Graduate School of Frontier Biosciences
Osaka University

2003 – 2004

Osaka University Graduate School of Frontier Biosciences
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Introduction to Graduate School of Frontier Biosciences

Graduate School of Frontier Biosciences is a new graduate school dedicated to advancing forefront of life sciences. Established in April 2002, the school has assembled, from within and outside Osaka University, top-level researchers and educators who are experts in a wide variety of disciplines, including medicine, biology, physics, and engineering. The creation of the new department is based on our strong belief that humans and animals are not merely a simple aggregate of genetic materials, molecules, and biological structures. It is rather an ever-changing complex dynamical system, whose understanding necessitates a true interdisciplinary systems approach. Graduate School (and Department) of Frontier Biosciences consists of 6 main groups of laboratories, and affiliated laboratories. The graduate program in Frontier Biosciences offers a unique 5-year intensive training culminating in a doctoral degree upon successful completion of the program. Our goal is to nurture students and scientists in our active research environment so that they become fully equipped for taking biosciences to the next height.

Unique and Flexible Interdisciplinary Education

Unlike most graduate schools in Japan that offer separate masters and doctorate programs, we offer a 5-year intensive Ph.D. program to foster top-level professionals in biosciences and related fields. Completion of the program does not necessarily require 5 years. If desired, exceptional students can complete the program on an accelerated schedule. Teaching staff has background in a wide variety of disciplines, including medicine, biology, physics, and engineering. Equally diverse are our students who also come with undergraduate (and sometimes graduate) background in many different fields. To ensure multidisciplinary training and research activities, we have lowered barriers among laboratories by organizing all groups under a single department, the Department of Frontier Biosciences. Furthermore, each student chooses multiple advisors from different disciplines to provide a broad training in diverse research areas. We are also emphasizing collaboration with the industry in research and education. In order to facilitate involvement of researchers from industry in our program, we are actively developing various industrial liaison programs, and have successfully solicited endowed chairs.
### Nanobiology Laboratories

- Soft Biosystem Group (Prof. Toshio Yanagida)
- Protonic NanoMachine Group (Prof. Keiichi Namba)
- Sensory Transduction Group (Prof. Satoru Kawamura)

### Biomolecular Networks Laboratories

- Research Laboratory of Lipid Biosignals (Prof. Mitsuhiro Okamoto)
- Biomolecular Dynamics Group (Prof. Yoshihiro Yoneda)
- Developmental Biology Group (Prof. Hisato Kondoh)
- Chromosome Replication Group (Prof. Akio Sugino)

### Integrated Biology Laboratories

- Laboratory of Genetics (Prof. Shigekazu Nagata)
- Pathology Division (Prof. Yukihiko Kitamura)
- KOKORO-Biology Group (Prof. Takeshi Yagi)
- Cellular Biology Group (Prof. Fumio Hanaoka)

### Organismal Biosystems Laboratories

- Laboratory of Developmental Immunology (Prof. Toshio Hirano)
- Developmental Genetics Group (Prof. Hiroshi Hamada)
- Human Cell Biology Group (Prof. Kiyoji Tanaka)
- Medicine and Pathophysiology Group (Prof. Iichiro Shimomura)
Neuroscience Laboratories

- Visual Neuroscience Group (Prof. Izumi Ohzawa)
- Developmental and Functional Neuroscience Group (Prof. Fujio Murakami)
- Cognitive Neuroscience Group (Prof. Ichiro Fujita)
- Cellular and Molecular Neurobiology Group (Prof. Nobuhiko Yamamoto)
- Laboratory of Synaptic Plasticity (Prof. Akihiko Ogura)

Biophysical Dynamics Laboratories

- Physiological Laboratory (Prof. Takashi Kurahashi)
- Nonequilibrium Physics Group (Prof. Shuichi Kinoshita)
- Functional Proteomics Group (Prof. Shigemi Norioka)
- Nano-Biophotonics Group (Prof. Osamu Nakamura)

Affiliates

Biomedical Engineering Laboratories

- Sato Laboratory (Prof. Hiromichi Sato)
- Department of Molecular Genetics (Prof. Hiroshi Nojima)
- Laboratory of Intercellular Communications (Prof. Eisuke Mekada)
- Laboratory of Stem Cell Research (Prof. Toru Nakano)
- Laboratory of Protein Informatics (Prof. Haruki Nakamura)
- Laboratory of Biocatalysis Science (Prof. Katsuyuki Tanizawa)
Non-Resident Fellows

**Graduate School of Human Sciences**

- Prof. Takashi Yamamoto  
  Behavioral Sciences

**Graduate School of Science**

- Prof. Yasuhiro Akutsu  
  Department of Physics
- Prof. Seiki Kuramitsu  
  Laboratory of Structural and Functional Analyses on Biomolecules
- Prof. Haruhiko Takisawa  
  Nuclear Function Research Group, Department of Biology
- Prof. Hisao Masukata  
  Laboratory of Molecular Genetics, Department of Biology

**Graduate School of Medicine**

- Prof. Yasuo Uchiyama  
  Department of Cell Biology and Neuroscience
- Prof. Yoshihisa Kurachi  
  Department of Pharmacology II
- Prof. Yoshimi Takai  
  Department of Molecular Biology and Biochemistry
- Prof. Hideki Yoshikawa  
  Department of Orthopaedic Surgery
- Prof. Yasuo Tano  
  Department of Ophthalmology

**Graduate School of Dentistry**

- Prof. Toshiyuki Yoneda  
  Division of Oral Biology and Disease Control

**Graduate School of Pharmaceutical Sciences**

- Prof. Takefumi Doi  
  Protein Molecular Engineering

**Graduate School of Information Science and Technology**

- Assoc. Prof. Tetsuya Yomo  
  Department of Bioinformatic Engineering

**Graduate School of Engineering**

- Prof. Hiroshi Masuhara  
  Department of Applied Physics
- Prof. Tetsuya Yagi  
  Department of Electronic Engineering
- Assoc. Prof. Wen-Jie Song  
  Department of Electronic Engineering
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<td>Prof. Kunihiro Kaneko</td>
<td>Dept. Pure and Applied Sciences, College of Art and Sciences, University of Tokyo</td>
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<td>Prof. Fadel Alexis Samatey (Visiting Research Scholar)</td>
<td>Protonic Nanomachine Project</td>
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Bio-molecules assemble into bio-molecular systems in which they interact dynamically and perform function such as energy transduction, cell signal processing and gene expression, subsistence, adaptability on and replication. These bio-molecular systems are characterized by high self- and extremely high efficiency, which are not attained by man-made machinery. Major focus of our lab is to approach the essential engineering principles of the adaptive bio-machine by uncovering the unique operation of bio-molecular systems along with the development of new techniques such as single molecule imaging and nano-manipulation.

Cellular activities such as motility and protein export are supported by intricate mechanisms of self-assembly, switching, force generation, and energy transduction by large-scale macromolecular assemblies. We develop and use methods of x-ray diffraction, electron cryomicroscopy and image analysis, and single-molecule nanophotometry and physiology to reveal the structures and dynamics of these molecular assemblies to unravel these mechanisms, which hopefully leads to future nanomachine designs and nanotechnology applications.

Our visual system consists of two types of photoreceptor cells, rods and cones. Rods are highly sensitive to light and mediate twilight vision. Cones are less sensitive than rods, and mediate daylight vision. In our first project, we are interested in why the light-sensitivity is so different between rods and cones. The photoreceptors are highly polarized: the machinery responsible for detection of light is localized at a distinct part of the cell. In the second project, we want to know the vesicular transport mechanism that directs the necessary proteins to appropriate sites of a photoreceptor.
Living cells specifically adapt to the stimuli coming from outer space by changing their metabolic pathways. Recent molecular biological investigations have identified various lipid mediators that are deeply involved in this stimulus-response coupling. Several compounds derived from isoprene, such as steroid hormones, vitamin D and retinoic acids, those derived from phospholipids, such as prostaglandins, leukotrienes, inositol phosphates and lysophosphatidic acid, are the examples. In our laboratory, by using biochemical, molecular biological and cytobiological approaches, we are investigating the mechanisms underlying the biosynthesis of these lipid biosignal compounds, the mechanisms underlying the biosignal-mediated stimulus-response coupling, and the pathobiology caused by biosignal-related metabolic disturbances.

In eukaryotic cells, cell functions are maintained in an orderly manner through the continuous nucleocytoplasmic traffic of a variety of macromolecules such as proteins and RNAs via the nuclear pore complexes that penetrate a double membrane, the nuclear envelope. We focus on the biological significance of the nucleocytoplasmic signaling, which is the fundamental function for life. We are now investigating the molecular mechanism of nucleocytoplasmic transport of proteins, nuclear export of mRNA, and intracellular localization of mRNA and intracellular signaling between the synapse and the nucleus in neurons. In addition, we are trying the molecular imaging of intracellular signaling, especially in neurons.

This group investigates regulation of the embryonic development, how intercellular signaling molecules act, how cells respond to the signals and activate transcriptional regulators, and how the action of transcriptional regulators elicits cell differentiation. The research is currently focusing on the embryonic development of the central nervous system and sensory organs.

In this group, one of the most fundamental and important processes of life, chromosomal DNA replication, is studied using various eukaryotic cells, such as Saccharomyces cerevisiae, Xenopus, mouse, and human cells. Furthermore, this group is investigating the mechanism of S-phase checkpoint regulation in these eukaryotic cells.
Integrated Biology Laboratories

› Laboratory of Genetics  Prof. Shigekazu Nagata  

Homeostasis in animals is controlled by growth, differentiation and death of cells. This process is often regulated by cytokines. Using techniques of biochemistry and molecular biology, we study the molecular mechanism of the signal transduction induced by cytokines. In addition, using genetics, we study physiological roles of the cytokines and their signal transducers.

› Pathology Division  Prof. Yukihiko Kitamura  

Mast cells play an important role in the immediate hypersensitivity reaction. Without mast cells, allergic rhinitis, atopic dermatitis and infantile asthma do not occur. We are studying regulation of mast cell development. Especially, the regulation by a transcription factor, MITF, is investigated.

› KOKORO-Biology Group  Prof. Takeshi Yagi  
http://www.fbs.osaka-u.ac.jp/en/seminar/06a.html

Our investigations are aimed toward understanding the biological mechanisms underlying the generation of brain function. The generation of brain function occurs through innate programming initially as well as by acquisition via environmental stimuli during brain development. Studies in our laboratory focus on the identification of molecular groups that regulate brain development, brain evolution, and mental disorders. We hope to employ these molecules in order to understand the biological mechanisms involved in neural circuit generation and reorganization, as well as the relationship between neural circuits and brain function. In particular, brain function analysis at the individual level is performed in our laboratory using gene-converted mice and rats.

› Cellular Biology Group  Prof. Fumio Hanaoka  

In order to carry out normal life, biological organisms must protect the integrity of the genetic information contained within their DNA. It is also important for them to transcribe DNA at appropriate timing as well as at appropriate place. Our laboratory is working on DNA replication, repair and transcription in eukaryotic cells, mainly in mammalian cells, both at DNA and protein levels. Among these, the most exciting finding in recent years is the discovery of a novel DNA polymerase that is capable of bypassing ultraviolet-induced damage, which protects our body from cancer. These studies are important to understand basic mechanisms of carcinogenesis, aging, reproduction, and differentiation.
The purposes of our laboratory are 1) elucidation of the roles of cytokines in immune response, autoimmune diseases and allergic response, 2) clarification of the signaling mechanisms of cytokine actions and regulation of immune response, and 3) understanding the molecular mechanisms underlying the cell fate specification and movements in immune system and developmental process, in particular gastrulation.

This group studies mechanisms of cell differentiation and morphogenesis that take place during mammalian development, by employing genetic and biochemical approaches. In particular, we are interested in 1) asymmetry in embryonic patterning, 2) maintenance of toti(pluri)potency, and 3) regulation of neurogenesis by secreted factors.

Human Cell Biology Group is analyzing a molecular mechanism of DNA repair network in mammals and a molecular pathogenesis of human genetic diseases with defect in DNA repair. Particularly, this group is interested in transcription-coupled repair which is an important DNA repair pathway efficiently removing a variety of lesions from the transcribed strand of active genes. By allowing rapid resumption of RNA synthesis, the process is of major importance for cellular resistance to transcription-blocking genotoxic damage and therefore for preventing human being from aging and several diseases.

The life style in developed countries, including hyperphasia and less exercise, leads to the incidences of obesity, diabetes, hyperlipidemia, hypertension, atherosclerosis, and colon cancer. The sites where these diseases occur are adipose, muscle, liver, artery, and indigestive organs. Our group is revealing that the above organs form a close network through the secretions of tissue-specific endocrine factors, and that various ligands activate the tissue-specific nuclear receptors. Through these analyses, our mission is always to try to develop the new strategy to combat the life-style related diseases.
Neurosciences Laboratories

› Visual Neuroscience Group  
Prof. Izumi Ohzawa  

The long-term objective of our research is to determine how the visual part of the cerebral cortex analyzes information that enters through the two eyes. By using advanced visual stimuli, neural mechanisms located within and beyond the primary visual cortex are analyzed. We are also conducting research on oculomotor control mechanisms and learning.

› Developmental and Functional Neuroscience Group  
Prof. Fujio Murakami  

The function of the brain relies upon information processing by neuronal circuits of the brain. Individual neurons are connected by axons that form synaptic connections with appropriate postsynaptic cells. It is crucially important for developing neurons to settle in a correct position and find correct pathways of growth and target cells. Our laboratory seeks molecular and cellular mechanisms of brain development focusing on neuronal migration and axon pathfinding.

› Cognitive Neuroscience Group  
Prof. Ichiro Fujita  

We aim at elucidating the neuronal mechanism of visual perception. We have focused our attention on a particular visual pathway in the primate cerebral cortex, the "ventral visual pathway", which is responsible for object recognition. As the name indicates, this pathway projects ventrally from the primary visual cortex to the inferior temporal cortex via several relays. We are interested in how the visual information from objects is processed along this pathway and what anatomical substrates underlie this processing.

› Cellular and Molecular Neurobiology Group  
Prof. Nobuhiko Yamamoto  

We are interested in how neuronal connections are formed during development. It has been suggested that fundamental patterns of neuronal circuits are established by a precise developmental program whereas fine connections are modified by electrical activity including spontaneous firing. We are exploring cellular and molecular mechanisms that underlie these processes, focusing on neocortical connections.

› Laboratory of Synaptic Plasticity  
Prof. Akihiko Ogura  

Synaptic plasticity, the cellular correlate of brain memory, consists of two phases; the short-lasting plasticity (SLP) due to the change of transmission efficiency in existing synapses and the long-lasting plasticity (LLP) due to the formation of new synapses. We are studying LLP, which is still full of mystery, beginning from the establishment of a model system for analysis. We found in cultured brain slices that the repetition of SLP-inducing stimuli with adequate intervals converted SLP to LLP. Mechanism for this conversion is now under pursuit.
Organisms respond to various stimuli from environment and the response ceases with adaptation to new environmental condition. Such process consisted of stimulus reception, response and adaptation occurs on the individual cells. Our group is using sensory receptor cells, culture cells of tissue, unicellular organism *Paramecium* and plant cells, and studying molecular dynamics of the cellular components that are included in the process of reception, response and adaptation.

We study the mechanisms of order formation processes under nonequilibrium conditions by means of linear and nonlinear laser spectroscopy. Particularly we investigate the physical mechanisms of pulse formation process in a femtosecond mode-locked laser, pattern formation in Belousov-Zhabotinskii reaction, order formation process in ferroelastic domain and cholesteric phase of liquid crystal, and so on. We try to answer a general question how these macroscopic orders come out from microscopic degrees of freedom. We also clarify the mechanism of structural color, which is produced through the self-organization process in nature.

On the bases of protein chemistry and proteomics, our group aims to elucidate a highly complicated bio-system by investigating the interactions among proteins, nucleic acids, and polysaccharides. Our major target is the self and non-self recognition system at fertilization in higher plants. We are investigating how pistils can recognize and reject self-pollen at fertilization from the view of protein-protein interactions. We are also developing a new methodology to analyze proteome dynamism in cells or tissues.

We carry out research on Nano-biophotonics, a new research field which includes Nanotechnology, Biology and Photonics. Ultra high spatial-resolution and sensitivity for sensing biomolecules and DNA can be achieved by the use of nanotechnology such as scanning probe techniques and non-linear photonics using ultra short pulsed lasers. We are evolving these techniques to create new biological applications, particularly, real-time measurement of the chemical reactions occurring in living cells and tissue.
Biomedical Engineering Laboratories (Affiliates)

› Systems Neuroscience Group

**Prof. Hiromichi Sato**
(School of Health and Sport Sciences)
http://www.vision.hss.osaka-u.ac.jp/

Neural circuitry of the mammalian brain is anatomically and functionally optimized to gain a high performance of information processing which has to be utilized to control behavior. It is the biological achievement of effectiveness and acceleration of information processing. To clarify the brain strategies, we study the stimulus-specificity and integration properties of the visual cortex with electrophysiological and psychophysical experiments.

› Department of Molecular Genetics

**Prof. Hiroshi Nojima**
(Res. Inst. Micro. Dis.)

Study on cell cycle regulation (mitosis and meiosis), particularly on checkpoint controls such as DNA damage checkpoint, spindle (centrosome) assembly checkpoint and recombination checkpoint. As an application of these basic researches, we study on chromosome instability of cancer cells that is caused by abnormal checkpoint regulation. We also aim to construct a novel diagnostic system using blood cells from angitis patients as an example of the potential industrial applicability of the newly developed technique denoted as “stepwise subtraction”.

› Laboratory of Intercellular Communications

**Prof. Eisuke Mekada**
(Res. Inst. Micro. Dis.)

We are studying the regulation mechanism of cell growth and differentiation through the growth factors and adhesion molecules which are existing at cell-cell contact sites. Particularly, we are focusing on the mode of action of HB-EGF, a member of the membrane-anchored growth factors and its association molecule CD9.

› Laboratory of Stem Cell Research

**Prof. Toru Nakano**
(Res. Inst. Micro. Dis.)

Multicellular organisms consist of various stem cell systems. The final goal of our group is to answer how immaturity of the stem cells maintains and how differentiation progresses from the immature cells. For the purposes, we are analyzing two typical stem cell systems, hematopoietic and germ systems. Currently, our major themes are pluripotency and reprogramming of stem cells, and regulation of cell differentiation by transcriptional manipulation. And we hope to apply our achievement to regenerative medicine.

› Laboratory of Protein Informatics

**Prof. Haruki Nakamura**
(Inst. Protein Res.)
http://www.protein.osaka-u.ac.jp/rcsfp/pi/

The Laboratory of Protein Informatics consist of (1) development and maintenance of international protein structural databases (PDB) and structural bioinformatics covering molecular modeling and design, (2) Development of a new database, eF-site, for protein surface geometry with the physicochemical properties, and identification of protein functions using the database, and (3) Development of new algorithms and softwares for large scale simulation calculations by parallel computers to examine free energy landscapes of biomolecular systems.

› Laboratory of Biocatalysis Science

**Prof. Katsuyuki Tanizawa**

(1) Biogenesis and catalytic role of the topa quinone cofactor in copper amine oxidase
Non-Resident Professors

**Graduate School of Human Sciences**

- **Prof. Takashi Yamamoto**  
  Behavior Sciences  
  [http://kosei4.hus.osaka-u.ac.jp/](http://kosei4.hus.osaka-u.ac.jp/)  
  To understand central neural processing of taste we record brain activity of rats and humans during ingestion of food and fluid. We integrate several neuroscientific approaches to address three highly related issues; cognitive mechanisms of taste quality and intensity, emotional aspects of taste palatability and disgust, and mechanisms of learning responsible for taste preference and aversion.

**Graduate School of Science**

- **Prof. Yasuhiro Akutsu**  
  Department of Physics  
  Research field: statistical physics and computational science

- **Prof. Seiki Kuramitsu**  
  Laboratory of Structural and Functional Analyses on Biomolecules  
  1. A Whole Cell Project of Extreme Thermophile, Thermus thermophilus HB8  
  - Systematic Analyses of Fundamental Biological Phenomena -  
  2. DNA Repair Systems of Extreme Thermophile  
  3. Protein Engineering

- **Prof. Haruhiko Takisawa**  
  Nuclear Function Research Group, Department of Biology  
  This research group is studying the following aspects of the nuclear functions using cell free system derived from Xenopus eggs. 1) Molecular architectures of supramolecular machinery involved in chromosome duplication and segregation. 2) Molecular machinery involved in monitoring the progression of cell cycle. 3) Dynamics of nuclear structures.

- **Prof. Hisao Masukata**  
  Laboratory of Molecular Genetics, Department of Biology  
  Our research is focused on the mechanisms how genetic information is maintained during cell proliferation. On-going projects are molecular mechanism of initiation of chromosome DNA replication, coupling of DNA replication and recombination in replication fork arrest, and molecular mechanism on homologous recombination in meiosis.

**Graduate School of Medicine**

- **Prof. Yasuo Uchiyama**  
  Department of Cell Biology and Neuroscience  
  The lysosomal system is important for the maintenance of cellular metabolism. Physiological events concerning lysosomal proteinases, intracellular transport, and autophagy are cell biologically studied. In particular, cell death induced by lysosomal disturbance is our main project in relation to neurodegenerative disorders.
Graduate School of Medicine

Prof. Yoshihisa Kurachi  Department of Pharmacology II
http://www.med.osaka-u.ac.jp/pub/pharma2/www/
Ion-channels are components essential for cellular function. We are conducting the research on ion-channels with an emphasis on K⁺ (potassium) channels. We investigate molecular mechanisms responsible for regulation of their function and subcellular localization by intracellular signal-transduction pathway and metabolism. We also have an interest in molecular pharmacology of the drugs that can activate or inhibit the ion-channels.

Prof. Yoshimi Takai  Department of Molecular Biology and Biochemistry
http://www.med.osaka-u.ac.jp/pub/molbio/index-jp.htm
Our group studies basic scientific questions how cell-cell adhesion, cell polarity, cell proliferation, cell movement, and formation and remodeling of synapses are established and regulated in mammalian cells. To approach these questions, we investigate a cell-cell adhesion system, the nectin and afadin system, and small G proteins using biochemical, cell biological, and molecular biological techniques.

Prof. Hideki Yoshikawa  Department of Orthopaedic Surgery
Research projects: development of new prosthesis, computer-assisted surgery (robotic surgery, navigation surgery), molecular biology of bone and cartilage, tissue engineering of bone, gene/genome analysis for bone/soft tissue tumors, nerve regeneration, cartilage regeneration, molecular analysis of bone metastasis

Prof. Yasuo Tano  Department of Ophthalmology

Graduate School of Dentistry

Prof. Toshiyuki Yoneda  Division of Oral Biology and Disease Control
http://www.dent.osaka-u.ac.jp/~biochm/
We are currently performing the following research projects: (1) Mechanism and treatment of osteoporosis (2) Molecular mechanism of cancer metastasis to skeleton (3) Role of phosphate metabolism in bone and cartilage metabolism (4) Mechanism of cancer-associated pain
We are also going to begin to study the following projects: (1) Regeneration of periodontal tissues and teeth (2) Molecular mechanism of taste

Graduate School of Pharmaceutical Sciences

Prof. Takefumi Doi  Protein Molecular Engineering
http://tanpaku05.phs.osaka-u.ac.jp/index.html
In our laboratory, we choose a protein as a target if it is associated in some way with a disease. We study the structure-function relationship of the target proteins and also their associated proteins. From all this information we strive to design new molecules to affect the function of the original target protein, or an associated protein, in order to develop molecular treatments for the associated disease state. At present, we are concentrating on research for the following proteins: macrophage scavenger receptors important for host defense and atherosclerosis; transcription factors related to megakaryocyte differentiation and maturation; HCV derived proteins; and nuclear receptors related to colon cancer and atherosclerosis.
Graduate School of Information Science and Technology

› Assoc. Prof. Tetsuya Yomo  Department of Bioinformatic Engineering  
http://www.bio.eng.osaka-u.ac.jp/ez/index.html
The Symbiotic Engineering Laboratory deals with experimental evolutions. What we are trying to evolve are artificial protein, artificial cell, and artificial symbiosis. The studies aim to understand the basic rules governing the biological complex systems, the nature of which highly depends on their evolutionary paths.

Graduate School of Engineering

› Prof. Hiroshi Masuhara  Department of Applied Physics  
http://dolphin.ap.eng.osaka-u.ac.jp/
We are promoting advanced research on photophysical and photochemical phenomena characteristic of interactions between intense laser beam and organic materials and their analysis by using time-resolved spectroscopy and imaging methods. Also development and application of laser nano-manipulation and nano-fabrication techniques are extended in view of molecular science and engineering.

› Prof. Tetsuya Yagi  Department of Electronic Engineering  
http://cobalt.ele.eng.osaka-u.ac.jp/e6/

› Assoc. Prof. Wen-Jie Song  Department of Electronic Engineering  
http://cobalt.ele.eng.osaka-u.ac.jp/e6/

Graduate School of Engineering Science

› Prof. Tadashi Itoh  Division of Material Physics, Department of Physical Science  
http://laser.mp.es.osaka-u.ac.jp/index_e.htm
Organic and inorganic nanoparticles and their self-organized complexes show close similarity in their structural and electronic properties to some kinds of biomaterials, such as light harvesting complexes. We study optical properties and functions of bio-inspired materials by means of laser spectroscopy.

› Prof. Katsuzo Wakabayashi  Department of Systems and Human Science  
http://www6.bpe.es.osaka-u.ac.jp/strbp/
To understand the functioning mechanism of the biological supramolecular systems, their dynamic structural changes are investigated at a submolecular level by using X-ray diffraction/scattering techniques. Main subjects are the molecular mechanism of the motor protein system, photoreceptor membrane system, chromatin condensation and the reaction dynamics of enzyme proteins.

› Prof. Shunsuke Sato  Department of Systems and Human Science  
http://www3.bpe.es.osaka-u.ac.jp/
Biological functions emerged from the level of neuron/heart cells to that of locomotion are studied experimentally and theoretically. Main methodologies used are nonlinear dynamical system theory and theory of signal processing including time-frequency analysis.

› Prof. Kozaburo Hayashi  Department of Systems and Human Science  
http://www-biomech.me.es.osaka-u.ac.jp/hayashiken-eng.html
Biomechanical analyses of biological tissues and cells and their applications to medicine and engineering, which include: 1) Biomechanical properties of such biological materials as cells and collagen fibers, 2) Biomechanical response of biological tissues and cells to stress, and their functional adaptation and remodeling, and 3) Tissue engineering and reconstruction of biological tissues.

› Prof. Masahito Taya  Department of Chemical Science and Engineering  
http://www.cheng.es.osaka-u.ac.jp/tayalabo/
Our general philosophy is to contribute to the quality of life (QOL) through knowledge of bioscience and bioengineering. The following research projects are actively ongoing. (1) Clarification and application of biological phenomena under unique conditions. (2) Design of biocidal materials and inactivation kinetics

**School of Health and Sport Sciences**

Prof. Yoshinobu Ohira  
School of Health and Sport Sciences  
http://www.hss.osaka-u.ac.jp/kenkyu/shintai_bunka/index.html

We have been performing a series of studies to investigate the mechanism responsible for the neuromuscular plasticity in human and animals. The effects of gravitational loading or unloading by using spaceflight and parabolic flight of jet airplane or various simulation models have been studied recently.

**Research Institute for Microbial Diseases**

Prof. Michiyuki Matsuda  
Department of Tumor Virology  
http://www-tv.biken.osaka-u.ac.jp

We are developing probes to visualize the signal transduction cascade of growth simulation in a living cell. Using these probes, we are analyzing the spatio-temporal regulation of various signaling cascades including those of oncogenesis and differentiation.

Prof. Hideo Shinagawa  
Department of Molecular Microbiology  
http://www.bio.sci.osaka-u.ac.jp/grad-sc/shinagawa.htm

We are studying the cellular responses to DNA damage and mechanisms of maintaining genomic stability with emphasis on 3R (Replication, Recombination & Repair) in *E. coli*, yeasts and mammals using tools of genetics, biochemistry and structural biology.

**Institute of Scientific and Industrial Research**

Prof. Tomoji Kawai  
Division of Advanced Materials Science and Technology  
http://www.sanken.osaka-u.ac.jp/labs/kawai-lab/

High resolution probe technology is used for the investigation of the mechanism on the molecular level evolution of living organism starting from DNA. Development toward brain type bioelectronic devices and systems are also the research subject in our group.

**Institute for Protein Research**

Prof. Toshifumi Takao  
Laboratory of Protein Profiling and Functional Proteomics  
http://www.protein.osaka-u.ac.jp/rcsf/profile/index/files/slide0001.htm

We have developed several chemical/analytical methods or equipments and software aid for analysis of protein primary structures by mass spectrometry, and applied those to unknown proteins and post-translational modifications.

Assoc. Prof. Takahisa Ikegami  
Laboratory of Structural Proteomics  
http://www.protein.osaka-u.ac.jp/rcsf/structure/nmr/

We are mainly determining the three-dimensional structures of proteins using nuclear magnetic resonance spectroscopy (NMR). In addition, we are analyzing dynamic structures including information on which parts of proteins are flexible, and developing NMR methodologies to facilitate the above mentioned studies.

**Cybermedia Center**

Prof. Macoto Kikuchi  
Large-Scale Computational Science Division

Assoc. Prof. Keiichiro Tokita  
Large-Scale Computational Science Division  
http://wwwcompy.phys.sci.osaka-u.ac.jp/~kikuchi/

On the basis of statistical mechanics and non-linear dynamics, we approach interdisciplinary subject between physics and biology, by means mainly of computer simulations. Current topics of researches are (1) Folding and design of proteins (2) Mechanism of molecular motors (3) Dynamics and stability of large-scale ecosystems.
Visiting Professors

Prof. Mitsuo Kawato  Human Information Science Laboratories
Advanced Telecommunications Research Institute International
Assoc. Prof. Hiroshi Imamizu  Human Information Science Laboratories
Advanced Telecommunications Research Institute International
http://www.his.atr.co.jp/~kawato/

The most distinguishable difference between human intelligence and that of other animals is that humans have the ability to communicate very efficiently even non-verbally. We are studying ways to elucidate the mysterious neural mechanisms behind this through a computational neuroscience approach, we are deeply involved in the scientific characterization of brain mechanisms for human communication. Special emphasis is placed on the theoretical concepts built by research on multi-modular sensory and motor skill acquisition such as internal models, MOSAIC [Module Selection And Identification Control] and reinforcement learning.

Prof. Kunihiko Kaneko  Dept. Pure and Applied Sciences, College of Art and Sciences, University of Tokyo
http://chaos.c.u-tokyo.ac.jp/index_j.html

Universal features of a complex biological system are studied, with the aids of dynamical-systems theory, numerical experiments, and constructive (experimental) biology. Although our study is mainly theoretical, we have a tight collaboration with Tetsuya Yomo's group, as well as Toshio Yanagida's group. Based on a theory for collective dynamics of interacting elements with internal degrees of freedom, we pursue theoretical studies to unveil the logic of life system, such as molecular energy conversion, replication of a cell, origin of heredity, cell differentiation and development, cellular memory, and relevance of phenotypic plasticity to evolution.

Prof. Fadel Alexis Samatey  (Visiting Research Scholar)
Protonic Nanomachine Project, ERATO
http://www.npn.jst.go.jp/member/alexis/alexis.htm

Bacteria such as Salmonella swim by rotating helical propellers, called flagella, driven by a motor embedded in the membrane. The bacterial flagellum is a complex machinery made by the self-assembly of many type of proteins. During the construction of the flagellum a large number of proteins are exported. My main interest is the understanding of the export apparatus and the mechanism of the motor at the molecular level.

Assoc. Prof. Toshiyuki Nakagaki  Laboratory of Cellular Informatics,
Research Institute for Electronic Science, Hokkaido University
http://www.es.hokudai.ac.jp/labo/cell/

The cell behavior in a maze and other complicated situations is output from information processing of environmental inputs. Using the protozoan organism of true slime mold, we study mechanism of cellular information processing by means of physiological experiment and mathematical modeling.