

◆ International Graduate Program for Bioscience and Biotechnology

1. Program Outline

The Graduate School of Bioscience and Biotechnology has launched a new program entitled “International Graduate Program in Bioscience and Biotechnology (BIO-IGP)” since 2012 within an integrated master’s and doctoral education (IMDE), a five years curriculum. This IMDE curriculum commences every October and the classes are conducted in English. The primary aim of BIO-IGP is to foster student excellence within our various and sophisticated educational plans by exposing students to the advanced science and technology that underpins medical, environmental and informational industries and to other related areas of bioscience and biotechnology. To this end, we set up three different courses, **Environmental & Chemical Biotechnology (ECB)**, **Medical Life Sciences & Biotechnology (MLB)**, and **Computational Life Sciences & Biotechnology (CLB)**. Through enhanced exchanges between international and Japanese students, we will bring out high-level researchers and engineers who will flourish as national and global leaders.

2. Departments in the Graduate School of Bioscience and Biotechnology

Department of Life Science

Department of Biological Sciences

Department of Biological Information

Department of Bioengineering

Department of Biomolecular Engineering

3. Graduation Requirements

[*Master’s degree*]

- (1) Students must acquire at least 30 credits from the following subjects groups: “Research Subjects (M)”, “Common Subjects (M)”, “Course Subjects” in the three courses, “Communication Skill Subjects”, and “Liberal Arts and General Education (G)”. Subjects of the other programs in the Graduate School of Bioscience and Biotechnology can be included in the above mentioned 30 credits.
The 30 credits required must include the following credits:
 - Four compulsory credits of IGP Seminars (I-IV) from the “Research Subjects (M)” in their own department. (Take one of these subjects (each one credit) in each semester.)
 - Eighteen credits from “Common Subjects (M)” and the “Course Subjects” for their own course, which must include the seven compulsory credits from “Common Subjects (M)” and four credits from the “Course Subjects” for their own course.
 - Two credits from the “Course Subjects” for the other two courses that they do not belong to.
 - Two credits from “Communication Skill Subjects” and “Liberal Arts and General Education (G)”.
- (2) With 30 credits acquired, students can file for a master’s degree usually in the first two years. Then they are supposed to submit a master thesis, conduct final presentation on their master thesis, and undergo the final examination and thesis evaluation.
- (3) In this IMDE, students qualified for a master’s degree must take a qualifying examination for the doctoral course immediately after the thesis evaluation.

[*Doctoral degree*]

Students must satisfy the following requirements to obtain a Doctoral degree:

- (1) Six credits of IGP Seminars (V-X) from the “Research Subjects (D)” in your own department.
(Take one of these subjects (each one credit) in each semester.)
- (2) One credit of IGP Off-Campus Training *.
*A research experience for at least a week in another research institution in Japan.
- (3) One credits of Progress Presentation for Doctoral Degree in your own department.
(Take it in the 3rd year or 4th year.)
- (4) Conduct of Qualifying Presentation on your mid-term progress in the year when you will not take Progress Presentation for Doctoral Degree.
- (5) Uploading of doctoral thesis, conduct of final presentation on your thesis and the final oral examination to obtain a doctoral degree.

Standard Course Schedule

1st year	2nd year	3rd year	4th year	5th year
M1	M2	D1	D2	D3
PP	FP, FE	PP(QP)	QP(PP)	FP, FE

PP: Progress Presentation, FP: Final Presentation, FE: Final Examination, QP: Qualifying Presentation

4. Tables of Course Subjects

**- For master students -
Research Subjects (M)**

Subject	Number	Credit	Chair	Semester	Remarks
IGP Seminar I (each dept.)		1	Mentor	M1, Autumn	Compulsory
IGP Seminar II (each dept.)		1	Mentor	M1, Spring	Compulsory
IGP Seminar III (each dept.)		1	Mentor	M2, Autumn	Compulsory
IGP Seminar IV (each dept.)		1	Mentor	M2, Spring	Compulsory

Common Subjects (M)

Subject	Number	Credit	Chair	Semester	Remarks
Directed Collaboration Works	78071	2	Kajiwara, Mihara	Autumn	Compulsory
Directed Laboratory Works I (each dept.)		2	Mentor	Spring	Compulsory
Directed Laboratory Works II (each dept.)		2	Mentor	Autumn	Compulsory
Progress Presentation for Master Degree	78718	1	Mentor	Spring	Compulsory
Advanced Biochemistry	78021	2	Ichinose et al.	Autumn	O
Essential Biological Sciences	78124	2	Ohta et al.	Autumn	
Advanced Biophysical Chemistry	78013	2	Kurokawa et al.	Autumn	O
Advanced Bioorganic Chemistry	78014	2	Yuasa et al.	Autumn	E
Advanced Molecular Biology	78015	2	Aizawa et al.	Autumn	E
Bioengineering Now	78023	2	Hirota et al.	Autumn	E
Advanced Bioscience and Biotechnology Frontiers	78024	2	Saito	Autumn	

“E” or “O” in the remarks column shows that the class is open only in even or odd year, respectively.

Course Subjects for Environmental & Chemical Biotechnology (ECB)

Subject	Number	Credit	Chair	Semester	Remarks
Advanced Course of Bioorganic Engineering	82003	2	Mihara, Matsuda	Autumn	E
Molecular Recognition of Biomolecules	78008	2	Seio et al.	Autumn	O
Advanced Biochemical Process	82001	2	Ogura, Hirasawa	Autumn	O
Cell Structure and Function	81002	2	Komada	Spring	E
Comparative Genomics	72025	2	Yamada	Spring	E

“E” or “O” in the remarks column shows that the class is open only in even or odd year, respectively.

Course Subjects for Medical Life Sciences & Biotechnology (MLB)

Subject	Number	Credit	Chair	Semester	Remarks
Brain Science	78034	2	Tanaka, Murayama	Spring	
Mechanisms of Development and Congenital Diseases	81006	2	Tanaka	Autumn	E
Biofunctional Molecule Design	79008	2	Tagawa	Spring	O
Advanced Life Science and Nanomedicine	79009	2	Kondoh	Spring	E
Advanced Course of Biological Molecular Function	78001	2	Aizawa	Spring	O
Advanced Neurobiology	81001	2	Suzuki	Spring	O

“E” or “O” in the remarks column shows that the class is open only in even or odd year, respectively.

Course Subjects for Computational Life Sciences & Biotechnology (CLB)

Subject	Number	Credit	Chair	Semester	Remarks
Advanced Topics in Systems Life-Sciences I	94072	2	Yamamura et al.	Autumn	
Advanced Topics in Systems Life-Sciences II	94101	2	Nakamura et al.	Spring	
Pattern Information Processing	76013	2	Sugiyama	Spring	E
Computational Brain Science	88032	2	Koike	Autumn	O
Advanced Data Analysis	76033	2	Sugiyama	Spring	O
Advanced Topics in Mathematical Information Sciences I	94075	2	Kabashima et al.	Autumn	

“E” or “O” in the remarks column shows that the class is open only in even or odd year, respectively.

Communication Skill Subjects

Subject	Number	Credit	Chair	Semester	Remarks
Advanced Biotechnical Presentation I	78126	2	Whittier	Spring	
Advanced Biotechnical Presentation II	78127	2	Whittier	Autumn	
Global Communication on Computational Life Sciences A&B	78108	2		Spring	ACLS
	78109			Autumn	
Global Presentation on Computational Life Sciences A&B	78110	2	Meldrum Kaz	Spring	ACLS
	78111			Autumn	
Global Debate on Computational Life Sciences	78112	2		Autumn	ACLS
Global Writing on Computational Life Sciences	78113	2		Autumn	ACLS

ACLS: The Education Academy of Computational Life Sciences

Liberal Arts and General Education (G)

International Communication(G) Interdisciplinary Courses(G) Interdepartmental Courses (G) Arts and Humanities(G) Career Development Courses (G) Courses for Developing Creativity(G) Courses for International Students(G)	Remarks Refer to VI.Liberal Arts and General Education Some are given in Japanese
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- For doctoral students -

Research Subjects (D)

Subject	Number	Credit	Chair	Semester	Remarks
IGP Seminar V (each dept.)		1	Mentor	D1, Autumn	Compulsory
IGP Seminar VI (each dept.)		1	Mentor	D1, Spring	Compulsory
IGP Seminar VII (each dept.)		1	Mentor	D2, Autumn	Compulsory
IGP Seminar VIII (each dept.)		1	Mentor	D2, Spring	Compulsory
IGP Seminar IX (each dept.)		1	Mentor	D3, Autumn	Compulsory
IGP Seminar X (each dept.)		1	Mentor	D3, Spring	Compulsory

Common Subjects (D)

Subject	Number	Credit	Chair	Semester	Remarks
IGP Off-Campus Training I	78130	1	Kajiwara et al.	Autumn	●
IGP Off-Campus Training II	78131	1	Kajiwara et al.	Spring	
Progress Presentation for Doctoral Degree	78857	1	Mentor	Spring	Compulsory

● Taking one of these credits is compulsory.

5. Syllabus

78071

Directed Collaboration Works

Autumn Semester (2-0-0)

Prof. Susumu KAJIWARA, Prof. Hisakazu MIHARA

To foster the creativity and planning about research and development in bioscience and biotechnology fields, and the scientific communication with the students from the other countries, the international graduate students plan to develop a new bio-industrial product(goods) with a team (2-3 students).

Directed Laboratory Works I

Spring Semester (0-0-2)

Directed Laboratory Works II

Autumn Semester (0-0-2)

78021

Advanced Biochemistry

Autumn Semester (2-0-0) (Odd Years)

Prof. Hiroshi ICHINOSE, Prof. Atsushi MARUYAMA and Prof. Masayuki KOMADA

Major areas of contemporary biochemistry will be covered to help students understand the latest progress in life science, especially from the viewpoint of molecular structures, functions and interactions with other molecules. The instructors adopt their own specialties as the topics for this course.

78124

Essential Biological Sciences

Autumn Semester (2-0-0)

Prof. Hiroyuki OHTA, Prof. Makio TOKUNAGA, Prof. Susumu KAJIWARA,

Assoc. Prof. Masaki KAJIKAWA, Assoc. Prof. Atsushi KAWAKAMI and Assoc. Prof. Shun -ichiro OGURA

The aim of this class is to provide the basic knowledge of biological sciences to graduate students who were not well trained in these subjects in undergraduate education. The essence of biochemistry, biophysics, molecular biology, and cellular biology will be given. Essential Cell Biology, 3rd edition (Bruce Alberts et al., Garland Science) will be used in the class.

78013

Advanced Biophysical Chemistry

Autumn Semester (2-0-0) (Odd Years)

Prof. Ken KUROKAWA, Prof. Takafumi UENO and Assoc. Prof. Hiroyuki OHTANI

Topics on advanced biophysical chemistry will be stated with the principles of the basic analytical instruments for the biological material.

78014**Advanced Bioorganic Chemistry**

Autumn Semester (2-0-0) (Even Years)

Prof. Hideya YUASA, Assoc. Prof. Kohji SEIO and Assoc. Prof. Akihiro OHKUBO

Bioorganic chemistry related to “bio activity” as well as advanced organic chemistry necessary for the study of bioscience and biotechnology is expounded.

78015**Advanced Molecular Biology**

Autumn Semester (2-0-0) (Even Years)

Assoc. Prof. Yasunori AIZAWA, Assoc. Prof. Kumiko SOGAWA and Assoc. Prof. Takuji YAMADA

This course will feature the molecular biological aspects of a variety of biological phenomena, such as embryogenesis, cell proliferation, cell differentiation, signal transduction, transcriptional regulation, cell response, etc. In addition, future aspects of gene technology, genetic diagnosis, and therapy will be presented.

78023**Bioengineering Now**

Autumn Semester (2-0-0) (Even Years)

Assoc. Prof. Junji HIROTA, Assoc. Prof. Tomoko MATSUDA and Assoc. Prof. Noriyuki ASAKURA

Most advanced research status of bioengineering is to be learned, where bio-functions derived from biological elements such as viruses/phages, enzymes, microbes, plant/animal cells are applied to the construction of innovative systems for producing materials and/or energy, and contributing environmental technology.

78024**Advanced Bioscience and Biotechnology Frontiers**

Autumn Semester (2-0-0)

Lecturer, Yuji SAITO

We will try to deepen understanding of various contemporary biochemical and biotechnological techniques by going over history of bioscience and biotechnology.

82003**Advanced Course of Bioorganic Engineering**

Autumn Semester (2-0-0) (Even Years)

Prof. Hisakazu MIHARA, Assoc. Prof. Tomoko MATSUDA

In a half of the lectures, basic and advanced research status of biocatalysis is to be learned. The other half is regarding chemical syntheses of biomolecules, DNA & peptide, and those applications in biotechnology.

78008**Molecular Recognition of Biomolecules**

Autumn Semester (2-0-0) (Odd Years)

Assoc. Prof. Kohji SEIO, Prof. Hideya YUASA

Principles and mechanisms of molecular recognition of biologically important molecules such as nucleic acids, sugars, proteins and small organic drugs will be discussed from the view points of organic chemistry and physical chemistry. This lecture is held in English.

82001**Advanced Biochemical Process**

Autumn Semester (2-0-0) (Odd Years)

Assoc. Prof. Shun-ichiro OGURA, Assoc.Prof.Takashi HIRASAWA

This course will introduce topics of advanced biochemistry and biochemical process based on protein engineering, cell engineering, molecular biology genetic engineering and metabolic engineering.

81002**Cell Structure and Function**

Spring Semester (2-0-0) (Even Years)

Prof. Masayuki KOMADA

(Aim)

Eukaryotic cells contain various organelles with unique functions. Because each organelle requires specific proteins to fulfill its function, precise transport of proteins to their target organelles is essential for normal cellular activities. This course addresses the roles of various organelles in eukaryotic cells, with a particular focus on protein transport to the organelles. Physiological and pathological aspects of organelle functions are another focus of this course. Efforts will be made to address the fundamentals as well as the recent findings on each subject.

(Schedule)

1. nuclear import and export
2. ribosome
3. protein folding and quality control
4. mitochondria
5. endocytosis (from plasma membrane to lysosome)
6. autophagy
7. secretory pathway (ER and Golgi)
8. membrane fusion
9. motor proteins in vesicle transport
10. Rab family of small GTPases

(How to Grade)

- 1) Small tests in the last ~15 min of every class
- 2) A term report

72025**Comparative Genomics**

Spring Semester (2-0-0) (Even Years)

Assoc. Prof. Takuji YAMADA

This course is designed to introduce basic/advanced bioinformatics for comparative genomics. The objective is to help students to reach the cutting-edge of genomics and metagenomics.

78034**Brain Science**

Spring Semester (2-0-0)

Assoc. Prof. Motomasa TANAKA, Assoc. Prof. Masanori MURAYAMA

We introduce basic neuroscience about structure and function of mammalian brain, mechanisms of neural activity and synapse formation in brain. In addition, we discuss about procedures to measure neural activity and brain-machine interface, BMI. Neuronal dysfunction in brain leads to a variety of neurodegenerative and psychiatric diseases such as Alzheimer's disease and schizophrenia, respectively. We introduce molecular mechanisms of these brain diseases and recent progress of therapeutic approaches to intervene the devastating diseases.

81006**Mechanisms of Development and Congenital Diseases**

Autumn Semester (2-0-0) (Even Years)

Assoc. Prof. Mikiko TANAKA

(Aim)

This course is designed to provide a basic understanding of the cellular and molecular mechanisms that regulate vertebrate development.

(Schedule)

1. Introduction to Developmental Biology
2. Nervous System
3. Neural Crest Cells
4. Heart
5. Paraxial and Intermediate mesoderm
6. Endoderm
7. Limb Development
8. Blood Vessels and Blood Cells
9. Germ Line
10. Regeneration
11. Medical Implications

(How to Grade)

Attendance and presentation

79008

Biofunctional Molecule Design

Spring Semester (2-0-0)(Odd Years)

Assoc. Prof. Yoh-ichi TAGAWA

This lecture will introduce some topics on advanced biofunctional molecule design based on principles of protein engineering and biomaterials. As examples of biofunctional molecules, cytokines and antibodies will be focused.

79009

Advanced Life Science and Nanomedicine

Spring Semester (2-0-0) (Even Years)

Prof. Shinae KONDOH

This course is designed to learn basic/advanced cell biology through recent topics of cancer research. The topics include the regulation of metabolism, cell cycle, differentiation and immune response. The basic knowledge of molecular biology is required for taking this course.

78001

Advanced Course of Biological Molecular Function

Spring Semester (2-0-0) (Odd Years)

Assoc. Prof. Yasunori AIZAWA

This course is designed for students interested in understanding eukaryotic gene expression on a genomewide scale. Topics include genome structures and function, RNA processing, mRNA translation, classical and recently discovered noncoding RNAs, and RNA-based technology. Focuses upon major concepts and recent advances in mammalian genomics and transcriptome.

81001

Advanced Neurobiology

Spring Semester (2-0-0)(Odd Years)

Assoc. Prof. Takashi SUZUKI

Major areas of neurobiology will be covered to help understand the recent advances in the brain science and regenerative neurobiology. The lecture will focus on the scientific questions and the approaches that are taken by the scientists in the area of genetics, developmental and regenerative biology. The students are expected to make a presentation and discussion in the latter half of the course (in English).

94072

Advanced Topics in Systems Life-Sciences I

Autumn Semester (2-0-0)

Prof. Masayuki YAMAMURA et al.

94101

Advanced Topics in Systems Life-Sciences II

Spring Semester (2-0-0)

Prof. Kiyohiko NAKAMURA et al.

The objective of this course is to introduce the state of art on Systems Life-Sciences. Topics are chosen from Bioinformatics, Genomic Researches, System Biology, Synthetic Biology, mathematical Biology, Biophysics, DNA Nano Engineering, and Brain Sciences.

76013

Pattern Information Processing

Spring Semester (2-0-0) (Even Years)

Assoc. Prof. Masashi SUGIYAMA

Inferring an underlying input-output dependency from input and output examples is called supervised learning. This course focuses on a statistical approach to supervised learning and introduces its basic concepts as well as state-of-the-art techniques.

88032

Computational Brain Science

Autumn Semester (2-0-0) (Odd Years)

Prof. Yasuharu KOIKE

The human brain adapts the new environment by exploring action to learn appropriate behavior. In this lecture, a computational methodology is described to elucidate the function of the brain related to motor learning. The purpose of this class is to know the mechanism of the brain through the modeling and its application using a biological signal, in particular, about the optimization of the movement, control, and learning.

76033

Advanced Data Analysis

Spring Semester (2-0-0) (Odd Years)

Assoc. Prof. Masashi SUGIYAMA

The objective of this course is to introduce basic ideas and practical methods of discovering useful structure hidden in the data.

94075

Advanced Topics in Mathematical Information Sciences I

Autumn Semester (2-0-0)

Prof. Yoshiyuki KABASHIMA et al.

The objective of this course is to introduce mathematical notions and methodologies which are developing in the current frontiers of research on computational intelligence and systems science in conjunction with their application examples. Topics are chosen from learning theory, fuzzy theory, control theory, information theory, mathematical

and computational statistics, theory of evolutionary computing and etc.

78126

Advanced Biotechnical Presentation I

Spring Semester (2-0-0)

Lecturer, Robert F. Whittier

This class is aimed at graduate students who want to develop their oral scientific presentation skills. Students will present their research orally, though research proposal-type presentations will be acceptable from those who do not yet have results. Based on feedback, students will improve their presentations for a second presentation. We will emphasize communicating to a general scientific audience using slide transitions, slide builds and animations appropriately to enhance audience comprehension while maintaining “stage presence” and avoiding the use of laser pointers.

78127

Advanced Biotechnical Presentation II

Autumn Semester (2-0-0)

Lecturer, Robert F. Whittier

This class is aimed at graduate students who have research results to present, and preference will be given to students who have external oral presentations scheduled. The length of student presentations will match any presentations they expect to give. We will put emphasis on matching the level of the presentation to the expected audience and managing Q&A in English. Presentations will be video recorded for students to assess their own strengths and weaknesses. In addition, we will also explore new presentation techniques made possible by the integration of tablet and laptop computing devices.

78110

Global Communication on Computational Life Sciences A

Spring Semester (2-0-0)

78111

Global Communication on Computational Life Sciences B

Autumn Semester (2-0-0)

This course aims to achieve comprehensive improvement of students in English conversation based on scientific topics. The instructors are well-trained native English teachers and will provide a practical English training program, using an original ACLS textbook. Students will study with others at a similar skill level in a small class setting. Students will be trained on useful expressions for having discussion, exchanging opinions, clarifying your viewpoint, etc. Towards the end of the course, each student will make use of what was learned in the course by presenting his/her own poster or Power Point presentation.

78101**Global Presentation on Computational Life Sciences A**

Spring Semester (2-0-0)

78102**Global Presentation on Computational Life Sciences B**

Autumn Semester (2-0-0)

Lecturer, Martin Meldrum, Diana Marie Kaz

The main objective of this course is to provide students with the opportunity to practice and polish their presentation skills in English. Class time will be devoted to practicing effective delivery skills: posture, eye contact, gestures, voice inflection and the use of note cards. Furthermore, we will also focus on presentation structure and how to create and explain visuals. You will study with other students of the similar skill level in a small class setting. Students are encouraged to choose a topic from their current research for their final presentation.

78112**Global Debate on Computational Life Sciences**

Autumn Semester (2-0-0)

This course aims to develop skills for debate in English. The instructors are well-trained native English teachers and will provide a practical English training program, using an original ACLS textbook. Students will study with others at a similar skill level in a small class setting. In each class, students will debate on a hot topic in scientific fields to learn skills in organizing your thoughts and stating them in effective manner. Students are recommended to take Global Communication on Computational Life Sciences A/B before this course.

78113**Global Writing on Computational Life Sciences**

Autumn Semester (2-0-0)

This course is recommended to students who write their first paper in English on their research. The instructor is a native English teacher with a lot of experience in teaching and editing of scientific papers. She will help you learn how to write a paper properly before you have to write your first paper. The class will be challenging but relaxed in a small class setting. A semi-private lesson allows for a high level of personal attention and support from the instructor.

78130**IGP Off-Campus Training I**

Autumn Semester (0-1-0)

Prof. Susumu KAJIWARA et al.

78131**IGP Off-Campus Training II**

Spring Semester (0-1-0)

Prof. Susumu KAJIWARA et al.

78718

Progress Presentation for Master Degree

Spring Semester (1-0-0)

78857

Progress Presentation for Doctoral Degree

Spring Semester (1-0-0)