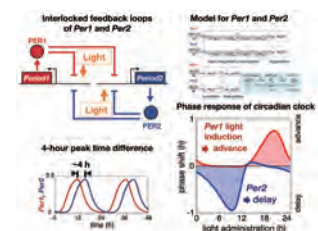
**Keywords** modeling, somitogenesis, circadian clock, simulation

Theoretical Biology

### Developmental clock



### Circadian clock





Associate Professor  
**YOSHIDA, Keisuke**

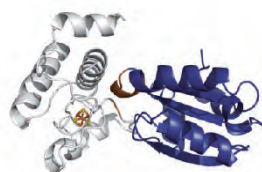
## Comprehensive analyses of regulatory mechanisms of plant organelle functions

How are plants living under environmental fluctuations? We are studying regulatory mechanisms of plant organelle functions using various techniques.

**Keywords** photosynthesis, environmental acclimation, redox regulation, organelle crosstalk

Plant

### Molecular mechanisms



### Physiological roles



Professor  
**KOSHIKAWA, Naohiko**

Assistant Professor  
FUNAHASHI, Nobuaki

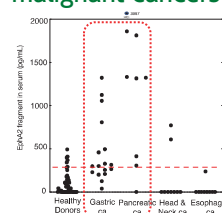
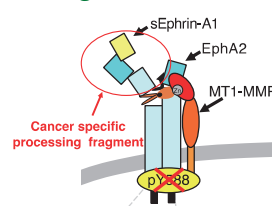
## Analysis of tumor progression by extracellular proteolysis and its clinical applications

Aim of our study is to develop novel cancer diagnostics and therapeutics focusing on extracellular metalloproteases that act as a driving force of tumor malignant progression.

**Keywords** Cancer, extracellular matrix, matrix metalloproteinase, diagnostics/therapeutics

Cancer biology

### Cancer-specific proteolytic fragment can be a potent diagnostic biomarker for malignant cancers



Professor  
**KURODA, Kumi**

Assistant Professor  
PROKOFEVA, Kseniia

## Neurobiology of social affiliation

We study the neural mechanisms of affiliative social behaviors, esp. parent-infant relations in mammals, aiming to science-backed parenting support and social security.

**Keywords** Parental care, infant attachment, Transport Response, mouse model

Neuroscience

### Neural mechanism of parental care in mammals



Professor  
**SANEYOSHI, Takeo**

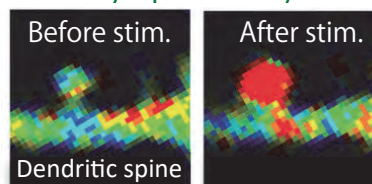
## Elucidation of molecular mechanisms of memory storage

We are interested in understanding the molecular mechanisms of memory storage and how dysfunction of these mechanisms leads to neurodevelopmental disorders.

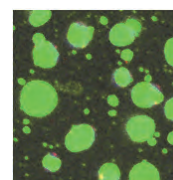
**Keywords** synaptic memory, liquid-liquid phase separation (LLPS), neurodevelopmental disorders, Quantum biology

Neuroscience

### Synaptic memory



### Molecular memory (LLPS)



Associate Professor  
**MIYASHITA, Eizo**

## Explore the brain to understand adaptive control mechanisms of the arm

Repeating a verification experiment based on a working hypothesis, we are trying to understand the brain that is called the last frontier around us. Experimental data are collected in multiple levels from behavior to neurons.

**Keywords** brain science, neuroscience, motor learning, brain machine interface

Neuroscience

### Measuring brain activity during task performance



### BMI as a medical application







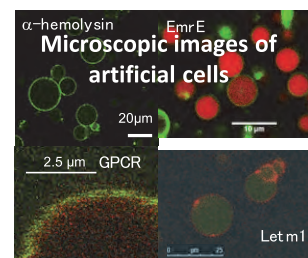
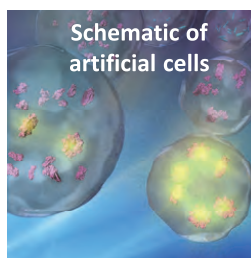
Professor  
**MATSUURA, Tomoaki**

### An artificial cell construction by design and evolution, and its application

We aim to clarify the nature of primitive cells that would have existed in the early stages of life, and construct molecules and molecular systems that can be put to practical use.

**Keywords** proteins, directed evolution, artificial cells, origins of life

**Bioinformatics,  
Synthetic biology**



Associate Professor  
**FUJISHIMA, Kosuke**

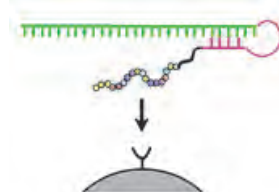
### Study of RNA-peptide function for understanding the biological system

We are using synthetic biology methods to understand the functionality and evolvability of early RNA and peptides. We also design and explore de novo functional enzymes

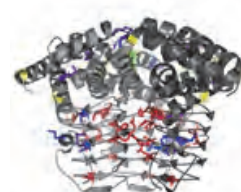
**Keywords** Origins of life, Directed evolution, RNA, Peptide, Astrobiology

**Synthetic biology**

#### mRNA display method to screen for functional peptides



#### Designing *de novo* functional enzymes



Associate Professor  
**MCGLYNN, Shawn**

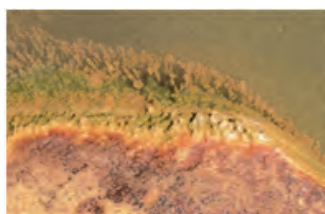
### The origin and evolution of life

How did life begin, and how has it changed through time? To understand these questions, we use diverse tools and model systems: chemistry, microbiology, stable isotopes, and more.

**Keywords** onsen, phylogeny, iron-sulfide, enzyme

**Geomicrobiology  
& Prebiotic Chemistry**

#### Hot Spring Microbiology



#### A simulated hydrothermal vent



### (Other Professor)

TAKINOUE, Masahiro : DNA nanotechnology, artificial cell engineering, and molecular computing

YAMAMURA, Masayuki : Computational modeling collective function and morphogenesis

YANAGIDA, Yasuko : Device innovation by MEMS and biotechnology

SEKIJIMA, Masakazu : Machine Learning and Molecular Simulation for Drug Discovery and  
Elucidation of Biological Phenomena

### (Assistant Professors)

DENDA, Kimitoshi : Molecular physiology of cell growth and development during embryogenesis

FURUTA, Tadaomi : Biophysical elucidations of biomolecular functions

INOHAYA, Keiji : Bone formation and development

OKUMURA, Eiichi : Cell cycle control and signal transduction

SATO, Takao : Protein structure analysis and elucidation of mechanism

TAMORI, Masaki : Physiology and morphology of echinoderms

TANAKA, Toshiaki : Protein transport and cell proliferation

For details of the research themes, please see the website  
of each laboratory linked from the following URL.

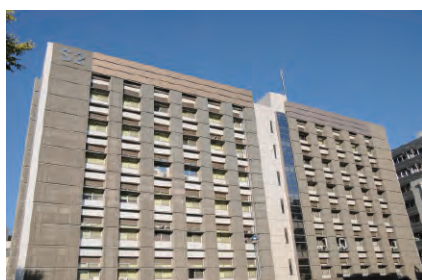
[https://educ.titech.ac.jp/bio/eng/faculty/research\\_lab/](https://educ.titech.ac.jp/bio/eng/faculty/research_lab/)



B1 • B2 Bldg.



J2 • J3 Bldg.



S2 Bldg.



R1 Bldg.

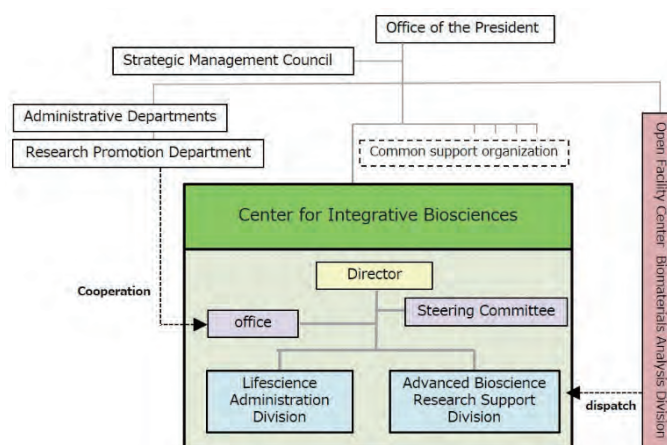


M6 Bldg.



## Center for Integrative Biosciences

The Center for Integrative Biosciences was established in April 2023 as an institute-wide support center providing advanced research promotion functions to design and promote cutting-edge bioscience research through the collaborative efforts of faculty, technical staff, and URAs. The Center will provide advanced research equipment and technical supports to create research platforms for promoting bioscience and biotechnology research that contributes to the national biotechnology strategy, and will serve as a venue for creating new fusion research in science and engineering to accelerate cutting-edge biotechnology research. In addition, the Center will bring together researchers and companies across disciplines to create new “bio-driven” research for the realization of “the world's most advanced bioeconomy society”.



### ◆Bioscience Management Division◆

- 1) Advises in researchers, coordinates joint and fusion research
- 2) Promotes cross-disciplinary fusion and industry-academia collaboration
- 3) Centralized management of various laws, regulations and compliance
- 4) Awareness-raises and consults for science and engineering researchers

### ◆Advanced Bioscience Research Support Division◆

- 1) Provides a 'place' and 'cutting-edge knowledge and technology' for bioscience research
- 2) Provides a sustainable advanced research promotion function
- 3) Maintains and manages animal facilities
- 4) Provides equipment for animal experiments
- 5) Develops strategies for cross-disciplinary and industry-academia collaboration

### Facilities

DNA sequencer, Transmission electron microscope, Scanning electron microscope, Inverted laser scanning confocal microscope, Upright laser scanning confocal microscope, Inverted fluorescence microscope, Zoom microscope, Holotomography microscope, Rotary microtome, Cryostat, Cell sorter, Automatic cell culture observation system, Realtime PCR, Automated electrophoresis system, Automated pipetting system, Microvolume Spectrophotometer, Automated cell counter, Biological safety cabinet, Clean bench, CO<sub>2</sub> incubator



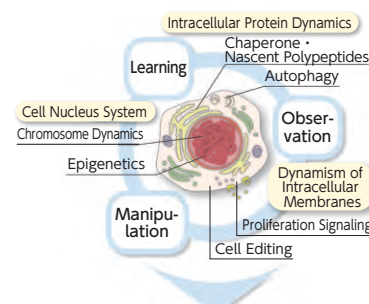
## Cell Biology Center

<http://www.rcb.iir.titech.ac.jp/en/index.html>

Led by Honorary Professor Yoshinori Ohsumi, the 2016 Nobel Prize laureate in Physiology or Medicine, the Cell Biology Center is a new consortium that will unite a diverse range of investigators from basic to applied science backgrounds. This center aims to investigate the structure and function of cells—the basic units of life—by observing molecular mechanisms and by manipulating cells with cell editing and cytoarchitectural techniques. The findings will be used to create cells with unique functions. Through these interdependent investigations, the center will elucidate the fundamental principles of cells through world class research and state-of-the-art techniques and ultimately contribute to next generation of cell engineering, human health, and disease treatment.

**Location:** Suzukakedai Campus, S2 Building

**Members:** Honorary Professor and Director Yoshinori Ohsumi, and Prof. Hiroshi Iwasaki, Prof. Hiroshi Kimura, Prof. Masayuki Komada, Prof. Hideki Taguchi, Prof. Hitoshi Nakatogawa, Prof. Fumi Kano, Assoc. Prof. Naonobu Fujita, Assist. Prof. Alexander I May, Assist. Prof. Toshiaki Fukushima, Assist. Prof. Tomoko Horie, Assist. Prof. Daiki Nakatsu, Assist. Prof. Tatsuya Niwa, Assist. Prof. Yuko Sato, Assist. Prof. Hideo Tsubouchi.



Elucidating the phenomena underlying life on a cellular level  
Contribution to human health and the treatment of disease through interdependent investigations



Honorary Professor  
**OHSUMI, Yoshinori**

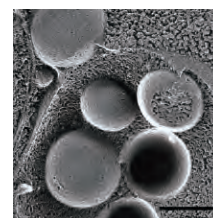
**Keywords** yeast, autophagy, vacuole, starvation, growth control

### Comprehensive studies of physiological roles of autophagy in yeast

We try to understand the induction mechanism and various modes of autophagy under various conditions. By biochemical analysis we have been studying degradation process of protein and RNA via autophagy and selective targets of autophagy.

Autophagosome by microscopy

### Cellular Function



## Life Science and Technology Open Innovation Hub (LiHub)

The Life Science and Technology Open Innovation Hub (LiHub) was established in 2016 with the goal of building up a new academic style for Open Innovation by accelerating collaborations between our faculty members and industrial communities. Our School is one of the largest academic organizations in life science and technology field in Japan, including 75 research laboratories, which covers a wide range of bio-related disciplines.

By taking this strong advantage, LiHub serves as interfaces for companies and/or public sectors that need expertise of life science and biotechnology for their business and social activities. LiHub arranges communication, discussion and collaborations with faculty members who meet requests from companies and/or public sectors. In LiHub, we have research groups that have already created communities for smooth academia-industry interactions, each of which is composed of 3-10 members of our faculties and specialized by one particular cutting-edge field such as biomaterial, biomatrix, bio-sustainable science, brain-environment interface, photosynthetic science, drug development and cancer research. New more LiHub research groups will be created upon companies and/or public sectors' requests.

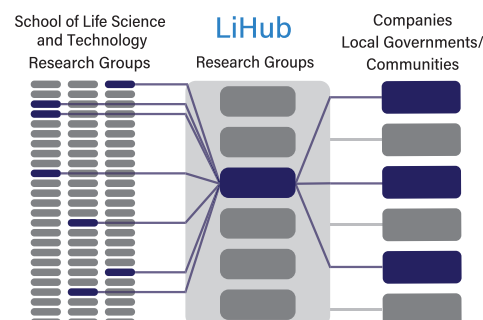
For more information, visit the LiHub website (or search with the keyword, "LiHub"): <http://www1.bio.titech.ac.jp/lihub/index.html>

### Conventional University-Industry Collaboration

One Research Group      One Company



### LiHub-Produced Innovative Structure for University-Company Collaboration



## Open Research Facilities for Life Science and Technology

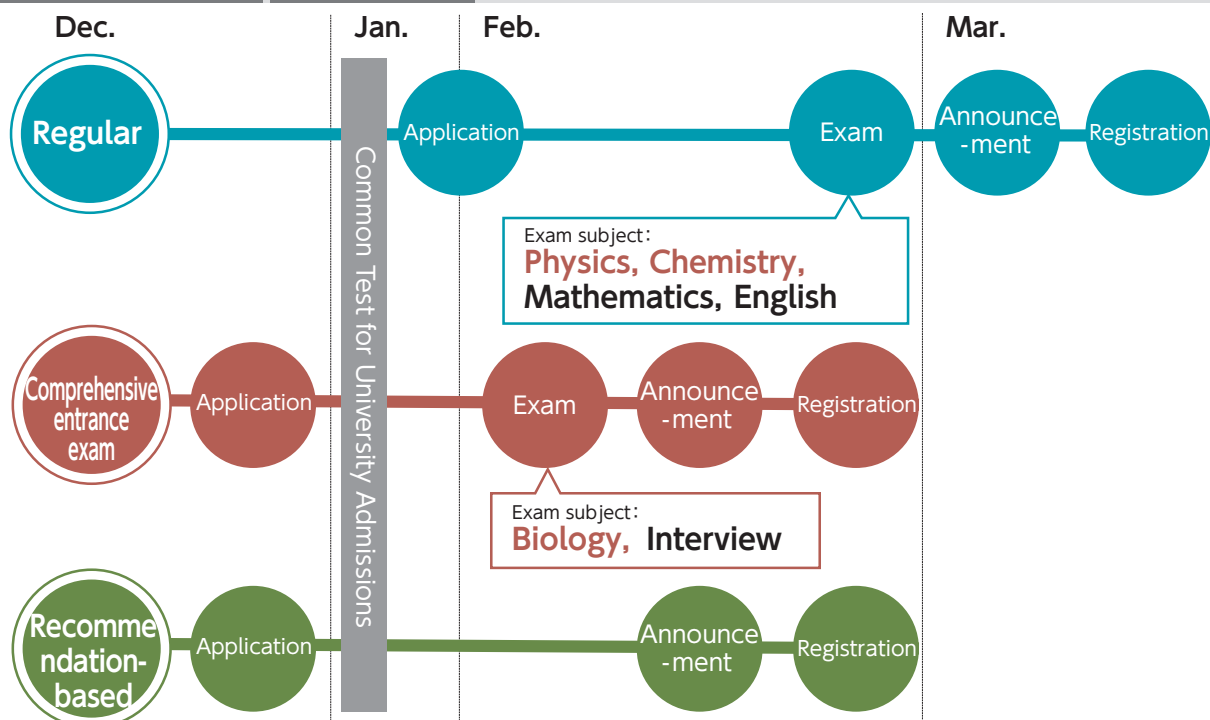
Our school operates the Open Research Facilities for Life Science and Technology, which consists of the Shimadzu Corporation Precision Analytical Instruments Room, biomolecular analysis facility, shared organic synthesis laboratory, cell and protein analysis facility, ultracentrifuge facility, cold room, aquatic animal laboratory, microbial culture room, and shared laboratory and office spaces. In 2022, the nuclear magnetic resonance spectrometer was upgraded to the latest model, and we are promoting the enhancement of these open research facilities by installing new equipment. All these facilities and spaces are provided to support research and education in the life sciences and technology at Tokyo Tech. We envision that these facilities will provide opportunities for active collaboration among scientists, students, and technical staff members.

In a collaboration between Tokyo Tech and the Shimadzu Corporation, The Shimadzu Corporation Precision Analytical Instruments Room was established in 2017. This is a unique attempt to enhance research activities at Tokyo Tech by using the instruments and knowledge of the Shimadzu Corporation. This room contains advanced bioanalytical instruments, including mass spectrometry and microchip electrophoresis systems, that were donated by or purchased from the Shimadzu Corporation. We often hold orientation sessions for new users, as well as open workshops and demonstrations for new instruments.



# Schedule for Admission

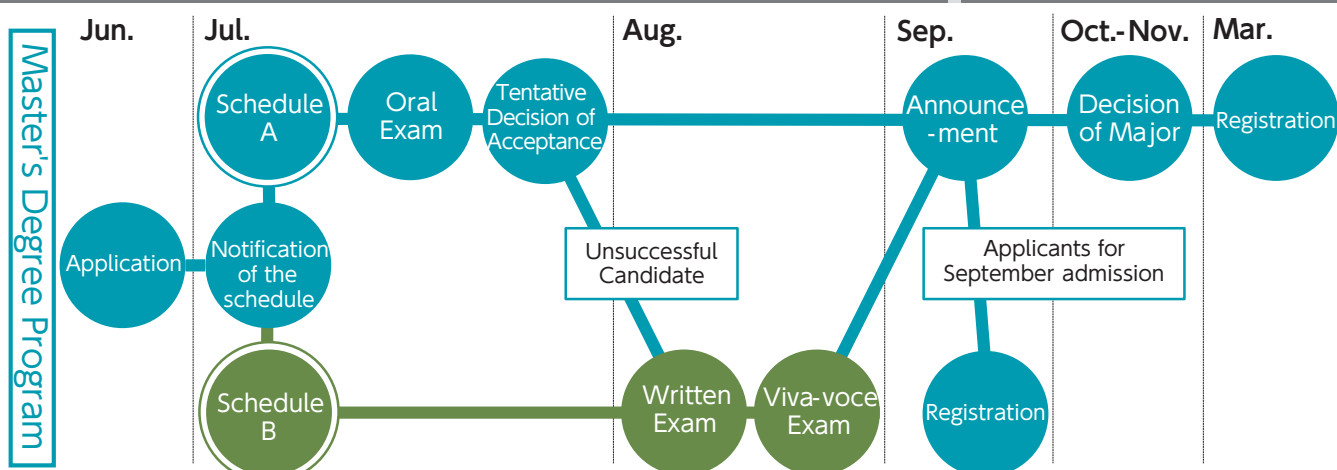
| Undergraduate School | Capacity | Examination Category |                             |                       |                           |
|----------------------|----------|----------------------|-----------------------------|-----------------------|---------------------------|
|                      | 150      | Regular              | Comprehensive entrance exam | Recommendation-based  |                           |
|                      |          | 105                  | 15                          | 15<br>(General quota) | 15<br>(Female-only quota) |



Examinations and programs are conducted in Japanese.  
For detailed information, please see <https://admissions.titech.ac.jp/admission>



| Graduate School | Capacity                    |
|-----------------|-----------------------------|
|                 | Master : 168<br>Doctor : 52 |

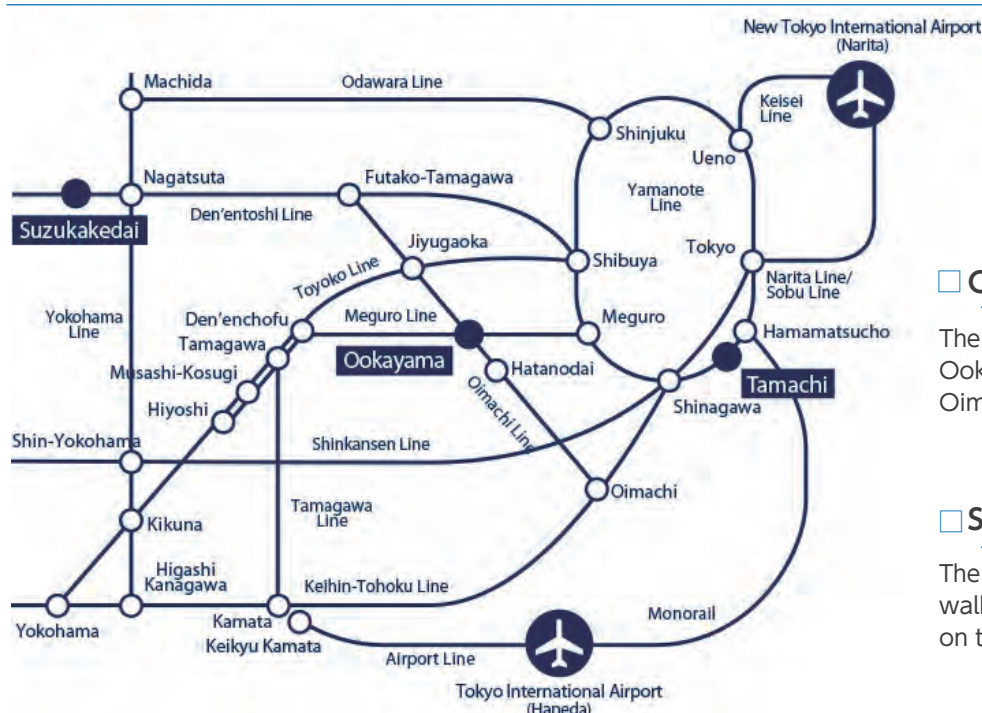


For detailed information of graduate programs (master's and doctoral degree programs), please see <https://www.titech.ac.jp/english/prospective-students>





## Access



### □ Ookayama Campus

The Main Gate is a 1-minute walk from Ookayama Station on the Tokyu Oimachi and Tokyu Meguro Lines.

### □ Suzukakedai Campus

The Suzukakedai Campus is a 5-minute walk from Suzukakedai Station on the Tokyu Den'entoshi Line.

## Latest Information

### Official site

<https://educ.titech.ac.jp/bio/eng/>



### Information for enrollment

#### Undergraduate School

<https://admissions.titech.ac.jp/admission>

#### Graduate School

<https://www.titech.ac.jp/english/prospective-students>



## Inquiries

4259 Nagatsuta-cho, Midori-ku, Yokohama, Kanagawa, 226-8501 JAPAN

Office, School of Life Science and Technology, Tokyo Tech.

TEL 045-924-5942 (9:00 - 17:15) E-mail [bio.adm@jim.titech.ac.jp](mailto:bio.adm@jim.titech.ac.jp)