

PROSPECTUS for DOCTORAL COURSE

Graduate School of Science, Kobe University

Term 1, 2021

(Starting in April, 2021)

The Graduate School of Science, Kobe University, was established as a result of the reorganization of the Graduate School of Science and Technology in April 2007. The Graduate School of Science has five departments offering both Master's and Doctoral Programs: Mathematics, Physics, Chemistry, Biology, and Planetology.

A Master's Degree of Science will be granted upon completion of the Master's Program, and a Doctoral Degree, either a Dr. of Science or a PhD, will be granted upon completion of the Doctoral Program.

For inquiries, please contact:

Kyomu-gakusei-kakari (Section of Academic Affairs)

Graduate School of Science, Kobe University, 1-1, Rokkodai-cho, Nada-ku, Kobe 657-8501

TEL: 078-803-5767

e-mail: sci-kyomu@office.kobe-u.ac.jp

<http://www.sci.kobe-u.ac.jp/english> (Web page of the Graduate School of Science, Kobe University)

<http://www.math.sci.kobe-u.ac.jp/index.html> (Department of Mathematics)

http://www.phys.sci.kobe-u.ac.jp/index_e.html (Department of Physics)

<http://www.chem.sci.kobe-u.ac.jp/en/> (Department of Chemistry)

<http://www.edu.kobe-u.ac.jp/fsci-biol/en/> (Department of Biology)

http://www.planet.sci.kobe-u.ac.jp/index_e.html (Department of Planetology)

The spread of the novel coronavirus (COVID-19) will affect how the entrance examination for admission is conducted. Updates on current admission details, such as postponements and change of examination contents, will be made available, depending on the pandemic and possibly other factors, such as weather conditions. The Graduate School of Science provides information regarding the entrance examination on the "Admission" page of our website (<http://www.sci.kobe-u.ac.jp/>). Please check this website and Kobe University's official twitter account (@kobeU_PR) for updates.

1. Number of Students to Be Admitted

Department	Number of students to be admitted
Mathematics	4 persons
Physics	5 persons
Chemistry	6 persons
Biology	6 persons
Planetology	6 persons
Total	27 persons

Notes: These numbers include foreign students, applicants who are expected to complete the Master's course of Kobe University in March 2021, and those who have work experience.

2. Eligibility for Application

1. Those who are expected to hold a Master's degree or a professional degree on or before March 31, 2021, or already hold a Master's degree or a professional degree, awarded in Japan.
2. Those who are expected to hold an equivalent degree on or before March 31, 2021, or already hold an equivalent degree, awarded from a university or college overseas.
3. Those who took classes in Japan through a correspondence course provided by a foreign school and are expected to hold an equivalent degree on or before March 31, 2021, or already hold an equivalent degree.
4. Those who have been enrolled in a graduate school in Japan of an overseas-based educational institution approved by the Minister of Education, Culture, Sports, Science and Technology, and are expected to hold a Master's degree or a professional degree studies on or before March 31, 2021, or already hold a Master's degree or professional degree.
5. Those who have held a degree equivalent to Master's degree after completing the course at United Nations University established according to the United Nations General Assembly Resolution of December 11, 1972 detailed in Article 1, paragraph 2 of the Act on Special Measures incidental to the enforcement of the Agreement between the United Nations and Japan regarding the Headquarters of the United Nations University (Act No. 72 of 1976).
6. Those who have taken courses in an educational curriculum at an overseas school, an educational institution specified in item 4 above, or at United Nations University, have passed examinations corresponding to those provided in Article 16-2 of the Graduate School Establishment Standards (Ordinance No. 28 of the Ministry of Education of 1974), and are recognized as having academic ability equivalent to or above those holding a Master's degree.
7. Those who were qualified by the Japanese Minister of Education, Culture, Sports, Science and Technology (i.e. those who were engaged in a post-graduate research for at least two years at a university or institution after graduating from a university/college or after completing 16 years of higher education overseas, whose academic records were approved by the Graduate School to be equivalent to, or higher than, those holding a Master's degree).
8. Those who received a separate qualification screening and were approved by the Graduate School to be equivalent to, or higher than, those holding a Master's degree or a professional degree. In this case, the candidate must have reached the age of 24 at the day of March 31, 2021. (Applicants who correspond to one of 7 and 8 should refer to Section 9.)

3. Application Period

From July 14, 2020 through July 17, 2020 (Office hours: 9:00-12:00 and 13:00-17:00, Monday-Friday).
If sent by mail, the application must be received by the office within this prescribed period.

4. Application Procedure

(1) Application Documents

- 1 Application Form: Fill in Form No. 1.
- 2 Curriculum Vitae: Fill in Form No. 2.
- 3 ID for the Examination: Fill in Form No. 3.
- 4 The certificate of payment card: Fill in Form No. 4.
- 5 Entrance Examination Fee: 30,000 yen. Follow the Form No. 5. Payment of the examination fee should be made with a payment form at a post office. After paying the entrance examination fee, a certificate of payment should be pasted on the certificate of payment card (Form No. 4) and submitted with the other application documents.

1. The applicants who reside outside of Japan must pay 30,000 yen as an international postal money order at the post office and submit the money order with the other application documents.
 2. The grantees of Japanese Government scholarship are exempted from paying the examination fee. If applicants are students with Japanese Government scholarship at other universities than Kobe University, they should submit a certificate of Japanese Government scholarship student.
 - 6 Photograph: Two photographs (4 cm x 3 cm), taken within the past three months, should be pasted on the application form and the ID for the examination.
 - 7 A copy of a Master's degree diploma or a letter that certifies the anticipated graduation.
 - 8 Academic Records:
 1. Undergraduate level: The record must be certified by the dean or the president of the applicant's university.
 2. Master's level: The record must be certified by the dean or the president of the applicant's graduate school.
 - 9 Master's Thesis
 - (a) Applicants who have completed a Master's course: i) A copy of the Master's thesis, or published manuscript(s) equivalent to the thesis. ii) A copy of the summary of the Master's thesis in English (about 1,200 words). Use A4 size paper and attach a cover sheet (Form No. 6).
 - (b) Applicants who anticipate a Master's degree: A copy of the summary of the research program in the Master's course in English (about 1,200 words). Use A4 size paper and attach a cover sheet (Form No. 6).
 - (c) Copies of published manuscript(s), if any.
 - 10 Research Plan: Describe your research proposal (goal, objectives, and experimental designs) in English (about 1,200 words). Use A4 size paper and attach a cover sheet (Form No.7).
 - 11 Certificate of Residence: An applicant who resides in Japan must submit a copy of the "Certificate of Residence" issued within 30 days by a local administration office in Japan or copies of both sides of the "Resident Card" issued by a Municipal office.
 - 12 Self-addressed Forms: Fill in your address and name. (Form No. 8)
- (2) Submission by mail
When submitting the forms by mail, be sure to send them by registered special delivery mail, and do not forget to indicate "Application Forms for Doctoral Course" in red on the envelope and enclose a self-addressed Envelope (23.5cm X12cm) with 362 yen-stamps.
- (3) Submission address
Kyomu-gakusei-kakari (Section of Academic Affairs), Graduate School of Science, Kobe University, 1-1, Rokkodai-cho, Nada-ku, Kobe, Japan 657-8501, Japan, Tel: 078-803-5767
e-mail: sci-kyomu@office.kobe-u.ac.jp

[Notes]

- (1) Applicants cannot make any changes to the documentation after submitting their application documents. The entrance examination fee is not refundable after application, except for the case that the application is not accepted.
- (2) Regarding any certificates written in other foreign languages than English, applicants must attach Japanese translations, with a certification issued by such public organizations as the Japanese government or the overseas mission of a foreign government.
- (3) Applicants should select a professor as a supervisor from the annexed "List of Departments and Divisions" and contact the professor in advance, when preparing the Research Plan. Application documents will not be accepted without nominating a professor.

[Notes]

RIKEN – Kobe University International School will support foreign students who will conduct Ph.D. project under supervision of BDR (Center for Biosystems Dynamics Research) scientists who hold positions as visiting faculty at Kobe University.
RIKEN will partially provide students' living costs under the International Program Associate (IPA) program. Details will be available from the web site of BDR (<http://www.bdr.riken.jp/en/index.html>) and of RIKEN (<http://www.riken.jp/en/careers/programs/ipa>).

5. Examination Procedures

Applicants will be selected based on the evaluation of the oral examination and the submitted documents. The oral examination is evaluated by focusing on the following points:

- (1) The contents of the Master's thesis or research program: Basic knowledge and capability for

- taking the course will be examined.
- (2) Language ability (For foreign applicants who graduated from a foreign university, ability in both the English and Japanese languages): Language ability for taking the course will be qualified.
 - (3) The contents of the Research Plan: It will be evaluated if the quality of the Research Plan is sufficient for granting the degree.

6. Date and Place of Oral Examination

Department	Date
Mathematics	August 21, 2020
Physics	August 25, 2020
Chemistry	August 28, 2020
Biology	August 21, 2020
Planetology	August 25, 2020

Place: Graduate School of Science, Kobe University.

*Time and place of each presentation will be announced later.

*In case of emergency, please check our website (<http://www.sci.kobe-u.ac.jp/english/>) or our Twitter account (@kobeU_PR).

Take Kobe City Bus bound for "Tsurukabuto Danchi" (Line No. 36) from "Rokko" station (Hankyu Railway), "Rokko-Michi" station (JR), or "Mikage" station (Hanshin Railway). Get off at "Shindai Bunrinogakubu Mae" and walk about 3 minutes southward.

7. Examination Results

Accepted applicants will be notified by mail. In addition, the names of the accepted applicants will be announced on the homepage (<http://www.sci.kobe-u.ac.jp/>) of Graduate School of Science at 10:00 on March 9, 2020. No telephone inquiries will be accepted.

8. Enrollment Procedures

- (1) Date: middle of March 2021. (As planned) Detailed date and the documents for admission will be sent by postal mail to each applicant with the examination result at the beginning of March 2021.
- (2) Admission Expenses:
 - (A) Entrance fee: 282,000 yen. (As planned)
 - (B) Tuition fee: 267,900 yen for the first semester, 535,800 yen per year. (As planned)
The tuition for the first semester must be paid on April 27, 2021 by bank account Transfer(electronic withdrawal). If the tuition fee is revised during enrollment, the revised Tuition fee will apply.

[Notes]

- (1) The entrance fee is not refundable.
- (2) An applicant will be deprived of entrance under the following cases:
 - (A) False statements on the documents.
 - (B) Failure to complete the enrollment procedures.
 - (C) Failure to obtain a Master's degree by March 31, 2021.
- (3) Foreign students with a Japanese Government scholarship are exempted from paying the entrance and tuition fees.

9. Examination of Qualifications for Application

Those who are qualified under items 7 and 8 in the Section 2 will be examined for their qualifications in applying.

(1) Application Documents

- ① Application Form for Examination of Qualification (Form No. 9)
- ② Academic Records: The record must be certified by the dean or the president of the applicant's university.
- ③ Curriculum Vitae (Form No. 2)
- ④ History or Research (Form No. 10): History of research needs to be certified by the deans or the

directors of the institutions where the applicant has worked and work. The history of research written by the applicant may be accepted, if it can not be certified at the corresponding institution(s).

- ⑤ Research Experience (Form No. 11): A copy of the summary of the thesis equivalent to the Master's thesis (about 1,200 words). Use A4 size paper and attach a cover sheet (Form No. 11).
- ⑥ Publication: Submit the list and reprints (copies) of significant publications. If an applicant is a co-author or one of several co-authors for any significant publication(s), specify your role and work.
- ⑦ Research Plan: Describe your research proposal (goal, objectives, and experimental designs) in English (about 1,200 words). Use A4 size paper and attach a cover sheet (Form No. 7).

Submissions of ④, ⑤ and ⑥ are not obligatory, if an applicant graduated from the Medical school, Dental school, or the 6-year course of Veterinary Medical school.

(2) Application Period and Place

Application documents will be accepted by June 29, 2020 at Kyomu-gakusei-kakari (Section of Academic Affairs), Graduate School of Science. (Office hours: 9:00-12:00 and 13:00-17:00, Monday-Friday). When application forms are sent by mail, they must arrive within this prescribed period.

When submitting the forms by mail, be sure to send them by registered special delivery, and do not forget to indicate "Application Forms for Examination for Qualification" in red on the envelope.

(3) Notification to Candidates

Each candidate will be notified before July 7, 2020.

10. Others

1. Exemption of Payment of Entrance Fee

Those who meet one of the following special requirements and have remarkable difficulties to pay the entrance fee, based on application and through a selection process, may receive a full or half exemption of entrance fee.

- (1) The person who was to pay for the applicant's school expenses died, or was involved in natural disasters such as wind and flood damage within a year of the applicant's enrollment.
- (2) Financial reason as well as having achieved excellent academic performance.

2. Postponement of Payment of Entrance Fee

Those who meet one of the following requirements and have difficulties to pay entrance fee by the designated date, based on application and through a selection process, may be given fixed time to prepare for paying the entrance fee.

- (1) The person who was to pay for the applicant's school expenses died, or was involved in natural disasters such as wind and flood damage within a year of the applicant's enrollment.
- (2) Financial reason as well as having achieved excellent academic performance.

3. Exemption of Payment of Tuition

Those who meet one of the following requirements and have difficulties to pay the tuition fee, based on application and through a selection process, may receive a full or half exemption of tuition fee.

- (1) The person who was to pay for the applicant's school expenses died, or was involved in natural disasters such as wind and flood damage within a year of the applicant's enrollment.
- (2) Financial reason as well as having achieved excellent academic performance.

4. Scholarship

Besides of the honor scholarship of Japan Student Service Organization, there are various scholarships. Details are announced separately.

5. Research Assistant Program

Our graduate school offers a Research Assistant Program for newly entering students (for those who paid the entrance fee only). Accepted applicants for this program can work as research assistants and receive an allowance (a maximum amount: approximately 282,000 yen). The program aims to support the students financially within 1 year after the enrollment and promote the research and study for Doctoral degree.

6. Privacy Statement

- (1) With regard to personal data possessed by this University, laws including the Law Concerning the Protection of Personal Information by Independent Administrative Institutions are observed, and every possible measure is taken to protect it based on the Personal Data Management Rules of Kobe University.
- (2) Personal data provided to this University for application are used for the selection of students, the announcement of accepted applicants, admission procedures, research into selection methods of students.

- (3) The personal data of accepted applicants provided to this University for application is used after admission for student support (health management, scholarship application, etc.), educational purposes (student registration, academic guidance, etc.), and services related to tuition.
- (4) With regard to the use of personal data for various services, some of the services may be entrusted by this University to outside operators (hereinafter referred to as "entrusted operators"). In such cases, all or part of the personal data provided to this University may be provided to the operators imposing the confidentiality of data, to the extent necessary to implement the entrusted services.

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Graduate School of Science, Kobe University

Department of Mathematics

I. Division of Analysis

This subject is aimed at the mathematical structures of changes occurring in phenomena. Included are the fields of functional equations, functional analysis, complex analysis, harmonic analysis, algebraic analysis and differential equations.

(1) Functional Equations

Mathematical analysis of nonlinear partial differential equations; methods of functional and harmonic analysis.

(2) Functional Analysis

Fourier analysis; Functional analytic methods for partial differential equations.

(K. Fukuyama, H. Takaoka)

(3) Complex Analysis

Complex analytic functions and special functions, such as elliptic functions and solutions of differential equations; Riemann surfaces; use of analytic and algebraic and geometric methods. (Y. Yamada)

II. Division of Algebra and Geometry

This subject is aimed at elucidating the essential properties behind the continuity and symmetry in structures related to equations and spaces. Included are the fields of number theory, automorphic forms, algebraic geometry, differential geometry and topology.

(1) Algebra

Structure and theory of algebraic manifolds, period integrals, moduli theory, automorphic forms, automorphic representations, number theory, integrable systems in geometry and mirror symmetry. (M.-H. Saito**, K. Yoshioka, T. Taniguchi)

(2) Geometry

Differential geometry and topology; differentiable manifolds; theory of knots and links; minimal and constant mean curvature surfaces; singularities on Riemannian manifolds; hyperbolic space and low dimensional topology. (Y. Nakanishi*, W. Rossmann, S. Satoh, K. Saji)

III. Division of Applied Mathematics

This subject is aimed at the fields of probability, combinatorics, automorphic forms, number theory, computational mathematics, information science and mathematical physics, with applications to such things as science, engineering, computer science and economics in mind.

(1) Probability

Applications of probability theory to random motions, fluctuations and random phenomena of mathematical objects. (N. Kajino)

(2) Combinatorics

Combinatorics and counting techniques, and their applications to discrete systems and mathematical physics; integrable systems and cellular automata. (Y. Ohta)

(3) Computational Mathematics

Computational methods in the mathematical sciences; efficient implementation on computers and development of computer algebra systems; applications to algebra, algebraic analysis and mathematical physics. (N. Takayama, S. Aoki)

Those staff members indicated by * are scheduled to retire at the end of March 2021.

Those staff members indicated by ** are scheduled to retire at the end of March 2022.

Department of Physics

I. Division of Theoretical Physics

The aim of this division is to study theoretically on elementary particles, the most fundamental constituents of the universe, and various physical properties of condensed matter systems.

(1) Elementary Particle Theory

The properties of elementary particles and physics beyond the standard model are studied theoretically. The main interests of our research include higher dimensional theories, functional renormalization group, and supersymmetric theories. (M. Sakamoto^{***}, H. Sonoda)

(2) Cosmology

The origin of the spacetime and matter in the universe is investigated. The evolution of the large scale structure of the universe is also studied. (J. Soda)

(3) Condensed Matter Theory

Mechanisms of superconductivity and magnetism in various systems are studied using analytical and numerical methods with emphasis on the view point of spontaneous symmetry breaking and quantum information. (K. Kuboki, T. Nishino)

(4) Quantum Solid State Physics

Electronic properties of solid states are theoretically investigated to understand the macroscopic quantum phenomena in strongly correlated electron systems such as heavy electron systems. (H. Harima)

II. Division of Particle Physics

The aim of this division is to experimentally study the properties of elementary particles and the interactions between them, and to answer questions about the early universe.

(1) Particle Physics

We work on experiments, using the most advanced experimental facilities, such as high-energy hadron collider experiment (LHC · ATLAS), neutrino experiments (Super-Kamiokande, Hyper-Kamiokande, T2K), and direct dark matter search experiments (XMASS, XENON, NEWAGE).

(H. Kurashige, Y. Takeuchi, Y. Yamazaki, A. Ochi, K. Miuchi, J. Maeda)

III. Division of Condensed Matter Physics

The aim of this division is to experimentally study on the magnetic, electric, and thermal properties of condensed matter systems such as magnetic material, superconductor, and semiconductor.

(1) Extreme Condition Condensed Matter Physics

Quantum phenomena are studied by electron spin resonance and nano-scale magnetometry under extreme conditions, such as low temperature, high magnetic field, and high pressure.

(H. Ohta, E. Ohmichi, S. Okubo)

(2) Low Temperature Condensed Matter Physics

Quantum phenomena, such as superconductivity, magnetism, and multipole order, are studied by nuclear magnetic resonance and macroscopic measurements under complex conditions such as low-temperature, high-magnetic field and high pressure.

(H. Tou, H. Kotegawa)

(3) Quantum Dynamics

Spectroscopic studies on the dynamical and microscopic responses of electrons, atoms and molecules in condensed matter by means of ultrashort laser pulses, and highly charged ions. (T. Kohmoto^{***}, M. Sakurai^{*})

(4) Correlated Electron Physics

Our study is focused on the crystal growth and low temperature measurements in highly correlated electron systems to explore new quantum phenomena, such as unconventional superconductivity and magnetism. (H. Sugawara, E. Matsuoka)

Those staff members indicated by * are scheduled to retire at the end of March 2021.

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Department of Chemistry

I. Division of Physical Chemistry

Research and education are directed toward understanding structures and dynamics of molecules, clusters, and solid surfaces using various laser spectroscopic and quantum chemical methods. The structures are investigated by high-resolution spectroscopy, resonant enhanced multi-photon spectroscopy, and scanning micro probe. The excited states and reaction dynamics are studied by time-resolved nonlinear spectroscopy, scanning micro probe, and pulse shaping method. Physicochemical understanding of chemical reaction mechanism is learned through the experimental studies.

(1) Molecular Structure and Dynamics

Research and education are aimed to understand molecular structure and control dynamics and chemical reaction on the basis of laser spectroscopy and quantum theory.

(A. Wada, S. Kasahara)

(2) Material Physical Chemistry

Chemistry at buried interfaces is studied with advanced scanning probe microscopy and optical spectroscopy. Brand-new methods for characterizing nanometer-sized materials are being developed. New solid compounds are synthesized. (H. Onishi, K. Kimura, K. Eda)

(3) Chemical Reaction Dynamics

Research and education focus on structure and electronic interaction of intermediate species in photoactive proteins and in solar cells by using time resolved electron paramagnetic resonance spectroscopy. Our main scope is elucidations of molecular function for novel light-energy conversion processes. (Y. Kobori, T. Tachikawa)

II. Division of Inorganic Chemistry

Research and education focus on coordination chemistry, inorganic materials chemistry, analytical chemistry, electrochemistry, and reaction chemistry: development of functional materials including organometallic compounds, metal oxides, and polyoxometalate compounds, and analysis of electrochemical reactions, electron transfer reactions, and chemical dynamics in condensed matter.

(1) Solid State Chemistry

Research and education focus on synthesis and characterization of functional inorganic materials including coordination compounds and metal oxides in crystalline or non-crystalline forms. (T. Mochida, T. Uchino, K. Takahashi)

(2) Solution Chemistry

Research and education focus on the charge (ion and electron) transfer reactions at electrode/solution and oil/water interfaces and their application to the electrochemical analysis of biologically relevant compounds. (T. Osakai**)

(3) Physical Inorganic Chemistry

Chemical dynamics is studied in condensed matter such as liquids and proteins including their interaction, reaction, and relaxation. (K. Tominaga, S. Akimoto)

III. Division Organic Chemistry

Fundamental researches on organic chemistry and biochemistry, in particular, investigations of new synthetic methodologies and molecular design based on supramolecular chemistry and protein science are executed.

(1) Organic Reaction Chemistry

Research and education are conducted on development of new methodologies for selective organic synthesis, investigation of general and highly efficient catalytic routes yielding useful compounds for life science and material science. (M. Hayashi, R. Matsubara)

(2) Organic Molecular Structure and Function

Research and education focus on molecular structure and functions based on organic chemistry and material science; design, synthesis, and structural analysis of supramolecular architectures composed of p-conjugated macrocycles and cage compounds.

(A. Tsuda)

(3) Biomolecular Science

Research and education focusing on folding and structural formation of proteins and enzymes, their dynamical functions in solutions and in biomembranes, and conversion of their functions by biotechnological methods. (A. Tamura, E. Chatani, T. Kimura)

IV. Visiting Academic Staff for Cooperative Division (Japan Synchrotron Radiation Research Institute)

(1) Materials Structure Science

Research and education are conducted with a focus on the structural analysis of crystalline materials with synchrotron radiation, dynamic structural analysis, and the use of diffraction techniques and biological macromolecules using X-ray scattering techniques and fluid structure analysis. (K. Sugimoto)

V. Visiting Academic Staff for Cooperative Division (Institute of Physical and Chemical Research)

(1) Theoretical Biochemistry

By computer simulations based on statistical mechanics and quantum chemistry, we aim to understand structural and functional relationships in biomolecules. (T. Nakajima)

Those staff members indicated by ** are scheduled to retire at the end of March 2022.

Department of Biology

I. Division of Biomolecular Organization

This division conducts education and research on the cell structure and functions in levels of molecules, cells, tissues, and individuals.

(1) Molecular Physiology

We educate and research on the molecular mechanisms of stimulus reception in sensory cells, and of cell motility of unicellular organisms. The molecular mechanisms functioning in inter-cellular and inter-individual relationships are also studied. (T. Suzaki*, M. Sakura)

(2) Cell Function

Plants do not have to move from where they live by conducting photosynthesis. Instead, they have abilities to change their cell function, organ growth, and developmental program in response to environmental changes. We educate and research on the mechanisms and their evolution of various plant physiological/morphological responses to environment based on the molecular and cell biology. (H. Fukaki, K. Ishizaki, Y. Kondo)

(3) Bioinformation

Aiming to explore information processing in biological systems, our education and research focus on signal transductions underlying "brain function" and "membrane traffic and cellular morphology in model organisms". (M. Miyamoto, M. Morita, H. Tsukamoto)

II. Division of Biosignal Transduction

This division conducts education and research on the mechanisms of gene expression and the regulation of biological responses through the intracellular signal transduction.

(1) Gene Expression

We educate and research on the mechanisms of gene expression and the related developmental processes; germ cell determination and differentiation in the nematode *C. elegans* and zebrafish, microRNA function, and regulation of RNA splicing in vertebrates and *C. elegans*, as well as gene regulatory mechanism of cell fate specification in cardiac neural crest. (H. Sakamoto, K. Inoue)

(2) Genetic Information

We educate and research on the molecular mechanisms underlying maintenance and diversification of genetic information, and also on the intracellular signal transduction pathways by the post-translational modifications of proteins that regulate biological responses to genotoxic stresses caused by various endogenous as well as environmental agents. (K. Sugasawa, M. Yokoi)

(3) Gene Function

We educate and research on the functions of genes involved in the regulation of cellular transformation, apoptosis, and senescence, and also in the processes of morphogenesis. Studies are focused on the molecular mechanisms of cell fate decision between apoptosis and senescence induced by cellular stresses, and the functions of long noncoding RNA and small peptide genes in *Drosophila* development. (S. Kamada, Y. Kageyama)

III. Division of Biodiversity

This division conducts research and educational program on ecology and systematic biology for elucidating origin and sustenance mechanism of biodiversity of various biota inhabiting both terrestrial and marine environments.

(1) Ecology and speciation

This course covers studies on ecological aspects of biodiversity and its conservation, with particular interests in revealing mechanisms of species interactions, evolutionary change, speciation and diversity of aquatic plants and animals. (T. Sato, K. Suetsugu)

(2) Evolution and phylogeny

We focus on the researches and education of the evolutionary aspects of biodiversity, systematics, metabolic physiology, cell structures and ecology of diverse algae, and apply the results for the conservation and improvement of the aquatic ecosystems. (S. Uwai, A. Murakami*, H. Sakayama)

IV. Division of Developmental Biology

Our educational program provides fundamental concepts and basic knowledge in developmental biology. We also conduct advanced research in developmental genetics, cell biology, and evolutionary biology.

(1) Developmental Biology****

Research and education in this division cover fundamental developmental processes, including epithelial morphogenesis in *Drosophila*, respiratory system development in mouse, evolutionary morphology in vertebrates, and genome evolution. (S. Hayashi, S. Kuratani, M. Morimoto, S. Kuraku)

V. Division of Bioregulatory Science

This division reviews the discovery research for bioactive compounds and the study of their mode of action, translocation and metabolism in organisms such as insects, fungi and plants.

(1) Bioregulatory Science****

Research and education in this division are conducted to clarify the interaction between the organisms and bioactive compounds integrating a variety of technologies. (S. Kawamura, S. Yamato)

Those staff members indicated by * are scheduled to retire at the end of March 2021.

For retirement schedule of the staffs in the research field indicated by ****, please contact each faculty member.

Department of Planetology

Why is this planet to be the Earth? In order to answer this fundamental question, we are aiming at comprehensive understanding of the evolution of the earth, planetary and solar systems by analyzing various processes occurring at spaces from the center of the Earth to the edge of the solar system with multidisciplinary approaches.

I. Division of Fundamental Planetology

This division aims at cultivating discerning persons leading society and /or academic communities by logical analyses and considerations of variable phenomena in planetary and Earth systems.

(1) Geology

We examine surficial materials and geologic structures of the Earth. Our main targets include the various geologic phenomena associated with plate subduction characterizing “planet Earth”, environments and life evolution, and tectonics. (Y. Yamamoto, K. Yamasaki)

(2) Petrology and Mineralogy

We examine various kinds of Earth and planetary materials to elucidate their origin and evolution by using various methods such as electron microscopy, chemical analyses, synchrotron radiation, experimental reproductions, field works, and so on. (K. Kaneko,, Y. Seto)

(3) Solid Geophysics

We study source processes of large earthquakes and slow earthquakes, seismic wave propagation, tsunami generation and propagation processes, and dynamics associated with subduction of oceanic plates such as slab deformation, temperature and flow fields. (S. Yoshioka)

(4) Fluid Geophysics

We investigate, by the use of theoretical and numerical methods, the structures and the evolutions of fluid spheres, mainly the atmospheres, of the planets in our solar and exosolar systems in general, and we are trying to argue the problem by understanding Earth's fluid sphere as one of the realization of those general features. (Y. Hayashi, Y. Takahashi)

(5) Planetary Astrophysics

The major goal of our group is to advance our understanding of the origin and evolution of ring-satellite systems, small solar system bodies, and planetary systems including those outside our solar system, mainly by theoretical research and analysis of data obtained by telescopes and spacecraft observations. (K. Ohtsuki, A. M. Nakamura)

II. Division of Frontier Planetology

This division aims at cultivating aspirational persons pioneering frontier researches in planetology in collaboration with national institutes of planetary and earth sciences.

(1) Experimental Planetary Science

We study the origin and evolution of planetary bodies by means of laboratory experiments and planetary explorations. Our research interests are the effects of planetary collisions on the variety of solar system bodies and the tectonics of icy satellites and cometary nuclei. (M. Arakawa)

(2) Marine Geodynamics

We conduct researches on the structure and evolution of the solid Earth using marine geophysical methods. (N. Seama, H. Sugioka, H. Hirose)

(3) Computational Planetology

We mainly study the formation and evolution of astronomical objects from the large scale structure of the universe for planets by means of theoretical and computational approaches. We also work on the research and development of numerical algorithms, software, and hardware. (J. Makino, T. Saitoh)

III. Cooperative Division

(1) Evolutionary History of the Planets and the Earth

We study the origin and evolution of solar system, and exoplanetary systems by astronomical observations (NAOJ), and the history of the Japanese Islands related to global evolution of the Earth (JAMSTEC). (M. Obayashi, S. Miyazaki)

(2) Applied Planetology

Japan has experienced natural disaster conditions brought by torrential rain, typhoons, and so on. The global warming is also an urgent issue. Thus, meteorology is an increasingly important branch of the planetary science. By making use of various facilities of the Meteorological Research Institute, we study the atmosphere close to the earth's surface and the data assimilation and predictions of local heavy rainfalls. (H. Mouri)