

Integrative Bioscience Education Program

Subject Code	Subject	Credit	Content of subject	
10PIB001	Introduction to Integrative Bioscience	1	First, the educational program for Integrative Bioscience is introduced. Then, driving forces for rapid development of biology are reviewed from a historical point of view, and the features of contemporary life science are overviewed. Based on these reviews what the Integrative bioscience is and why it is necessary are discussed. Particularly, it is emphasized that a large volume of information on sequences and structures of genome, RNA, proteins, sugars, metabolites etc. and that of spacio-temporal expression of these molecules are integrated to understand their meaning at a cell, tissue, organ or organism level and to unravel the mechanisms of high order biological functions, diseases, environmental responses etc.	Makoto Tominaga
20DFM001	Functional Biomolecular Science	2	1. Basic and applications of solution and solid-state NMR spectroscopy in structural analyses of biomolecules 2. Basic of microscopy, Single-molecule imaging, Optical tweezers, Magnetic tweezers, Super resolution microscopy, High-speed atomic force microscopy 3. Functional mechanisms of biomacromolecules including glycoproteins, membrane proteins, and multidomain proteins, Working mechanisms of motor proteins, Molecular basis of protein assembly	Ryota Iino Koichi Kato Katsuyuki Nishimura
20DSM004	Structural Biomolecular Science	2	The molecular mechanisms of various biological processes will be lectured in this course. Especially, the molecular mechanisms of the following topics will be provided: Structure and function of proteins, DNA replication, transcription and translation of DNA, cellular homeostasis, biological energy conversion such as respiration and photosynthesis, sensory receptors, bioelectronics in a neuron, and some recent research topics.	Shigetoshi Aono Yuji Furutani Nobuyasu Koga
10SLS011	Training Course for Bioinformatics	1	The following objectives are attained through lectures and hands-on tutorials. 1. To understand basic principles in biological sequence analyses and learn the practical skills. 2. To understand the theoretical background of transcriptome and proteome data analysis, and learn the practical skills to analyse these data. 3. To learn current topics and future directions of genomics.	Shuji Shigenobu
10SLS014	Imaging Science	1	We are now enjoying various imaging techniques in the cutting edge of biological and medical sciences. The well known from old is microscopic techniques and nowadays MRI, PET and MEG are popular imaging tools. Imaging science is a novel discipline trying to integrate the old and the new. It consists of three categories, hardware tools to generate primary data, software tools to digitally process the primary data and imaging analysis to quantitatively analyze imaging digital data. In this lecture, 3D imaging and quantitative image analysis are in a particular focus. The former includes the theoretical background of 3D imaging and its practical applications with electron and light microscopy. The latter includes a novel quantitative image analysis based on various numerical algorithms.	Kazuyoshi Murata Shigenori Nonaka
10PIB002	Integrative Bioscience Series	1	To learn biological processes at various levels, covering molecular, cellular and individual processes, with broader perspective in an integrative manner, seven departments (Departments of Structural Molecular Science, Functional Molecular Science, Basic Biology, Physiological Sciences, Genetics, Evolutional Studies of Biosystems, and Statistical Science), which participate in the Integrative Bioscience Education Program, offer a series of 7 lectures in a manner understandable for every student.	Makoto Tominaga
10SPS014	Introduction to Biomolecular Simulation	1	Basic theories and computational methods for molecular simulations for biomolecules will be introduced. For example, basic and various advanced methodologies for molecular simulations as well as fundamentals of analytical mechanics and statistical mechanics will be lectured.	Shinji Saito Hisashi Okumura

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10DESB05	Integrated Evolutionary Biology	2	Biosystems on the earth can be classified into systems with different levels of complexity, from a cell to society. This course is to discuss evolution of such systems from the viewpoints of "elements (members) in each system", "interaction between elements" and "theory to describe this interaction".	Yoko Satta
10SLS002	Molecular and Cellular Biology II	2	Basic features of molecular and cellular biology will be lectured and discussed. These include regulation of transcription and translation, protein structure and function, post-translational modification, structure and dynamics of chromosome, structure and dynamics of cell, organelles and cytoskeleton, metabolism, protein traffic, signal transduction and cell imaging.	Kazuhiro Maeshima Shigenori Nonaka
10PIB003	Bioinformatics	1	Basic principles of statistics and informatics to deal with big data such as genome, transcriptome, proteome, metabolome etc will be described. This subject consists of several lectures (0.5 credits per lecture). Credits will be given when students complete two of the following lectures.	Yoko Satta
10PIB004	Origin of Life	1	How the life originated on earth and evolved will be discussed by the broad perspective of organic chemistry, molecular biology, extremophile biology and astrobiology.	Shinya Miyagishima
10SPS018	Fundamentals of Biomolecular Science	2	Core aspects of biophysical chemistry will be overviewed with the life-science student in mind. This course aims at cultivating the fundamentals necessary to complete the advanced courses of Structural Biomolecular Science and of Functional Biomolecular Science. The lectures will be given with life-science examples using a textbook covering the laws of thermodynamics, biological standard state, chemical equilibrium and its temperature dependence, chemical kinetics, enzyme kinetics, and molecular dynamics.	Shuji Akiyama Ryota Iino Nobuyasu Koga
10PIB005	Mechano-systems Biology	1	Mechanical forces in environments or cells/tissues play important roles in various complex life processes such as embryogenesis, brain/neural network formation and function, circulatory system, cognition and memory. The lectures will discuss how cells sense mechanical signals and respond to them (mechanotransduction) in various biological systems and also the application of the mechanics for human benefit.	Makoto Tominaga
10PIB006	Quantitative Biology	1	The lectures will describe and discuss basic quantitative methodologies to analyze experimental data and construct models to understand the dynamics of living systems—mainly focusing on cell and developmental biology fields.	Akatsuki Kimura
10PIB007	Practical Course for Integrative Bioscience	1	This course inducts the hot research technique for integrative bioscience through the lecture and actual practice.	Makoto Tominaga
20DGE016	Evolutionary Genomics	1	After introduction of basic knowledge on various fields of evolutionary and population genetics, such as adaptive evolution, neutral evolution, speciation, symbiosis evolution, and epigenetics evolution, we discuss what kinds of new questions will be possible to answer by employing emerging genomic technologies.	Jun Kitano Naruya Saitou Hiroshi Akashi Asano Ishikawa Shin-ya Miyagishima Tetsuji Kakutani Ken Kurokawa Tomotaka Matsumoto
20DGE001	Developmental Biology II	1	Various developmental events, such as cell fate determination, cell differentiation, morphogenesis and animal behavior will be analyzed in light of gene expression, cell-cell interaction, intracellular signaling and evolution. Classes will be run by critical reading of the primary literature and discussion.	Yumiko Saga Takuji Iwasato Toshihiko Siroishi Hitoshi Sawa Tatsumi Hirata Yutaka Sato Tsuyoshi Koide Noriyoshi Sakai Ken-ichi Nonomura
20DGE002	Developmental Biology III			
20DGE003	Developmental Biology IV			