

Ph. D. Program in Human Biology

Common Subjects

Course Number	Course Name	Course Type	Credits	Standard Academic Year	Course Offering Term	Weekday and Period	Classroom	Instructor	Course Overview	Remarks
02RA010	Initiation Seminar	1	1.0	1	SprA	Intensive		Satoru Takahashi, Atsushi Kawaguchi	Initiation Seminar aims to lead the students to learn the purpose of human resource development and program curricula of the Ph.D. Program in Human Biology. Listening to practical lectures by academic researchers, government administrators, and entrepreneurs or researchers who successfully work at business companies, the students will understand the diverse career paths possible after completion of the program. In this seminar, the students will have discussions with their classmates on their future career paths and study proposals, and write a report on their learning objectives and future directions of their study.	Lectures are conducted in English. 4/20 主専攻必修科目。
02RA020	World-science Leaders' Seminar	1	1.0	1	Annual	by appointment	2Z706	Akira Shibuya	The students attending this seminar should be able to learn basic knowledge and recent research trends related to the specialized fields of world-leading researchers. The students should also be able to develop their professional and 'Cognoscente' skills for research as well as acquire skills of research presentation and discussion by discussing with their mentoring instructors the above topics including related matters. In addition, they are expected to gain a better understanding of research procedures and develop abilities to conduct research by writing a report.	Lectures are conducted in English. 主専攻必修科目。
02RA030	Business Leaders' Seminar	1	1.0	1	Annual	by appointment	2Z706	Akira Shibuya	In this seminar, the students will listen to business leaders' omnibus lectures and submit reports on the key points of the lectures for feedback for themselves.	Lectures are conducted in English. 主専攻必修科目。
02RA050	Serendipity in Human Biology	1	1.0	1	SprAB	Mon5	2Z706	Tomoki Chiba, Keiji Kimura	Serendipity in Human Biology engages the students in the researches and processes which trigger "unexpected discoveries" and "the breakthrough experiments and ideas" in each special field of Human Biology. As well as participating in academic discussion of the ideas and significance of those breakthroughs, original papers of related fields are read and discussed with the supervisor and others so that a report can be created and understanding deepened. By performing training which engages in detail with various fields of Human Biology students accumulate knowledge, polish practical skills, and understand how surprising, unpredictable developments in research arise from a scientific background of logical conceptual development.	Lectures are conducted in English.
02RA065	Scientific Ethics	1	1.0	1	SprAB	Wed4		Bryan James Mathis	This course will use traditional lectures and interactive presentations in the Socratic method for didactic learning. Students will also convene into groups for intensive discussion and reaction papers will be issued as homework to carry the learning outside of the classroom. Digital learning through iTunes modules will reinforce concepts using interactive technology.	Required for 1st-year students of the Ph.D. Program in Human Biology Identical to 01EQ061. Lectures are conducted in English.
02RA070	Communication in Human Biology I	2	1.0	1	SprAB	Mon2	4A104	Kiong Ho	A literature-based, seminar-type course for the students to evaluate and review the latest scientific breakthroughs and classical topics that significantly impact Human Biology.	Lectures are conducted in English.
02RA080	Communication in Human Biology II	2	1.0	1	FallBC	Mon2		Kiong Ho	Consists of a literature-based, seminar-type course for the students to evaluate and review the latest scientific breakthroughs and classical topics that have significant impact on Human Biology.	Lectures are conducted in English.

Course Number	Course Name	Course Type	Credits	Standard Academic Year	Course Offering Term	Weekday and Period	Classroom	Instructor	Course Overview	Remarks
O2RA090	International Discussion on Human Biology I	4	1.0	1	SprABC	Fri1,2		Kenji Irie, Ryosuke Ohniwa	Focusing on molecular biology of the cell, International Discussion on Human Biology I provides the opportunities for the students to have interactive online distance learning with the National Taiwan Univesrity and Kyoto Univesrity, and to engage in thesis presentation and discussion conducted in English. In this course, the students should be able to understand basic knowledge of life sciences and acquire scientific communication skills in English.	Lectures are conducted in English. 遠隔授業
O2RA100	Internaitional Discussion on Human Biology II	4	1.0	1	FallABC	Wed1,2		Kenji Irie, Ryosuke Ohniwa	Focusing on cancer biology, International Discussion on Human Biology II provides opportunities for the students to have interactive online distance learning with the National Taiwan Univesrity and Kyoto Univesrity, and to engage in thesis presentation and discussion conducted in English. In this course, the students should be able to understand basic knowledge of life sciences and acquire scientific communication skills in English.	Lectures are conducted in English. 遠隔授業
O2RA101	Research Presentation and Discussion	2	1.0	2	SprABC	Wed2	4F305	Hiroyuki Suzuki	In this course, every student will make a presentation in English about their own research plan and achievements. In addition, students can examine the world situation of relevant fields and discuss in English results published in English that are broadly related to human biology.	Lectures are conducted in English.
O2RA102	Home Internship (Omics Analysis)	3	1.0	2	Sum Vac	by appointment		Taka-aki Sato	Home Internship engages the students in on-campus internships. Attending laboratory activities led by researchers working at business companies, the students should be able to understand research principles in business circles, and understand a variety of research approaches regarding recent social needs.	Identical to 01RC015 and 02RC005. Lectures are conducted in English.
O2RA110	Introduction to Appropriate Technology	4	1.0	1	SprB	Intensive		Kenji Irie	Through a series of lectures and discussions, Introduction to Appropriate Technology provides opprortunities for the students to gain the basic knowledge required for studying a wide range of appropriate technology subjects, such as appropriate technology training, current social circumstances in developing countries, and field activities.	Lectures are conducted in English.
O2RA111	International Research Rotation	3	5.0	2	FallABC	by request		Mitsuyasu Kato	This course offers the students the opportunity to select one or two laboratories that they are interested in from those hosted by the faculty members of the Ph.D. Program in Human Biology. The students will then engage in their own research in the laboratories for 1-2 months and discuss with their instructors its objectives, procedures and results. In this course, they should be able to acquire a wide range of research techniques and develop their skills for analysis of research results and get an international mindset.	Lectures are conducted in English. 主専攻必修科目。
O2RA112	Internship in Overseas Companies	3	5.0	2	FallABC	by request		Akira Shibuya	In this course, the students are expected to find a possible overseas company for internship and work on-site	Lectures are conducted in English. 主専攻必修科目。
O2RA113	Appropriate Technology	3	5.0	2	FallABC	by request		Kenji Irie	In terms of local needs, cultures, environments, and people, Appropriate Technology provides opportunities for the students to develop the optimum technology needed for targeted communities and to generate problem-solving skills, improvisational capabilities, and entrepreneurial abilities for future social needs.	Lectures are conducted in English. 主専攻必修科目。

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02RA114	Entrepreneurship Training	2	5.0	2	Fall IAB	Intensive	2Z706	Yoshinori Harada, Osamu Ohneda	Entrepreneurship Training aims to lead the students to nurture the mindset and skill required for application of their technical seeds and ideas to society. Invited lecturers who have successfully started their own business will instruct the students to understand ideas and skills from the standpoints of social needs, entrepreneurial activities, and business continuity. In addition, the students will study project management skills, success and failure cases in business.	Lectures are conducted in English. 主専攻必修科目。
02RA115	Advanced International Research Rotation	1	10.0	3 - 5	Annual	by request		Mitsuyasu Kato	This course offers the students the opportunity to select one or two overseas laboratories that they are interested from those hosted by the faculty members in Ph.D. Program in Human Biology and conduct research there for 2-18 months. The students will then proceed with the writing of their doctoral dissertation during their research period and discuss with their instructors the objectives, procedures, results and future policy of their research. In this course, they should be able to acquire abilities to conduct and guide research and develop professional research skills and an international mindset.	Lectures are conducted in English.
02RA116	Advanced Internship in Overseas Companies	1	10.0	3 - 5	Annual	by request		Akira Shibuya	In this course, the students are expected to negotiate with an overseas company for the internship's design and plan, and implement the plan.	Lectures are conducted in English.
02RA117	Advanced Appropriate Technology	3	10.0	3 - 5	Annual	by appointment		Kenji Irie	Based on practical skills obtained from the Appropriate Technology course, Advanced Appropriate Technology further aims to lead the students to conduct field experiments and address technological developments for starting a new business in targeted communities.	Lectures are conducted in English.
02RA118	Advanced Entrepreneurship Practice	3	10.0	3 - 5	Annual	by request	2Z706	Yoshinori Harada, Osamu Ohneda	Advanced Entrepreneurship Practice is designed for the students who have completed Entrepreneurship Training to learn the basic mindset and skills required for application of their technical seeds and ideas to society. With the support of advisors, the students will develop proposals and practical scenarios (scripts) to start and sustain new business with regards to existing research subjects. Projects that attract entrepreneurial funding will be launched as bio-ventures.	Lectures are conducted in English.
02RA303	Practical Training of Career Management	3	10.0	3 - 5	Annual	by request		Akira Shibuya	In this course, the students are expected to have opportunities to undertake practical business training at private companies, relevant government offices, or independent administrative corporations for their career development and management possible after completion of the Ph. D. program.	Lectures are conducted in English.

Basic Specialized Subjects

Course Number	Course Name	Course Type	Credits	Standard Academic Year	Course Offering Term	Weekday and Period	Classroom	Instructor	Course Overview	Remarks
02RA120	Human Anatomy and Embryology	1	2.0	1	Fall IAB	Mon3, 4	2Z706	Satoru Takahashi	Human Anatomy and Embryology engages the students in the developmental program of human beings. The students will learn how human beings are organisms and how the bodies of human beings consist of cells, tissues, vital organs, and internal organs.	Lectures are conducted in English. 主専攻必修科目。
02RA121	Human Pathology and Oncology	1	2.0	1	SprBC	Wed5, 6	4B119	Mitsuyasu Kato	Human Pathology and Oncology provides opportunities for the students to learn about the basic disease entities of circulatory disorders (i.e., edema, thrombosis, and infarction), inflammation, and neoplasia, in terms of the causes, pathogenesis, and morphological changes of human diseases. Examining pathological specimen of common diseases, the students should be able to understand various human in vivo phenomena.	Lectures are conducted in English. 主専攻必修科目。

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O2RA122	Human Infection and Immunology	1	2.0	1	SprAB	Mon3, 4		Akira Shibuya	Human Infection and Immunology provides the opportunity for the students to understand infectious diseases through interrelationships between pathogenic microbes and human beings, and study roles of immune systems. The roles of immune systems are to protect the human body from infectious disease.	Lectures are conducted in English. 主専攻必修科目。
O2RA123	Human Endocrinology and Metabolism	1	2.0	1	SprAB	Tue3, 4		Hitoshi Shimano	This course aims to develop the students' abilities to understand the theory of the pathophysiology of human endocrine and metabolic disease through learning 1) development, anatomy and function of endocrine tissue, 2) glucose and lipid metabolism, and 3) physiological functions of hormones and pathological conditions caused by their failure.	Lectures are conducted in English. 主専攻必修科目。
O2RA124	Environmental Medicine	1	1.0	1	SprAB	Wed4		Yoshito Kumagai	This course aims to lead the students to acquire 1) better understanding of the condition of environmental substances existing in the air, water, soil and food products, and their biological effects on organisms and 2) skills for discussing the mechanisms of related adverse reactions.	Identical to O1RC405. Lectures are conducted in English.
O2RA130	Biochemistry and Molecular Biology	1	1.0	1	SprAB	Mon1	4F204	Kenji Irie	This course is designed for the students to learn about 1) the structure, function and metabolism of human biomolecules to understand life phenomena at the molecular level and 2) the structure and function of human cells to understand their molecular function in life phenomena at the cellular level.	Lectures are conducted in English.
O2RA140	Molecular Cell Biology	1	1.0	1	FallAB	Tue3	2Z706	Tomoki Chiba	In this course, the students will learn about the molecular mechanisms underlying the fundamental cellular events and discuss the latest topics in the field.	Lectures are conducted in English.
O2RA160	Basic Toxicology	1	1.0	1	FallAB	Wed4	4E608	Yoshito Kumagai, Masahiro Akiyama, Yumi Abiko	In this course, the students will learn 1) dose-response relations that are fundamental in toxicology and understand the onset mechanism of toxicity caused by chemical substances at the molecular level, and 2) the biological defense system against chemical substances and understand basic toxicology.	Identical to O1ER231. Lectures are conducted in English. Required for students of International Joint Degree Master's Program in Agro-Biomedical Science in Food and Health
O2RA171	Organic Chemistry / Chemical Biology	1	1.0	1	FallA	Mon1, 2		Noriki Kutsumura, invalid, Tsuyoshi Saito, Takayuki Ohyoshi, Yoko Nagumo, Yusaku Miyamae	This course provides the basic organic chemistry required for learning about medicinal chemistry and chemical biology. Mini-exam and report (homework) will promote greater understanding of organic synthetic chemistry. Topics in chemical biology such as target identification and protein labeling will be also discussed.	Identical to O1RC201. Lectures are conducted in English.
O2RA180	Frontier Science in Drug Discovery	1	1.0	1	FallAB	Wed5	4F204	Satoru Takahashi	In this course, the students will be able to grasp the basic concepts of the logical process of drug discovery by using computational simulation technology. They will learn chemosynthesis, by using in silico screening of lead compounds, molecular design, and combinatorial chemistry methods, and current pharmacokinetics studies to deepen their knowledge of linkages between medical and pharmaceutical sciences.	Lectures are conducted in English.
O2RA181	Structural Biology of Macromolecules	1	1.0	2	SprA	Tue1, 2	2Z706	Toshiya Senda	When macromolecules (Proteins, DNA, RNA) perform their functions inside a cell, they require specific structures in order to demonstrate their biological roles. Structural biology is a research field that investigates macromolecular structures in order to understand their mechanisms at the atomic/molecular level. This course is designed to assist students in the understanding of structural biology methods, and their applications in life and medical sciences.	Lectures are conducted in English.

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02RA182	Neurobiology	2	1.0	1	Fall/AB	Mon7		Kaspar Vogt	The aim of the series was to provide students an introduction to basic neurophysiology, a topic students are not generally exposed to in their undergraduate curriculum. All lectures and discussions will be performed in English.	Lectures are conducted in English.
02RA185	Prominent Discoveries in Neuroscience	1	1.0	1, 2	Spr/A	Tue/Thu7		Masashi Yanagisawa, Hiroshi Nagase, Masanori Sakaguchi, Michael Lazarus, Hiromasa Funato, Qinghua Liu, Yoshihiro Urade	The goal of this omnibus course is to learn advanced principles in neuroscience, by reading "landmark" papers of historical significance in the broad area of neurobiology chosen by each instructor.	Code share with HBP Identical to 01EQ052 and 01RC105. Lectures are conducted in English.
02RA205	Application of Information Technology in Science	5	2.0	1	Sum Vac	Intensive	2Z706	Takeshi Nagata	In this course, students will learn 1) application of information technology to biology from over-viewing computational science including numerical analysis, statistical analysis, and image analysis and 2) practical programming by using Matlab (Octave).	Lectures are conducted in English. 8/30, 8/31, 9/7, 9/14, 9/21, 9/28, 10/5, 10/12, 10/19, 10/26
02RA210	Basic Computational Biology	1	2.0	1, 2	Fall/AB	Thu1, 2	3B301	Tetsuya Sakurai, Yuji Inagaki, Mitsuo Shoji, Shoji Makino, Mitsuhiisa Sato	In this lecture, the students will learn 1) basic methods to solve a wide variety of problems by using a program in the field of biology and 2) molecular phylogenetic analysis molecular dynamics method, modelization and algorithm of a phenomenon, high-performance computation (HPC), and component analysis.	2012-2014年度に02RA210の単位を修得したものは履修不可。 Identical to 01CH107. Lectures are conducted in English.
02RA215	Computational Algorithms	4	2.0	1					Lectures are held on the various types of modeling and algorithms that occur in scientific computing, with a particular focus on large-scale linear calculations.	Open in an odd number year. Identical to 01CH103. Lectures are conducted in English.
02RA220	High Performance Computing Technology	1	2.0	1	Fall/AB	Wed2, 3	3Z1001	Taisuke Boku, Daisuke Takahashi	In this course, we lecture the overall technology and scientific value of high performance computing such as very large scale numerical computation on the level of hardware, system software, algorithm and applications. Especially, parallel processing technology and related issues to support today's high-end computing are discussed.	2012-2014年度に02RA220の単位を修得したものは履修不可。 Identical to 01CH406. Lectures are conducted in English.
02RA225	Computational Structural Biology and Drug Discovery	1	1.0	2	Fall/AB	Fri3-5		Takatsugu Hirokawa, Mitsuo Shoji, Yasuteru Shigeta	Biological functions and information are carried by biomolecules in vivo such as proteins and nucleic acids. Therefore, in order to clarify the basic principle of life phenomena, it is indispensable to understand the structure-function relationships (relation between three-dimensional structure and its biological function) of biomolecules in the living body. Although the relation has been clarified by experimental methods so far, detailed analysis by a computer simulation becomes important in recent years since its mechanisms are extremely complicated. The purpose of this lecture is to learn techniques of structure and function analysis and drug discovery using computers and to deepen their understanding by practical training.	Lectures are conducted in English.
02RA230	Reproductive Biology	2	2.0	1					The essential significance of "reproduction" will be considered under the current social conditions in the world. Reproductive technology for the future will be also be discussed as an ethical issue. Students need to have a fundamental grounding in reproductive biology before taking this class.	Lectures are conducted in English. Not open in 2018.

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02RA231	Gene Engineering and Genetically Modified Mice	2	1.0	2	SprABC	Tue5	4B119	Satoru Takahashi	Gene Engineering and Genetically Modified Mice provides the opportunity for the students to study fundamental techniques of gene engineering and principle of making transgenic mice which is application of gene engineering. In addition, the students will debate how to use this lecture for their researches.	Lectures are conducted in English. 遺伝子組換え実験を含む
02RA232	Epigenome Physiology	2	1.0	2	SprC	Mon5, 6	2Z706	Akiyoshi Fukamizu, Koichiro Kako	In this course, the students should be able to grasp the outline of the biological consequences of two genetic codes, genome and epigenome. The students give a presentation on the theme related to these codes and get a better understanding of them by asking and answering questions.	Lectures are conducted in English.
02RA233	Signal Transduction and Drug Design	1	1.0	2	SprAB	Thu2	2Z706	Yuji Funakoshi	This course is designed to assist the students to learn about intracellular reactions controlling cellular function, i.e. signal transduction and diseases caused by failure in signal transduction. They should then be able to acquire the basic knowledge of drug discovery research through learning about developed drugs and strategies for development of new drugs.	Lectures are conducted in English.
02RA234	Stem Cell Therapy	2	1.0	2	SprAB	Thu3	4F204	Osamu Ohneda, Toshiharu Yamashita, Mami Takasaki	Stem Cell Therapy engages the students in basic knowledge and application of human stem cells. The students will learn current existing stem cell therapy and also have discussions on future directions of stem cell therapy.	Lectures are conducted in English.
02RA235	Analysis of Machineries in Human Biology	1	1.0	2	SprBC	Thu4, 5		Taka-aki Sato	The students studying in this course should be able to acquire basic knowledge of biomarker research essential for diagnosis and treatment of diseases such as cancer and cardiac disease and its application by mainly using the cutting-edge mass spectrometry system along with metabolomic and proteomic analysis. The students should also be able to foster better understanding of analytical methods applied to drug discovery in life sciences and the environmental field.	Lectures are conducted in English.
02RA293	Advanced Topics in Biotechnology and Medicine I	1	1.0	1					In order to nurture world-level communication/discussion skills and leadership in scientific community, this course is performed in abroad with the cooperation of universities in foreign countries. The students are expected to work together with the local students and lead the group discussion.	Open in an odd number year. Lectures are conducted in English.
02RA294	Advanced Topics in Biotechnology and Medicine II	1	1.0	1	FallABC	Intensive	2Z706	Kiong Ho, Ryosuke Ohniwa	In order to nurture world-level communication/discussion skills and leadership in scientific community, this course is performed in abroad with the cooperation of universities in foreign countries. The students are expected to work together with the local students and lead the group discussion.	Lectures are conducted in English.
02RA302	Genomics Database Access and Application	2	1.0	1	SprC	Fri5, 6	4B212	Masafumi Muratani	Recent advances in DNA sequencing technologies allowed scientists to obtain large scale data from genome and epigenome analysis. Most of datasets acquired so far are accessible for the research community. However, to appreciate full potential of these resources, it is essential to know how to find and use the data. Researchers are also expected to be aware of ethical concerns when handling clinical genomics data. In this course, students will learn how to access genomics databases and bioinformatics tools through hands-on experiences of typical sequencing data analysis.	Lectures are conducted in English.

Specialized Subjects

Course Number	Course Name	Course Type	Credits	Standard Academic Year	Course Offering Term	Weekday and Period	Classroom	Instructor	Course Overview	Remarks
02RA240	Basic Experiments in Human Biology	3	4.0	1	SprC	by request		Akira Shibuya	Through working in the laboratories run by the faculty members, the students should be able to understand the outline of the members' researches and the principles of the fundamental experimental techniques involved. They will also practice the techniques learnt.	Lectures are conducted in English. 主専攻必修科目。

Course Number	Course Name	Course Type	Credits	Standard Academic Year	Course Offering Term	Weekday and Period	Classroom	Instructor	Course Overview	Remarks
O2RA250	Special Lectures in Human Biology I	1	1.0	1	FallABC	by request		Akira Shibuya	Special Lectures in Human Biology I provides opportunities for the students to attend the research progress meetings of many laboratories which offer candidate areas of study that the students will aspire to focus on. Featuring the latest research presentations, the students will have discussions on the research achievements, learn professional knowledge, and develop their skills to proceed with research activities.	Lectures are conducted in English. 主専攻必修科目。
O2RA260	Special Seminars in Human Biology I	2	1.0	1	FallABC	by request		Akira Shibuya	Special Seminars in Human Biology I provides the opportunity for the students to attend the journal clubs of many laboratories which offers candidate areas of study that the students will aspire to focus on. Featuring the latest original research papers, the students should be able to understand the research objectives, methods, and results, and also have discussions on the meanings, problems, and issues facing the research.	Lectures are conducted in English. 主専攻必修科目。
O2RA271	Special Lectures in Human Biology II	1	1.0	2	SprABC	by request		Akira Shibuya	Special Lectures in Human Biology II provides the opportunity for the students to attend the research progress meetings of the particular laboratories which offers specialized areas of study that the students will aspire to focus on. Featuring the latest research presentations, the students will have discussions on research achievements, learn professional knowledge, and develop their advanced skills to proceed with research activities.	Lectures are conducted in English. 主専攻必修科目。
O2RA272	Special Seminars in Human Biology II	2	1.0	2	SprABC	by request		Akira Shibuya	Special Seminars in Human Biology II engages the students in the journal club of the particular laboratory which offers the specialized area of study that the students will aspire to focus on. Featuring the latest original theses, the students should be able to understand the research objectives, methods, and results, and also have advanced discussions on the meanings, problems, and issues facing the research.	Lectures are conducted in English. 主専攻必修科目。
O2RA273	Special Research in Human Biology II	3	1.0	2	SprABC	by request		Akira Shibuya	In the Special Research in Human Biology II course, the students will gain practical understanding of the principles and methods of advanced research skills in the particular laboratory which offers the specialized area of study that the students will aspire to focus on.	Lectures are conducted in English. 主専攻必修科目。
O2RA280	Special Practice in Human Biology I	2	2.0	1	FallABC	by request		Akira Shibuya	In this course, the students will learn methods to acquire basic knowledge required for selecting a topic for their dissertation through tutorials with their mentoring instructors. The students will also select the subject for their research through discussion, determine approaches for conducting the research, go through application procedures necessary for the research such as animal experiments and genetic recombination, and then plan their dissertation.	Lectures are conducted in English. 主専攻必修科目。
O2RA281	Special Practice in Human Biology II	6	10.0	2	Annual	by request		Akira Shibuya	In this course, the students should be able to acquire 1) methods for evaluation of each result of their research leading to their dissertation writing, 2) skills to develop and modify their research plan and conduct their research based on the plan, and 3) skills to write their dissertation from accumulated research results.	Lectures are conducted in English. 主専攻必修科目。
O2RA296	Laboratory Training in Human Biology I	3	5.0	1	FallABC	by request		Akira Shibuya	In the Special Research Practice in Human Biology I course, the students gain practical understanding of the principles and methods of research skills to consider their application for the student's own research topics.	Lectures are conducted in English. 主専攻必修科目。
O2RA306	Special Practice in Human Biology III	3	10.0	3	Annual	by request		Mitsuyasu Kato	Based on the research topics for the dissertation, students set up the research plan and perform experiments under the supervision of professors. Students need to properly interpret their research results and literatures to progress their research topics, and acquire the skill to publish a paper in peer reviewed journals.	Lectures are conducted in English. 主専攻必修科目。