

## Doctoral Program in Geo-environmental Sciences

The Doctoral Program in Geo-environmental Sciences aims to (a) explore the natural scientific processes and mechanisms of geo-environmental change from the temporal and spatial point of view, and (b) synthetically elucidate the world's changing geo-environmental conditions, including the impact on human activities. The program includes the study of human geography, regional geography, geomorphology, hydrological science, atmospheric science, geographical information science, terrestrial water cycle-systems, and atmosphere-ocean interaction systems: the program provides opportunities for research leading to the degree of Doctor of Philosophy (Ph.D) in Science or Geoenvironmental Science. Faculty members are currently involved in the research topics listed in the table below.

Field of Research	Faculty	Detailed Description of Research Field
Human Geography	MATSUI Keisuke jiji@geoenv.tsukuba.ac.jp	Cultural geography, Geography of tourism and religion, Theory of cultural tourism
Regional Geography	KUREHA Masaaki mkureha@geoenv.tsukuba.ac.jp TSUTSUMI Jun jtsu@geoenv.tsukuba.ac.jp	Regional geography of Europe and Japan, Geography of tourism Regional geography of Australia, Urban geography, GIS
Geomorphology	MATSUOKA Norikazu matsuoka@geoenv.tsukuba.ac.jp IKEDA Atsushi aikeda@geoenv.tsukuba.ac.jp SEKIGUCHI Tomohiro sekiguchi@ied.tsukuba.ac.jp HATTANJI Tsuyoshi hattan@geoenv.tsukuba.ac.jp	Experimental geomorphology, Rock weathering, Slope processes Periglacial geomorphology, Permafrost monitoring, Mountain environments Sedimentary processes, Bedform, Experiment Hydrogeomorphology, Landslides, Rock weathering, Karst geomorphology
Hydrological Science	ASANUMA Jun asanuma@ied.tsukuba.ac.jp SUGITA Michiaki sugita@geoenv.tsukuba.ac.jp TSUJIMURA Maki mktsuji@geoenv.tsukuba.ac.jp YAMANAKA Tsutomu tyam@geoenv.tsukuba.ac.jp	Hydro-meteorology, Land-vegetation-atmosphere system, Atmospheric turbulence Hydrology, Evapotranspiration, Arid-regions, Lakes Tracer hydrology, Ground water flow and age in various regions, Rainfall-runoff process in mountainous watershed Water and material cycle, Isotopic tracer, Eco-hydro-meteorology
Atmospheric Science	UEDA Hiroaki hueda.hiroaki.gm@u.tsukuba.ac.jp TANAKA Hiroshi tanaka@ccs.tsukuba.ac.jp UENO Kenichi ueno.kenichi.fw@un.tsukuba.ac.jp	Atmosphere-ocean-land interaction involved in the Climate system General circulation of the atmosphere, Energetics Low-frequency variability Precipitation system studies, Mountain meteorology, land-atmosphere interaction, Local climate observation
Geographical Information Science	KUSAKA Hiroyuki kusaka@ccs.tsukuba.ac.jp MURAYAMA Yuji mura@geoenv.tsukuba.ac.jp MORIMOTO Takehiro tmrmt@geoenv.tsukuba.ac.jp	Urban climate, Local wind, Wind power prediction, Dynamical downscaling GIS, Urban and transportation geography Agricultural geography, Sustainability of rural area, GIS
Terrestrial Water Cycle System	SHIMOKAWA Shinya simokawa@bosai.go.jp MISUMI Ryohei misumi@bosai.go.jp SHUSSE Yukari shusse@bosai.go.jp	Physical oceanography, Coastal disasters, Marine ecosystem Radar meteorology, Natural disasters Detailed Description of research Field: Clouds and precipitation, Radar meteorology
Atmosphere-Ocean Interaction System	ISHII Masayoshi maish@mri-jma.go.jp KATO Teruyuki tkato@mri-jma.go.jp KAJINO Mizuo kajino@mri-jma.go.jp	Oceanography, Atmosphere-Ocean Interactions, Climate Change Meso-scale meteorology, High impact weather Atmospheric Chemistry, Aerosol-Cloud-Radiation Interactions

**Doctoral Program in Earth Evolution Sciences**

The Doctoral Program in Earth Evolution Sciences includes the following research fields: paleobiological science, paleogeosphere science, geodynamics, petrology, mineralogy, planetary resource geology, and earth historical analysis, the latter as an exchange program with the National Museum of Nature and Science. This broad program enables students to become both familiar with world-class research and capable of making substantive research contributions; the program develops professionals with a high level of theoretical and practical knowledge. Completion of the program leads to a Ph.D. in Science or Geoscience. Staff members are currently involved in the research topics listed in the table below.

Field of Research	Faculty	Detailed Description of Research Field
Paleobiological Science	※1 SASHIDA Katsuo sashida@geol.tsukuba.ac.jp AGEMATSU Sachiko agematsu@geol.tsukuba.ac.jp	Paleontology of Mesozoic and Paleozoic radiolaria and foraminifera, and historical geology of Southeast Asia Conodont, Graptolite, Tentaculite, Paleozoic historical geology of Southeast Asia
Paleogeosphere Science	※2 HISADA Ken-ichiro hisadak@geol.tsukuba.ac.jp KAMATA Yoshihito yoshi_kamata@geol.tsukuba.ac.jp FUJINO Shigehiro shige-fujino@geol.tsukuba.ac.jp	Sedimentary basin analysis and reconstruction Geological evolution of Southeast Asia Sedimentology and Stratigraphy, Geological records of tsunamis in Japan and Asian countries
Geodynamics	UJIE Kohtaro kujie@geol.tsukuba.ac.jp YAGI Yuji yagi-y@geol.tsukuba.ac.jp	Structural Geology and Tectonics Earthquake rupture process and seismicity
Petrology	ARAKAWA Yoji yaraka@geol.tsukuba.ac.jp TSUNOGAE Toshiaki tsunogae@geol.tsukuba.ac.jp	Petrology and petrochemistry of igneous rocks Petrology of metamorphic rocks
Mineralogy	KUROSAWA Masanori kurosawa@geol.tsukuba.ac.jp	Composition and behavior of fluid in crust
Planetary Resource Geology	※1 HAYASHI Ken-ichiro khayashi@geol.tsukuba.ac.jp	Migration mechanisms of metals in Earth's surface Geochemistry of hydrothermal system
Earth Historical Analysis	KOHNO Naoki kohno@kahaku.go.jp SHIGETA Yasunari <a href="mailto:shigeta@kahaku.go.jp">shigeta@kahaku.go.jp</a> TSUTSUMI Yukiyasu ytsutsu@kahaku.go.jp	Paleobiology of Cenozoic animals (especially for aquatic animals) Paleobiology of cephalopoda

※1 The faculty member marked with ※1 will be retired by March 31, 2019.

※2 The faculty member marked with ※2 will be retired by March 31, 2020.

## Doctoral Program in Biological Sciences

The chief aim of the Doctoral Program in Biological Sciences is to train good scientists and professionals who have the research ability and scholarship necessary to achieve creative study. The core of the Biological Sciences Doctoral Program is basic biology. The program comprises eight complementary major fields:

- 1) Systematics and Evolutionary Biology
- 2) Ecology
- 3) Plant Physiology and Developmental Biology
- 4) Animal Physiology and Developmental Biology
- 5) Molecular and Cellular Biology
- 6) Genomics and Bioinformatics
- 7) Advanced Cellular Biology
- 8) Advanced Molecular Biology

Considering that the 21<sup>st</sup> Century is “the Age of Biology”, our program is organized so as to integrate inter-disciplinary research fields of biological sciences. The curriculum is thus designed to cultivate each student’s ability to solve a wide range of biological problems with an inter-disciplinary approach. The degrees to be awarded in the program are Doctor of Philosophy, Doctor of Philosophy in Science, and Doctor of Philosophy in Biological Science. To receive the doctoral degree, students are required to write a dissertation, and to pass a final examination. All the compulsory subjects and some of the elective subjects will be held in English (or bilingually) on demand. The time required to complete the doctoral program is basically three years, but students with high motivation, talent, and research ability, are encouraged to obtain a degree in less than three years. In addition to study on the main campus, as part of the Cooperative Graduate School System, students may also study under the supervision of guest professors who work in public or private institutions in and around Tsukuba.

The table below summarizes the faculty members and their major research fields. Students who are interested in the program should study the list and contact a possible supervisor before submitting their application; the e-mail addresses of the faculty members are available at <http://www.mbs.life.tsukuba.ac.jp/e/index.html>.

Field of Research	Faculty	Detailed Description of Research Field
Systematics and Evolutionary Biology	※IKUWABARA Tomohiko	① Biogeosciences of (hyper)thermophiles and iron/sulfur ② Fermenter–methanogen syntrophy ③ Cell division of Thermotogales
	ISHIDA Ken-ichiro	① Classification of micro-and macro-algae based on ultrastructure and molecular phylogenetic analyses ② The endosymbiotic acquisitions and evolution of plastids ③ Searching for new useful algae for algal biomass research
	HONDA Masanao	① Taxonomy of reptiles based on morphological data ② Molecular phylogeny and biogeography of reptiles and birds ③ Conservation genetics of amphibians and reptiles
	※IMACHIDA Ryuichiro	① Phylogenetic studies of hexapods (insects s. lat.), from comparative embryological and morphological approach ② Systematics of hexapods
	WADA Hiroshi	① Evo-Devo research of chordates ② Comparative embryology of marine invertebrates, including bivalves and echinoderms
	NAKANO Hiroaki	① Evolution, development, morphology, and ecology of placozoans, <i>Xenoturbella</i> , and echinoderms ② Origins and evolution of deuterostomes and metazoans ③ Diversity and evolution of marine invertebrates
	NAKAYAMA TAKESI	① Classification of protists including microalgae based on ultrastructural characters and molecular phylogenetic analyses ② Searching for new useful algae for algal biomass research
	DEGAWA YOUSUKE	① Natural history and biodiversity of the Kingdom Fungi ② Taxonomy and phylogenetic studies of the basal lineage of Fungi (Zygomycota and Chtridiomycota) ③ Fungal ecology focused on their interactions with other organisms and their life cycles
Ecology	TANAKA Kenta	① Ecological and genetic mechanism of survival, reproduction and adaptive evolution of field plants ② Evolutionary biology focusing adaptive genes of wild Arabidopsis in the natural fields ③ Population and community ecology of tropical rain-forest, cool temperate forest, sub-alpine grassland and alpine region
	HIROTA Mitsuru	① Plant response to environmental changes, perspective from ecology ② Ecosystem ecology focused on carbon cycling in terrestrial ecosystem
	TOQUENAGA Yukihiko	① Experimental ecology with field and laboratory populations ② Theoretical biology with mathematical models

Ecology	TSUDA Yoshiaki	<ul style="list-style-type: none"> <li>① Population genetics and inference of past and future demographic dynamics of forest trees</li> <li>② Ecosystem management and conservation using molecular ecology approaches</li> <li>③ Impact of human activities on forest ecosystems and their history</li> </ul>
	OHASHI KAZUHARU	<ul style="list-style-type: none"> <li>① Foraging behavior of pollinators with special reference to their cognitive abilities</li> <li>② Ecological and evolutionary interactions between angiosperms and their pollinators</li> </ul>
Plant Physiology and Developmental Biology	SUZUKI Iwane	<ul style="list-style-type: none"> <li>① Acclimation of photosynthetic apparatus to environmental stress</li> <li>② Mechanisms of perception of the environmental signals in photosynthetic organisms</li> <li>③ Basic research for the production of useful metabolites by metabolic engineering of algae</li> </ul>
Animal Physiology and Developmental Biology	SASAKURA Yasunori	<ul style="list-style-type: none"> <li>① Developmental mechanisms of ascidians</li> <li>② Metamorphosis of ascidians</li> <li>③ Evolution of chordates</li> </ul>
	※ 2FURUKUBO-TOKUNAGA, Katsuo	<ul style="list-style-type: none"> <li>① Molecular genetics of brain development in <i>Drosophila</i></li> <li>② Molecular genetics of learning and memory in <i>Drosophila</i></li> <li>③ Molecular genetics of human psychiatric diseases in <i>Drosophila</i></li> </ul>
	NIWA Ryusuke	<ul style="list-style-type: none"> <li>① Studies of insect steroid hormone biosynthesis and its roles in development, aging and circadian clock</li> <li>② Identification and characterization of genes regulating developmental timing and aging in the nematode <i>C.elegans</i></li> <li>③ Basic research for developing insecticides and nematicides</li> </ul>
	YAGUCHI Shunsuke	<ul style="list-style-type: none"> <li>① Axis specification/formation of the sea urchin embryo</li> <li>② Development of the serotonergic neurons in the sea urchin embryo</li> <li>③ Evolution of the anterior neuroectoderm</li> </ul>
	CHIBA Chikafumi	<ul style="list-style-type: none"> <li>① Molecular mechanism of adult newt body-part regeneration</li> <li>② Induction and regulatory mechanisms of transdifferentiation</li> </ul>
	KOBAYASHI Satoru	<ul style="list-style-type: none"> <li>① Common mechanisms regulating germline formation in animals</li> <li>② Genetic pathway regulating sex determination of germline in <i>Drosophila</i></li> <li>③ Mechanism regulating germline-stem-cell maintenance in <i>Drosophila</i></li> </ul>
Molecular and Cellular Biology	MIURA Kenji	<ul style="list-style-type: none"> <li>① Perception and signaling mechanisms for abiotic stress response and sugar accumulation in plants</li> <li>② Production of pharmaceutical proteins with plant biotechnology</li> </ul>
	MIYAMURA Shinichi	<ul style="list-style-type: none"> <li>① Cell biological studies on evolution of sex in eukaryotic algae</li> <li>② Studies on sexual reproduction of marine green algae</li> </ul>
	INABA Kazuo	<ul style="list-style-type: none"> <li>① Structure, motility, and regulation of cilia and flagella</li> <li>② Diversity of cilia and eukaryotic evolution</li> <li>③ Mechanism of fertilization and reproduction of marine organisms (protists, marine invertebrates and fishes)</li> </ul>
	CHIBA Tomoki	<ul style="list-style-type: none"> <li>① Genetic analysis of selective protein degradation</li> <li>② Cell biology of the ubiquitin family</li> <li>③ Knockout mice analysis of the ubiquitin system</li> </ul>
	NAKADA Kazuto	<ul style="list-style-type: none"> <li>① Functional morphology of mammalian mitochondria</li> <li>② Generation of mouse models for mitochondrial DNA-based diseases</li> <li>③ Therapeutics for mitochondrial DNA-based diseases</li> </ul>
	SAKAMOTO Kazuichi	<ul style="list-style-type: none"> <li>① Molecular and physiological analysis of anti-ageing (skin, hair, muscle, loco, longevity, behavior, etc ) by using model animals</li> <li>② Molecular and physiological analysis of preventive medicine (obesity, diabetes, stress tolerance, etc ) by using model animals</li> <li>③ Application studies for anti-aging and wellness by using bioactive substances (phytochemicals, fermented materials, etc))</li> </ul>
	NAKANO Kentaro	<ul style="list-style-type: none"> <li>① Investigation of signal transduction controlling cytoskeleton and membrane dynamics</li> <li>② Studies on the molecular diversity and evolution of cytoskeleton and its regulatory systems</li> <li>③ Molecular biology of the mechanisms of cell division using yeast and protist</li> </ul>

Molecular and Cellular Biology	SUZAKI Takuya	① Molecular genetic studies on root nodule development during legume- <i>Rhizobium</i> symbiosis ② Molecular genetic studies on shoot apical meristem maintenance
Genomics and Bioinformatics	HASHIMOTO Tetsuo	① Molecular phylogeny of eukaryotic micro-organisms ② Molecular evolutionary studies on the origin and early divergences of eukaryotes
	INAGAKI Yuji	① Molecular phylogeny of eukaryotes ② Evaluation of the impact of lateral gene transfer to genome evolution ③ Estimation of protein functions combining evolutionary parameters and tertiary structures
	KUWAYAMA Hidekazu	① Molecular analysis of biological soliton in multicellular movement ② Functional analysis of a genetic disease in intracellular signaling pathway ③ Memory of cell and spatio-temporal pattern recognition ④ Analyses of a novel anti-tumor factor and the mechanism of caffeine-dependent enhancement of anticancer drugs
	SAWAMURA Kyoichi	① Evolutionary Genetics ② Genetic analysis of hybrid inviability and sterility in <i>Drosophila</i> ③ Genetic analysis of sexual isolation in <i>Drosophila</i> ④ Interspecific introgression in natural populations of <i>Drosophila</i>
Advanced Cellular Biology	*ABE Kuniya (RIKEN, Tsukuba)	① Systematic analyses of gene expression epigenetic regulation and genomic reprogramming processes during development of embryonic stem cells and primordial germ cells ② Developmental genetics of early mammalian embryogenesis
	*OHNISHI Kazuo (NIH, Tokyo)	① Immunity to infectious diseases ② Antibody producing B cell differentiation ③ Function of cadherin-family molecules in immune system
	*KATO Kaoru (AIST, Tsukuba)	① Cell physiology on molecular mechanisms of growth cone advance and cell motility ② Biophysical analysis on the activity of single protein molecule in living cells ③ Development of new imaging technique for cell biology
	*SHITARA Hiroshi (IGAKUKEN, Tokyo)	① Molecular genetics of mitochondrial DNA in mammals ② Generation of new mouse strains using transgenic technology ③ Imaging techniques for visualizing mitochondria in mammals
	*NAGAMUNE Kisaburo (NIH, Tokyo)	① Understanding the infectious mechanism of parasitic protozoa ② Study about the unusual organelle of parasitic protozoa ③ Basic research for the development of anti-parasitic drug
	*HIROSE Keiko (AIST, Tsukuba)	① Structural studies of protein molecules using electron microscopy and computer image analysis ② Motile mechanism of molecular motor proteins
Advanced Molecular Biology	*HOSOYA Masaki (Fujifilm Corporation, Kanagawa)	① Directed differentiation of pancreatic $\beta$ -cells from human iPS cells ② Controlling cellular differentiation with low-molecular compounds
	*HOSOYA Tsuyoshi (National Museum of Nature and Science)	① Phylogeny, taxonomy, and evolution of inoperculate discomycetes ② Biodiversity of plant-fungus relationship

※1 The faculty member marked with ※1 will be retired by March 31,2019.

※2 The faculty member marked with ※2 will be retired by March 31,2020.

Note: \*Adjunct Professor of the Cooperative Graduate School

## Doctoral Program in Appropriate Technology and Sciences for Sustainable Development

One of the largest issues facing mankind in the 21<sup>st</sup> century is how to achieve sustainable development of agriculture and forestry production and establish development systems in harmony with environmental conditions. The aim of the Doctoral Program in Appropriate Technology and Sciences for Sustainable Development is to educate students so they become capable of both developing appropriate technologies based on conventional and innovative technologies, and enhancing the practical application of these technologies under varying natural and socio-economic environments to suit regional requirements. To enable the students to contribute to such large and globally-important issues, a wide range of curricula has been prepared, as described in the table below.

(\*Replace “#/#” with “@”.)

	Field of Research	Faculty	Detailed Description of Research Field
Eco-region Development Engineering Field	Environmental Colloid and Interface Engineering	ADACHI Yasuhisa adachi.yasuhisa.gu##@#u.tsukuba.ac.jp KOBAYASHI Motoyoshi kobayashi.moto.fp##@#u.tsukuba.ac.jp	① Water and solute transportation in soil. Salinity and erosion of soil ② Water resource engineering in arid land, water quality control, water treatment ③ Physics and chemistry of soil, soil pollution soil, colloid and interface
	Bio - resource Process and System Engineering	NOGUCHI Ryoza noguchi.ryoza.gm##@#u.tsukuba.ac.jp	① Resource and energy utilization using agricultural waste, biomass and organic wastewater based on bio-resource recycling system ② LCA, LCC, and simulator development for optimization design of bio-resource conversion process and grasping of biomass potential and its utilization
	Watershed Conservation	NASAHARA(NISHIDA) Kenlo 24dakenlo##@#gmail.com HOTTA Norifumi hotta.norifumi.ge##@#u.tsukuba.ac.jp	① Mechanism of sediment production and transport ② Sabo planning in harmony with natural environment ③ Environmental analysis through remote sensing
	Water Resources Management Engineering	ISHII Astushi ishii.atsushi.fu##@#u.tsukuba.ac.jp	① Development and management of irrigation systems ② Water resources evaluation for development ③ Participatory irrigation management
	Bioproduction and Machinery	※2 TAKIGAWA Tomohiro tomohiro-takigawa.ff##@#u.tsukuba.ac.jp NOGUCHI Ryoza noguchi.ryoza.gm##@#u.tsukuba.ac.jp Tofael AHAMED tofael.ahamed.gp##@#u.tsukuba.ac.jp	① Intelligent machinery and robotics for agricultural production ② System analysis for bioenergy production and utilization ③ Real-time crop monitoring systems for site-specific management ④ Process analytical technology for postharvest engineering using spectroscopy
	Farmland System Engineering	KOBAYASHI Motoyoshi kobayashi.moto.fp##@#u.tsukuba.ac.jp	① Farmland engineering, soil conservation engineering ② Soil Physics, Environmental materials
	Protected Area and Wildlife Management	ITO Taiichi ito.taiichi.ft##@#u.tsukuba.ac.jp SAKATA Keisuke sakata.keisuke.gn##@#u.tsukuba.ac.jp	① Ideas behind protected areas ② Planning methods of natural areas ③ Management of recreational use ④ Wildlife management in protected areas
	Rural Environment Improvement	*TARUYA Hiroyuki taruya##@#affrc.go.jp (National Inst. for Rural Engineering)	① Planning methodology for improving the productive function and living environment in rural and semi- mountainous areas ② Evaluation technologies for hydrological and ecological environment in rural areas
	Biosphere Informatic Control Engineering	* MOTOBAYASHI Kota kmoto##@#affrc.go.jp (Institute of Agricultural Machinery, NARO)	① Fundamental technologies for agricultural machinery ② Advanced informantion and communication technologies (ICT) for agricultural machiery ③ Development of standardized data transfer technologies for food production

	Field of Research	Faculty	Detailed Description of Research Field
Food and Biomass Science Field	Food Resources Engineering	※1 NAKAJIMA Mitsutoshi nakajima.m.fu#@#u.tsukuba.ac.jp	① Micro/nano-engineering for advanced bioresource processing ② Micro/nano-channel technology for advanced food processing ③ Formulation of food micro/nano-dispersions and evaluation of their gastrointestinal digestion ④ Effective utilization of food processing waste for value addition
	Science for Food Functions	MIYAZAKI Hitoshi miyazak.hitoshi.gb#@#u.tsukuba.ac.jp	① Exploration study on food-derived functional compounds for the prevention and improvement of lifestyle-related disease ② Exploration study on food-derived functional compounds for the prevention and improvement of fertility of livestock and human
	Chemistry of Biomaterials	OHI Hiroshi oi.hiroshi.gm#@#u.tsukuba.ac.jp NAKAGAWA-IZUMI Akiko nakagawa-izumi.a.gm#@#u.tsukuba.ac.jp	① Chemistry for wood pulping and pulp bleaching ② Chemical utilization of biomaterials and bio-refinery ③ Micro-analysis of wood components (lignin, tannin, carbohydrate and others) and the related compounds
	Engineering of Biomaterials	ENOMAE Toshiharu t#@#enomae.com OBATAYA Eiichi obabaya.eiichi.fu#@#u.tsukuba.ac.jp KAJIYAMA Mikio kajiyama.mikio.fp#@#u.tsukuba.ac.jp	① Creation of paper-based electronics maintaining general paper functions ② Development of paper sensors by using capillary liquid transport through fiber network ③ Development of saltwater immersion method for saving flood-damaged paper cultural heritage and paper-salt interaction ④ Synthesis of fluorine containing condensation polymers for composite materials ⑤ Chemical modification of poly (amino acid) and poly saccharides ⑥ Property enhancement of biomaterials for high-performance musical instruments ⑦ Investigation on the mechanical properties of wood with respect to its fiber-reinforced cellular structure, and development of technology for their effective utilization ⑧ Physical and chemical characterization of natural adhesives such as Japanese lacquer and chitosan, and development of technology for their utilization
	Agri-Food Process Engineering	KITAMURA Yutaka kitamura.yutaka.fm#@#u.tsukuba.ac.jp	① Milling and spray drying for health food production ② Development of novel food by applying rice slurry
	Nano and Micro-scale Food Analysis	*TODORIKI Setsuko setsuko#@#affrc.go.jp (National Food Res. Inst.)	① Microbial control of food with ionizing radiation ② Quality changes of food components by oxidative stresses
	Sustainability of Biomass Resources	*KOSUGI Akihiko akosugi#@#affrc.go.jp (Japan International Res. Center for Agricultural Sci. (JIRCAS))	① Development of biomass utilization technology using Microbialfunction
	Regional Forest Resource Development	*YAMADA Tatsuhiko yamadat#@#affrc.go.jp (Forestry & Forest Products Res. Inst.)	① Development of lignin based functional bio-materials ② Chemical conversion of cellulosic biomass for preparing useful chemicals, liquid fuels and fuel additives ③ Rapid analysis of lignocellulosics to evaluate potential of forest biomass

	Field of Research	Faculty	Detailed Description of Research Field
Rural Development Economics Field	Agricultural and Bioresource Economics	SHIGENO Ryuichi shigeno.ryuichi.gb#@#u.tsukuba.ac.jp SHUTO Hisato shuto.hisato.ke#@#u.tsukuba.ac.jp	① Agricultural policy and economic development in the globalized world economy ② Quantitative analysis of food demand ③ Industrial organization of agribusiness
	Resource Management and Development Studies	MATSUSHITA Shusuke matsushita.shusuk.gb#@#u.tsukuba.ac.jp	① Development of Decision Support System for Farm Management Agency ② Analysis of Risk Management and Consumers' Behavior on Agricultural Products and Food ③ The Possibility and Extension of Smart Agriculture for Farm Management and Food Distribution System
	Farm Business and Agribusiness Management	NOHGUCHI Ruriko nohguchi.ruriko.fw#@#u.tsukuba.ac.jp UJIE Kiyokazu ujiie.kiyokazu.gf#@#u.tsukuba.ac.jp	① Farm production and supply economics under the risk ② Farm and agribusiness firm management and marketing ③ Food consumption and consumer policy
	Rural Sociology and Agricultural History	KATO Morihiro kato.morihiro.ft#@#u.tsukuba.ac.jp YUZAWA Noriko yuzawa.noriko.gw#@#u.tsukuba.ac.jp	① Historical study on agriculture and rural communities of Japan ② Study on 17-19 <sup>th</sup> centuries manuals of agricultural technology
	Forest Resource Economics	TACHIBANA Satoshi tachibana.satoshi.gn#@#u.tsukuba.ac.jp	① Study on forest economics and policy ② International comparative study on management and utilization of forest resources ③ International comparative study on production and Marketing of forest products
	Forest Resources Sociology	KOHROKI Katsuhisa kohroki.katsuhisa.gu#@#u.tsukuba.ac.jp	① Historical study of forest management in Japan ② Socioeconomic study on regional forest management in Japan ③ Comparative study on forestry organizations
	Rural Development Study	*FURUYA Jun furuya#@#affrc.go.jp KOBAYASHI Shintaro (Japan International Res. Center for Agricultural Sci.(JIRCAS))	① Identification of the socio-economic factors and conditions for sustainable agriculture development in the Asian and African countries ② World food model analysis of impacts of global warming on agriculture and food security
	Regional Forest Resource Development	*HIRANO Yuichiro hiranoy#@#affrc.go.jp (Forestry and Forest Products Research Institute(FFPRI))	① Identification of social conflicts over forest resources ② Study on how to lead rural development by utilizing forest resources

\*Adjunct professor of the Cooperative Graduate School (not assigned an academic advisor's position for research students [kenkyusei]).

※1 The faculty member marked with ※1 will be retired by March 31, 2019.

※2 The faculty member marked with ※2 will be retired by March 31, 2020.

**Doctoral Program in Biosphere Resource Science and Technology**

The Division of Biosphere Resource Science and Technology consists of a total of 22 professional disciplines (or fields of research), some of which are included in the cooperative graduate school program. The doctoral program covers two major fields: Biological Resource Science and Biosphere Environment Science. Biological Resource Science focuses on the disciplines of plant genetics and breeding, crop science, olericulture and floriculture, pomology and postharvest physiology of fruits, animal science, crop production system, plant molecular biology, metabolic network biology, disease vector control, and epigenetics, the objectives of this section of the program are education and research on molecular biology, genetics, physiology, and ecology in plants, animals, and insects from the viewpoints of practical use, sustainable agriculture production, and environmental conservation in natural ecosystems and agro-ecosystems. Biosphere Environment Science focuses on the disciplines of plant parasitic mycology, applied entomology and zoology, environmental soil chemistry, environmental plant biochemistry, forest ecotology, and conservation of regional resources; the objectives of this field of the program are education and comprehensive analysis of biosphere factors, and development of sustainable control and management systems for these factors. Also, six professional disciplines within the cooperative graduate school program provide specific topics on functional analysis of agro-forest microorganisms, international development of biological resources, plant stress biology, international food production and development sciences, functional utilization of beneficial insects, and climate change impact assessment on vegetation. A doctoral education program on Arid Land Resource Science was newly established for foreign students in 2011. The curriculum of the doctoral program involves lectures, field study, and individual Ph.D research. All the lectures in the course are given in English.

Details of the individual disciplines are provided in the table below.

(\* E-mail address: add following domain name: @u.tsukuba.ac.jp . Or replace “#” with “@” . )

	Field of Research	Faculty	Detailed Description of Research Field
Biological Resource Production Field	Plant Genetics and Breeding	OHSAWA Ryo osawa.ryo.gt@	① Study on conversation and efficient utilization of genetic resources ② Genetic analysis of important traits in crops ③ Pollination biology for seed multiplication of crops ④ Development of digital phenotyping method
	Crop Science	※1 MARUYAMA Sachio maruyama.sachio.ge@ NOMURA Koji nomura.koji.gb@	① Physiological and ecological research for raising grain yield and quality of crop plants ② Physiological research on the mechanisms and control of Stress tolerance in crop plants
	Olericulture and Floriculture	EZURA Hiroshi ezura#gene.tsukuba.ac.jp FUKUDA Naoya fukuda.naoya.ka@ MATSUKURA Chiaki matsukuc#gene.tsukuba.ac.jp ARIIZUMI Tohru ariizumi#gene.tsukuba.ac.	① Molecular and physiological dissections of useful traits involved in agricultural production in vegetables and ornamentals ② Development of genetic engineering and intensive production technologies for vegetables and ornamentals ③ Genetics and genomics for fleshy fruit (Solanaceae and Cucurbitaceae) research and development
	Pomology and Postharvest Physiology of Fruit	SUGAYA Sumiko sugaya.sumiko.fw@	① Physiology of fruit during pre- and postharvest ② Environmental and chemical growth regulation on fruit trees ③ Propagation of woody plants
	Animal Science	TAJIMA Atsushi tajima.atsushi.gb@	① Studies on reproduction and their applications for the conservation of animal genetic resources. ② Holistic approaches toward the development of sustainable animal production system. ③ Development of the novel healthy lean meat production system.
	Crop Production System	HAYASHI Hisayoshi hayashi.hisayoshi.gt@	① Establishment of sustainable crop production systems with conscious of environment load ② Development and utilization of high level and stable production systems on millets and regional special crops
	Plant Molecular Biology	SHIBA Hiroshi shiba.hiroshi.gm@	① Molecular mechanisms of epigenetic regulation in heterosis ② Molecular mechanisms of epigenetic regulation in sexual plant reproduction ③ Epigenetic engineering of plant development

Graduate School of Life and Environmental Sciences

	Field of Research	Faculty	Detailed Description of Research Field
Biological Resource Production Field	Metabolic Network Biology	KUSANO Miyako kusano.miyako.fp@	① Genetic analysis of important agronomic traits in crops and vegetables ② Development of analytical platforms to capture quantitative and qualitative changes of metabolite levels ③ Metabolic network biology using “omics” datasets
	Disease Vector Control	TAYLOR, DeMar taylor.de.mar.ge@	① Hormonal and nutritional regulation of reproduction in ticks and other arthropods ② Immune responses and their regulatory mechanisms in ticks and other arthropods ③ Effects of nutrition and immune regulatory mechanisms on the vector capacity of ticks
	Epigenetics	BUZAS Diana Mihaela buzas.mihaela.ka@	① Defining promoter and polycomb recruiting cis acting elements at FLC chromatin. ② Function of Polycomb recruiting elements in Arabidopsis. ③ Epigenetic mechanism for quantitative and priming memory of Vernalization insensitive 3.
	Functional Analysis of Agro-forest Microorganisms	*HATTORI Tsutomu hattori#@#affrc.go.jp (Forestry and Forest Products Research Institute(FFPRI))	① Studies on wood decay mechanisms, ecology and physiology of wood decaying fungi ② Studies on effects of forest managements on wood-inhabiting fungi ③ Studies on taxonomy and phylogeny of wood decaying fungi
	International Development of Biological Resources  (Not available)	*FUKUTA Yoshimichi zen#@#jircas.affrc.go.jp (Japan International Res. Center for Agricultural Sci. (JIRCAS))	① Genetic and breeding studies for global differentiation of resistance to blast disease in rice ② Genetic and breeding studies for development of high productive rice Adapted to various environments
	Plant Stress Biology	*FUJITA Yasunari yasuf#@#affrc.go.jp (Japan International Res. Center for Agricultural Sci. (JIRCAS))	① Molecular elucidation of stress tolerance mechanisms in plants ② Development of environmental stress-tolerant crops
	International Food Production and Development Sciences	*MURANAKA Satoru smuranaka#@#affrc.go.jp (Japan International Res. Center for Agricultural Sci. (JIRCAS))	① Morphological and physiological characterization of cowpea breeding materials for the development of machine-harvestable varieties. ② Physiological mechanism of tuber initiation and growth of White Guinea yam, <i>Dioscorea rotundata</i> .
Biosphere Environmental Science Field	Plant Parasitic Mycology	YAMAOKA Yuichi yamaoka.yuichi.gp@ OKANE Izumi okane.izumi.fw@	① Systematics of plant parasitic fungi including symbiotic fungi, particularly rust fungi, blue stain fungi, endopytes and mycorrhizal fungi. ② Studies on ecology and physiology of these fungi. ③ Functional analysis of genes associated with disease resistance in plant.
	Applied Entomology and Zoology	KAINOH Yoichi kainoh.yoichi.gf@ FURUKAWA Seiichi fukurawa.seiichi.ew@	① Biological control and chemical ecological approaches in pest management ② Insect immune mechanisms against pathogens and parasitoids ③ Elucidating volatile compound-mediated plant-plant and plant-insect communications using molecular biology approaches
	Environmental Soil Chemistry	TAMURA Kenji tamura.kenji.gn@	① Environmental chemistry of forest soils ② Soil ecological studies on soil organic matter ③ Soil conservation under grassland in Eurasian steppe
	Environmental Plant Biochemistry	YAMAJI Keiko keiko.yamaji.fp@	① Effect of endophytic microbes on heavy-metal stress tolerance in plants ② Effect of endophytic microbes on environmental stress tolerance in plants ③ Effect of endophytic microbes on radio Cs accumulation in plants
	Forest Ecotopology	KAMIJO Takashi kamiyo.takashi.fw@	① Dynamics and function of forest ecosystem ② Vegetation science and management ③ Conservation and restoration of arid and semi-arid ecosystem ④ Conservation of endangered species
	Conservation of Regional Resources	TSUMURA Yoshihiko tsumura.yoshihiko.ke@ FUJIOKA Masahiro fujioka.masahiro.gn@ SEINO Tatsuyuki seino.tatsuyuki.gw@	① Conservation genetics of tropical tree species, and phylogeography of forest tree species and genetic study of local adaptation ② Study on conservation of regional resources ③ Wildlife management and biodiversity conservation

Functional Utilization of Beneficial Insects	*KIMURA Kiyoshi kimura#@#affrc.go.jp (NARO Institute of Livestock and Grassland Science (NILGS))	① Improvement of Honeybee health for the advancement of apiculture ② Genetic improvement in characteristics of honeybees to contribute to apiculture ③ Research on characterization and utilization of pollinator insects
Climate Change Impact Assessment on Vegetation	*MATSUI Tetsuya tematsui#@#affrc.go.jp (Forestry and Forest Products Research Institute (FFPRI))	① Relations between distributions of forest vegetation and climatic conditions ② Impact assessment and adaptation planning of climate change on forest ecosystem functions and ecosystem services ③ Ecological study on the beech forests at their northern natural range limit

\*Adjunct professor of the Cooperative Graduate School (not assigned an academic advisor's position for research students [kenkyusei]).

※1 The faculty member marked with ※1 will be retired by March 31, 2019.

※2 The faculty member marked with ※2 will be retired by March 31, 2020.

**Doctoral Program in Life Sciences and Bioengineering**

Life Sciences and Bioengineering is a fusion of two major fields: Biochemistry of Cell Functions and Engineering for Application of Biological Functions. Education and research guidance is carried out based on an interdisciplinary curriculum that includes biology, chemistry, and engineering.

The major field of Biochemistry of Cell Functions comprises the following nine areas: biochemistry of bioactive molecules, genomic biology, structural biochemistry, molecular and developmental biology, biology for gene regulation, molecular microbial bioengineering, molecular analysis of signaling, biochemistry of plant proteins, and animal bioresource engineering. Education and research on the elucidation of the dynamic behavior of living cells and analysis of biologically active substances that possess signal transfer functions are emphasized in the course.

The major field of Engineering for Application of Biological Functions comprises the following ten areas: bioreaction engineering, applied microbiology, cell cultivation engineering, biomimetic chemistry, ecological molecular microbiology, functional foods and food chemistry, molecular and cellular chronobiology, molecular neurobiology, applied bioengineering of microbial ecosystems, and evolutionary biology of symbiosis. This field also incorporates research and study on engineering applications, the imitation of biofunctions, and the elucidation of functions of a wide range of biological entities, including enzymes, microorganisms, and animal and plant cells.

The research fields of the faculty members are listed in the table below.

(\*Replace “#” with “@”.)

	Field of Research	Faculty	Detailed Description of Research Field
Biochemistry of Cell Functions Field	Biochemistry of Bioactive Molecules	MATSUMOTO Hiroshi hmatsu#@biol.tsukuba.ac.jp USUI Takeo	① Identification of molecular targets of the bioactive compounds in mammalian and plant cells and their action mechanisms. ② Antioxidative responses to photooxidative stresses. ③ Biosynthesis of aroma compounds. ④ Semiochemicals mediating interactions among insects, plants and animals.
	Genomic Biology	FUKAMIZU Akiyoshi TANIMOTO Keiji	① Functional studies on molecular network of transcription factors and chemical modifications ② Aging regulated by nutrition and metabolism ③ Brain function and metabolism ④ Genomic imprinting ⑤ Gene expression mechanism for homeostasis
	Structural Biochemistry	TANAKA Toshiyuki ttanaka#@tara.tsukuba.ac.jp	① Analysis of the structure-function relationships of proteins involved in signal transduction and transcription regulation ② Analysis of the chromophore-protein interactions of chromoprotein antitumor antibiotics ③ Protein engineering based on detailed structural information on functional proteins
	Molecular Microbial Bioengineering	KOBAYASHI Michihiko HASHIMOTO Yoshiteru	① Screening of new metabolism, and functional analysis of physiological functions. ② Metabolic engineering and screening/ analysis /design/ remodeling of useful enzymes and genes. ③ Functional analysis of enzymes involved in cleavage and synthesis of a C-N bond and their molecular evolution. ④ Development of super biological catalysts with novel functions of microorganisms and their enzymes. ⑤ Functional analysis of nucleic acid-related enzymes and its application to DNA/RNA engineering.
	Molecular and Developmental Biology	BABA Tadashi baba.tadashi.gf#@u.tsukuba.ac.jp KASHIWABARA Shin-ichi kashiwabara.shin.fw#@u.tsukuba.ac.jp	① Transcriptional and translational regulation of genes during gametogenesis ② Functional roles of proteins involved in fertilization, egg activation, and early embryonic development ③ Development of reproductive and developmental technologies for future life
	Biology for Gene Regulation	KIMURA Keiji	① Analysis for dynamics of mitotic chromosomes. ② Analysis for function of condensin complex. ③ Analysis for novel function of the nucleolus.
	Molecular Analysis of Signaling	* ( ) (NARO)	① Molecular analysis of transcriptional regulation involved in disease resistance in rice. ② Molecular analysis of signaling crosstalks in induced disease resistance in rice. ③ Development of epigenetic strategies to control disease resistance.

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	Field of Research	Faculty	Detailed Description of Research Field
Biochemistry of Cell Functions Field	Biochemistry of Plant Proteins	*( ) (NARO)	① Proteome analysis of plant under environmental stresses ② Functional analysis of crop seedling under flooding stress using comprehensive approach ③ Identification of flooding responsive protein-protein interaction in crop ④ Development of creation technology for transgenic crops and application to mechanism clarification research
	Animal Bioresource Engineering	*OGURA Atsuo *INOUE Kimiko (RIKEN)	① Characterization of the germ cell genome using a nuclear transfer technique ② Analysis of the mechanisms for zygotic gene activation using a nuclear transfer technique ③ Development of techniques for preservation of male germ cells using microinsemination
Engineering for Application of Biological Functions Field	Bioreaction Engineering	ICHIKAWA Sosaku	① Application of polymolecular aggregates for bioprocesses ② Production of useful materials by enzymes and microorganisms
	Applied Microbiology	NOMURA Nobuhiko	① Bacterial cell-cell communication and biofilm formation
	Cell Cultivation Engineering	AOYAGI Hideki	① Development of cultivation system for cell and protoplast with novel functional activities and their biotechnological application ② Analysis of naturally-occurring microbial symbiotic association, construction of artificial symbiotic system and their application for various bioprocesses ③ Cell cultivation engineering and development of novel bioreactors
	Biomimetic Chemistry	( )	① Enzyme isomerism leading chiral homogeneity ② Characterization of polyelectrolyte complex ③ Polymer chemistry for exploration and simulation of biological functions
	Ecological Molecular Microbiology	TAKAYA Naoki NAKAMURA Akira	① Environmental response and morphogenesis of filamentous fungi ② Enzymology and molecular biology of microbial enzymes ③ Bacterial metabolisms and communication
	Functional Foods and Food Chemistry	YOSHIDA Shigeki	① Structure and function of bioactive compounds in food ② Production of bioactive compounds by using bioconversion process ③ Development of industrial enzymes for food production
	Molecular and Cellular Chronobiology	*( ) (AIST)	① Mammalian circadian clock genes and application for diseases (sleep abnormality) ② Molecular circadian clock and sleep of Drosophila (clock and neurodegeneration) ③ Clock genes, lipid metabolism and torpor ④ Molecular Biological model of Parkinson's and Gaucher disease
	Molecular Neurobiology	*DOI Motomichi (AIST)	① Molecular analysis of nervous-system formation and maintenance ② Development of screening systems for neuronal dysfunctions and diseases ③ Development of in-vivo imaging methods for neuronal functions
	Applied Bioengineering of Microbial Ecosystems	*KIMURA Nobutada (AIST)	① Culturing the uncultured beneficial and fastidious microorganisms from the environment ② Exploration and elucidation of unidentified functions in novel biological and genetic resources and their application for bio-industries ③ Environmental metagenomics-driven discovery of novel microbial genetic resources ④ Ecophysiology of environmental microorganisms contributing to energy production and environmental remediation
Evolutionary Biology of Symbiosis	*FUKATSU Takema (AIST)	① Biological function, evolution and origin of endosymbiotic associations between insects and microorganisms ② Molecular, physiological and regulating mechanisms underlying sophisticated inter-organismal interactions in symbiosis, parasitism, manipulation and sociality	

\*Adjunct professor of the Cooperative Graduate School (not assigned an academic advisor's position for research students [kenkyusei]).

※1 The faculty member marked with ※1 will be retired by March 31, 2019.

※2 The faculty member marked with ※2 will be retired by March 31, 2020.

(NARO) = National Agriculture and Food Research Organization

(RIKEN) = RIKEN

(AIST) = National Institute of Advanced Industrial Science and Technology

## Doctoral Program in Bioindustrial Sciences

Through the practical education and encouragement of students, the Doctoral Program in Bioindustrial Sciences develops professionals who can contribute to the establishment of strategies and policies from an international point of view. In addition, the program prepares specialists who can play a part in the creation of new bioindustries, the securement and circulation of resultant new biomaterials, and the protection of innovative properties and patents. The program's goals of providing higher education and innovative research for the development of the life sciences and a sustainable society in the 21st century are accomplished through six academic fields, created from the fusion of social and natural sciences:

- 1) gene resources and industry, which focuses on finding progressive ways to utilize the various genetic resources on the earth;
- 2) bioindustry and bioscience, which focuses on industrializing bioscience technology for the utilization of biotic and genetic resources;
- 3) ecosystem technology, which focuses on enhancing sustainable development with proper remediation and control technology corresponding to the ecosystem and living environment;
- 4) bioresource development technology, which includes food and biological processes engineering and material science (an interdisciplinary subject that ranges from the study of biomass to the study of functional food composition);
- 5) environmental decision science and engineering of bioresource utilization, which aims to establish sustainable development and stability in the areas of poverty and environmental degradation; and
- 6) environmental symbiosis science, which focuses on developing symbiotic and sustainable cities and areas in the environment.

The International Bioindustrial Sciences Course has been established in our doctoral program as a special course for the Global 30 project; it develops internationally competitive human resources over multi-disciplinary practices with technology and science components and includes legal, regulatory, social, and ethical aspects for bioindustry promotion.

The research fields of the faculty members in 2017 are listed in the table below.

Research Field	Faculty	Specialized Field
Genetic Resource Science and Technology	NAKAMURA Kouji	Molecular mechanism of protein secretion, Functional analysis for functional RNA gene
	KIKUCHI Akira	Stress physiology, Molecular breeding, Somatic embryogenesis
	ONO Michiyuki	Photoperiodic induction of flowering, Development and differentiation, Circadian rhythms, Gene literacy, Plant biotechnology
	NOMURA Nakao	Development of sustainable agriculture, Forestry and fisheries industry using bioengineering technique
Bioindustry and Bioscience	SHIGEMORI Hideyuki	Naturally occurring bioactive substances, Phototropism, Gravitropism, Flowering, Apical dominance, Allelopathy, Plant growth regulators, New drugs from unexplored natural resources, Preventive medicines of lifestyle-related disease, Environmental preservation-type functional agents
	YAMADA Kosumi	Plant growth regulators, Phytohormones, Environmental response in plants, Chemical communication in plants
	NAKAJIMA-KAMBE Toshiaki	Isolation and screening of microorganisms with potential for bioproduction/biotransformation. (plastic degradation, biotransformation of oil/fat-related biomass, and methane conversion)
	WATANABE N. Kazuo	Biodiplomacy, Assessment of biodiversity, Sustainable use for genetic resource, Biosafety, Access for bioresources and its appropriation
Eco-system Technology	ZHANG Zhen Ya	Production of high functional matters from biomass resources
	UTSUMI Motoo	Functional analysis of marine microorganisms and its role in cycling of matter, Bio eco-engineering
Bioresource Development Technology	KITAMURA Yutaka	Biomass and food waste conversion and utilization
	YANG Yingnan	Photocatalytic technology, Solar light utilization system, Bioreactor, High efficiency conversion and effective utilization of bioresources, Renewable energy
Environmental Symbiosis Science	YOSHIDA Shigeki	Enzyme engineering, Enzyme kinetics, Enzymatic conversion technology, Immobilized enzyme, Glycotechnology, Protein engineering, Biotechnological production of bioresources, Microbial conversion technology, Microbiological control technology
Bioindustry and Bioscience	ITO Yuzuru (AIST)*	Basic technology of the regenerative medicine using human stem cells (Quality control, mass cultivation, differentiation) Developmental biology (Mechanisms of organ development and regeneration about model organisms)
	TANIGUCHI Akiyoshi (NIMS)*	Study of the interactions between nanomaterials and cells The effect of nanoparticles on cellular response The effect of nanoparticles on drug response

Note: \*Adjunct Professor of the Cooperative Graduate School  
(AIST)=National Institute of Advanced Industrial Science and Technology  
(NIMS)= National Institute for Materials Science

**Doctoral Program in Sustainable Environmental Studies**

The Doctoral Program in Sustainable Environmental Studies accepts students who have obtained a master's degree or its equivalent in a related field, and provides the research programs of interdisciplinary intensification which aims at building up sustainable environmental studies. Our educational policy emphasizes three aspects:

- 1) fostering of scientific and analytical skills while undertaking introspective studies in the humanities;
- 2) gaining practical skills and a better understanding of practical problems through fieldwork and in situ study methods; and
- 3) appropriately using the hypothetical-deductive method and development of the students' laboratory skills in both practical and experimental analysis.

The program strengthens each student's ability to apply the abovementioned knowledge and methods to clarify or resolve an issue within the wider academic community. After receiving a doctoral degree, students are expected to work in an environmentally-related international organization, company, or civic organization (e.g. NGO, NPO) as a practical scholar. They may also work at a university or research institution as an academic or researcher.

Students are required to participate in two out of three forums offered by various research fields; these three forums are designed to intensify interdisciplinary research skills through presentation and discussion. To improve the students' practical and social skills, the option is provided to undertake a long-term internship through arrangement with their supervisor in advance. To deepen each student's knowledge of their research theme and improve their writing, presentation, and debating skills, students are assigned special exercises of sustainable environmental studies (I, II and III).

Each student is supervised by an advisory committee that contains one academic supervisor and at least two co-supervisors. This committee gives the student both advice and supervision toward the completion of their doctoral thesis and evaluates the student's thesis proposal, research progress, and research achievement. Once the student passes the sustainable environmental studies exercises (I, II and III), they may submit their doctoral thesis. The student makes a public presentation as a preliminary evaluation and then defends their thesis in front of a thesis examination committee of the program and a thesis examination committee of the graduate school. After the student passes the defense, the thesis examination committee evaluates the thesis and awards the Doctoral Degree in Sustainable Environmental Studies.

The doctoral thesis must contribute new knowledge to the field of sustainable environmental studies and must have been completed through independent study and research. The duration of the doctoral course is ordinarily three years; however, early completion is also available if the student satisfies all the requirements in less than three years. The students can complete the doctoral course in English in the framework of the SUSTEP (Sustainable Science, Technology and Policy) Program.

The faculty members and their research fields are listed in the table below.

Field of Research	Faculty	Detailed Description of Research Field
Processes of Atmosphere-land Interaction	UEDA Hiroaki KAMAE Yoichi*	Influences of cryosphere, land-surface hydrology, and vegetation
Sustainability Hydrology	TSUJIMURA Maki ASANUMA Jun ONDA Yuichi	Groundwater contamination and human activities, monitoring of water resources and water environment Dynamics of radio nuclides in water environment
Environmental Sustainable Soil Science	MATSUMOTO Hiroshi YAMAJI Keiko	Mode of action of agrochemicals, Stress responses of plants Chemical response of plants and microorganisms in the rhizospheric soil
Microbiology for Sustainable Environment	NOMURA Nobuhiko ※1 SHIMADA Akihiko* TOYOFUKU Masanori*	Cell-cell communication Evolutional analysis of microbial metabolites and their application for bioremediation
Sustainable Recycling of Bio-resource	ZHANG Zhen Ya LEI Zhongfang UTSUMI Motoo SHIMIZU Kazuya	Techniques for improving water quality with lower load and friendly symbiosis to environment Recycling and reusing of agricultural waste and development of functional food material from agricultural wastes. Development of wastewater treatment technologies based on ecosystem engineering Aquatic Biogeochemistry and Engineering Aquatic environmental remediation for sustainable water use Inhibition by microbial metabolite on water purification process and development of its measures
Soil Environment Conservation	ADACHI Yasuhisa	Fundamental of colloid science and its application to soil and water
Inorganic chemistry	SUEKI Keisuke	Environmental distributions of radioisotopes and trace elements
Biodiversity and Conservation Ecology	YOKOI Tomoyuki*	Life History Strategy of Insects Ecosystem Conservation and Mitigation Microbial diversity and population genetics, Evolutionary ecology of flower visiting insects
Ecosystem Ecology	HIROTA Mitsuru OMORI Yuko* ADACHI Minaco*	Dynamics of bioelements in ecosystems Evaluation of the effects of global change to biosphere Distribution of terrestrial plants and their adaptive strategy to environments Carbon dynamics in terrestrial ecosystem, Response to environmental change in alpine ecosystem: species, community and ecosystem components, Mechanism of successional change in ecosystem functioning and structure Aquatic Biogeochemistry and Engineering Carbon cycle of terrestrial ecosystems, process-based model

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Field of Research	Faculty	Detailed Description of Research Field
Environmental Health Perspective	KUMAGAI Yoshito SHINKAI Yasuhiro*	Cellular response to environmental chemicals, Environmental toxicology, Cellular defense mechanisms against chemicals Infectious Diseases, International Health
Bioethics	WATANABE Kazuo	Bioethics, Environmental biosafety of transgenic organisms
Plant physiology	SUZUKI Iwane	Plant molecular biology, Plant physiology
Symbiosis and Cultural Ecology	( )	Cultural ecology
Urban Landscape Planning	FUJIKAWA Masaki MURAKAMI Akinobu YAMAMOTO Sachiko SHIMPO Naomi*	History of dwelling environment Conservation of traditional built environment, Urban planning, Regional planning
Environmental and Socio-economic Policies	YABAR Helmut MIZUNOYA Takeshi	Evaluation and analysis of technological externality, market failure, revealed preference in demand and common property in the ecosystem, Methods for comprehensive evaluation of the environment integrated waste management systems: policy and planning
Analysis and Assessment of Ecological Environment	YOSHINO Kunihiko KAIDA Naoko	Remote sensing and GIS application to environmental problem Monitoring natural environment, Environmental change prediction and environmental impact assessment, Policies for environmental preservation, Environmental policy, Environmental economic
Integrated Watershed Management	NASAHARA Kenlo HOTTA Norifumi	Integrated management of watershed for the prevention of rainfall-induced disasters, Environmental monitoring and monitoring with satellite remote sensing Sediment dynamics in mountain watershed Earth and environmental sciences, Ecosystem modeling, Remote sensing, Environmental dynamics analysis, Biogeoscience
Culture, social land ecological symbiotic	MATSUI Kenichi	Rural resources management and forest conservation in developing nations, Environmental ethics
Functional food resources	ISODA Hiroko MIYAMAE Yusaku VILLAREAL Myra* TAKAHASHI Shinya*	Mechanisms behind functional food resources for potential applications in food and cosmetics. Studies on small molecules that modulate the cellular metabolism Pigment Cell Research (Melanogenesis and Melanoma Research) Search for functional components from biomass
Environmental Disaster Prevention	( )	Policy of natural disaster prevention, Strategy for natural disaster prevention, Risk management against natural disaster Risk assessment and mitigation for Natural disasters Crisis management for natural Disasters
Regional Air Pollution [Cooperative graduate school system: National Institute for Environmental Studies]	TAKAMI Akinori SUGATA Seiji NAGASHIMA Tatsuya	Observation and analysis of air pollution including PM2.3 in East Asia and study of its health and climate impact Numerical study of regional air pollutants, Material transport in the atmosphere Studies on Asian air pollution and its effects using chemical transport model
Regional Environmental Health Sciences [Cooperative graduate school system: National Institute for Environmental Studies]	TIN Tin Win Shwe KOIKE Eiko	Studies on immune toxicity of environmental chemicals and their mechanisms Environmental medicine, Air pollution and behavioral assessment, Air pollution and behavioral assessment Biological analysis for the effects of environmental pollutants on immune system

Faculty members marked by \* cannot be assigned as thesis director, but can advise the student under the direction of a qualified thesis director within the same research field.

The faculty member marked with ※1 will be retired by March 31, 2019.

E-mail addresses of the faculty members are available on the following web site: <http://www2.envr.tsukuba.ac.jp/eng/>.

**Doctoral Program in Advanced Agricultural Technology and Sciences**

Agriculture in Japan must realize stable food supply and food safety and reduce its environmental impact while strengthening its platform and increasing its productivity. Agricultural research and education are anticipated to provide solutions for these targets by developing totalized and efficient agricultural production technologies and by developing human resources capable of exploring the application of these technologies to practical agriculture. To this end, the Doctoral Program in Advanced Agricultural Technology and Sciences aims to supervise students who intend to advance their studies from a Master's degree to a Ph.D, covering the areas of field informatics, crop production management systems, function and regulation of animal production, crop genomic breeding, fruit tree physiology and genomics, and development and utilization of ornamental plants.

This three-year independent doctoral program is conducted under affiliation with the National Agriculture and Food Research Organization located in Tsukuba Science City, and is fully administered by the scientists of the organization as visiting professors (see table below).

Field of Research	Faculty (e-mail address)	Detailed Description of Research Field
Field Informatics	HAYASHI Takeshi (hayatk@affrc.go.jp) TAKEZAWA Kunio (takezawa@affrc.go.jp)	① Model theories to evaluate biological function and environmental dynamics ② QTL analysis, Statistical genetics, Breeding theory ③ Software technology for grid computing and modeling
Crop Production Management Systems	OTOBE Kazunori (otobek@affrc.go.jp) SHIGETA Kazuto (kazuto@affrc.go.jp)	① Establishment of advanced technology for labor-saving and knowledge-based crop production based on precise field management using sophistication of sensing device ② Farming systems to reduce labor, production costs and environmental loads ③ Farm-ecosystem instrumentation by using nanotechnology, biotechnology, and information technology
Function and Regulation of Animal Production	KUSHIBIKI Shiro (mendoza@affrc.go.jp) MITSUMORI Makoto (mitumori@affrc.go.jp) TAJIMA Kiyoshi (ktajima@affrc.go.jp)	① Functional analysis of hormones for growth and lactation in daily cows ② Molecular ecological and functional analysis of rumen bacteria ③ Utilization of fermented liquid feed and Eco-feed for pig nutrition
Crop Genomic Breeding	OTOBE Chikako (ochika@affrc.go.jp) TANAKA Junichi (tanajun@affrc.go.jp)	① Genetic analysis for important agronomic traits and development new crop cultivars. ② Construction of molecular linkage maps and development of Molecular markers for important agronomic characters in crop plants ③ Molecular cloning and characterization of genes with agronomic Importance in crop plants ④ Development of novel breeding strategies using genome information in crop species
Fruit Tree Genomic Breeding	※MORIGUCHI Takaya (takaya@affrc.go.jp) YAMAMOTO Toshiya (toshiya@affrc.go.jp) KUNIHISA Miyuki (miyuky@affrc.go.jp)	① Genetic analysis for improvement of fruit traits using genetic resources ② DNA markers, molecular genetics, and genomic breeding of deciduous fruit trees ③ Research on the application of mass data for genomes in apple breeding
Development and Utilization of New Genetic Resources in Ornamental Plants	※OHMIYA Akemi (ohmiya@affrc.go.jp) NISHIJIMA Takaaki (takaaki@affrc.go.jp) NAKAYAMA Masayoshi (nakayosi@affrc.go.jp)	① Genetic engineering of ornamental plants ② Physiological analysis and mutagenic technology aimed at improvement of flower size and shape ③ Flower color regulation based on analysis of pigments and their related compounds

※ The faculty member marked with ※ will be retired by March 31, 2020

## Doctoral Program in Integrative Environment and Biomass Science

The global environment is the common heritage of humankind; all life is dependent upon it. In the 21<sup>st</sup> century, the fate of the global environment has become a critical issue in both developed and developing countries. To sustain this environment we need to solve two main issues. First, to counter global warming, it is crucial to produce carbon-neutral and renewable energy resources: for instance, biodiesel produced from microalgae has raised the interest of economists and scientists. Second, to conserve high-quality water resources, it is necessary to develop effective techniques (e.g., water purification systems) and management policies (e.g., land management policies). The Integrative Environment and Biomass Science program aims to tackle both of these targets in parallel and harmonically to help create sustainable global and local societies.

To this end, we need to train specialized technical experts and constructive researchers who (a) can perform frontier research on fields related to water, biomass or both, (b) possess broad perspectives on both the environment and biomass energy, (c) have a sense of social responsibility, and (d) can take on an international leadership role. To achieve these goals, the curriculum of the doctoral program includes practical training with our existing project team and an internship in one of the world's leading research institutes.

To widen the background and views of all program participants, the curriculum covers a wide range of specialties. We guide the students' selection of courses through our course advisor system and a multiple tutoring system. We encourage students to join an internship and implement a project in private enterprise, so they become accustomed to project management and the atmosphere of private enterprise. By encouraging students to study in leading foreign institutes, we train people who can work internationally; the entrance exam can be taken in either Japanese or English. We welcome foreign students and people who already work in society. We encourage people with high capacity and ability to obtain a doctoral degree in less than 5 years.

Our objective is to train people who will play an active role in international society, as scientists and policy makers. The faculty members and their major research fields are listed in the table below.

Field of Research	Faculty	Detailed Description of Research Field
Environment and Phycology	(WATANABE Makoto) makoto@biol.tsukuba.ac.jp NAKAYAMA Takeshi algae@biol.tsukuba.ac.jp (YOSHIDA Masaki) yoshida.masaki.gb@u.tsukuba.ac.jp KAWACHI Masanobu* (National Institute for Environmental Studies) kawachi.masanobu@nies.go.jp	① Systematics, phylogeny, cell biology, physiology and ecology of algae ② Collection, culture, screening and mass cultivation of microalgae ③ Bioorganic chemistry of microalgal components related with a renewable energy and bioactive compounds of microalgae ④ Engineering research of oil extraction process from microalgae and process energy balance evaluation and LCA analysis ⑤ Molecular and ecological diversity of environmental microbes and its high-degree application to algal biomass production ⑥ Algal culture collection and the utilization
Regulation of Photosynthetic Metabolism	SUZUKI Iwane iwanes6803@biol.tsukuba.ac.jp (MINODA Ayumi) minoda.ayumi.gb@u.tsukuba.ac.jp NAKAJIMA Nobuyoshi* (National Institute For Environmental Studies) naka-320@nies.go.jp	① Optimization of carbon and nitrogen metabolisms involved in the biomass production and interaction among cellular metabolisms in microalgae ② Molecular mechanisms for perception of the environmental factors to acclimatize function of photosynthesis in microalgae ③ Biochemical and molecular biological studies for production of renewable energy from oil-producing algae ④ Elucidation and application of a unique metal metabolism in a sulfo-thermophilic red alga

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Environmental Plant Physiology	SATOH Shinobu satoh.shinobu.ga@u.tsukuba.ac.jp IWAI Hiroaki iwai.hiroaki.gb@u.tsukuba.ac.jp FURUKAWA Jun furukawa.jun.fn@u.tsukuba.ac.jp (IRVING Louis John) irving.louis.fb@u.tsukuba.ac.jp	① Regulation of root functions by environment & hormones and role of xylem sap organic substances, Molecular mechanism of recovery from injury and tissue reunion ② Functions of cell wall network in plant morphogenesis and development. ③ Regulation of metal transport, toxicity of metal ions and adaptation mechanisms ④ Carbon / nitrogen interactions between legumes and parasitic plants
Environmental Molecular Microbiology	NAKAMURA Akira nakamura.akira.fm@u.tsukuba.ac.jp	① Development and application of host-vector systems in extreme thermophiles ② Analysis of metabolism of rare sugars and its application
	YING Bei-Wen ying.beiwen.gf@u.tsukuba.ac.jp	① Cell-cell communications mediated coexistence in microbes ② Experimental evolution with bacterial cells for novel biological functions and principles
	TAKAYA Naoki takaya.naoki.ge@u.tsukuba.ac.jp	① Identification and application of novel fungal metabolic mechanisms
Water and Environmental Resources	ONDA Yuichi onda@geoenv.tsukuba.ac.jp MARUOKA Teruyuki maruoka.teruyuki.fu@u.tsukuba.ac.jp KATO Hiroaki hiros980@ies.life.tsukuba.ac.jp ANMA Ryo amma.ryo.ge@u.tsukuba.ac.jp (TAKAHASHI Junko) takahasi.junko.ka@u.tsukuba.ac.jp	① Sediment yield and overland flow generation in forest plantations ② Interaction between subsurface water movement and sediment yield ③ Transfer of isotopes in environment by Fukushima NPP accident ④ Geochemistry to detect and understand environmental perturbations ⑤ Global geochemical cycles ⑥ Water circulation under sea floor and water-rock interaction
Water Environment	MATUSHITA Bunkei matsushita.bunkei.gn@u.tsukuba.ac.jp	① Integrating remote sensing and GIS techniques with an ecosystem process-based model to monitor the global environmental changes ② Analysis and modeling of environmental changes and their causes ③ Conservation of aquatic environments ④ Analysis and improvement of regional and global sustainability

\*Adjunct professor at the Cooperative Graduate School (not assigned an academic advisors' position for research students [kenkyusei]).

Faculty members listed in parentheses cannot be assigned an academic advisor's position, but the listed research projects can be done in collaboration with other academic advisors in the same research field