Outline of Educational Units

Basic Medicine

- Biochemistry
- Molecular Genetics
- Anatomy
- Physiology
- Infectious Diseases
- Microbiology
- Parasitology
- Immunology
- Pharmacology
- Pathology
- Legal Medicine
- Preventive Medicine and Public Health
The division is responsible for lectures on various aspects of biochemistry, including metabolic pathways, enzymology, protein chemistry and metabolic regulation as well as nutrition, vitamins and hormones. All of our students conduct experiments on: 1) fractionation of mouse liver cell homogenates into nucleus, mitochondria, microsomes and supernatant, 2) purification of liver lactate dehydrogenase, 3) extraction of glycogen from starved and well-fed rat liver, 4) extraction and characterization of lipids from brain and serum with thin layer chromatography and gas-chromatography, 5) purification of DNA from calf thymus, 6) purification of human blood Ig-A1, 7) molecular weight determination of proteins by SDS-PAGE and measurement of protein quantity, 8) measurement of glucose quantity by enzymological method, 9) measurement of oxygen consumption by mitochondria, and 10) measurement of oxidized and reduced hemoglobin by spectrophotometry. Students in groups of ten work on each experiment at a time.

Research activity of the division consisted of works done by three major teams during the period of 1971 to 2000. A team lead by Prof. S. Horie was one of the major players in the classical mitochondriology in Japan. They produced numerous reports on cytochrome oxidases and P450 of adrenal mitochrondria. Prof. K. Hotta and her colleagues established the role of gastric mucus in preventing the digestive components of stomach from eating itself. The team had strength in the biochemical analysis of glyco or sugar containing proteins. Prof. Y. Tamai and his colleagues analyzed glycolipids in the brains of various animal species. Many medical students participated in these researches.

Molecular Genetics, Department of Molecular Medicine

Previously called Molecular Biology, the division is responsible for lectures on molecular biology of genes. In laboratory experiments, all students in their 2nd year experience the restriction analysis of DNA, PCR amplification of DNA, the identification of DNA by southern hybridization and joining of DNA by ligase reaction. Students wishing to advance further have an opportunity to clone a gene of their interest and conduct analyses by DNA sequencing.

Molecular Biology Department of KUSM was started in 1971, at the advent of gene technology, indicating the foresight of the founders of the school. The major work of this division headed by Prof. M. Kawakami was the discovery in 1980 of the lectin pathway of complement activation, triggered by Ra-reactive factor reacting to Ra lipopolysaccharide structure of bacterial surface. This discovery is now widely recognized in textbooks and review articles on innate immunity.

Since 1995, the division has been headed by Prof. Y. Takagaki, who was a member of S. Tonegawa’s group at the Massachusetts Institute of Technology, which discovered the T cell receptor α-chain and γ-chain genes in 1984 and γδ T cells in 1987.
At the entrance of learning medicine, we believe careful structural observation at the macroscopic level, as well as at the microscopic level, will foster students strong bases to understand human body and its function. We provide the 2nd-year students 40 didactic anatomy lectures, 53 afternoons of gross anatomy practicum using human cadavers, 29 didactic histology lectures, and 21 afternoons of practical histology, using microscopes and ready-made electron microscope pictures. We provide one of the most extensive and intensive programs in macro- and microanatomies among Japanese medical schools. When combined with the lectures in cell biology and developmental biology, our group is at the top in terms of the hours spent teaching students.

We have been very lucky in obtaining sufficient number of volunteer body donors. With 40 to 50 human cadavers every year, the students come across ample examples of individual differences and abnormality in body structure. At social events, students have opportunities to meet with the members of Kitasato University White Chrysanthemum Society, which is a group of volunteers donating bodies for the cause for advancement of medicine. We hope these opportunities foster the students a feeling of awe and respect for human life and also of gratitude to their fortunate circumstances.

Although the teaching load is high, the Department of Anatomy, with two independent units, has been very active in research. Prof. Y. Kameda has published numerous reports on the mammalian thyroid C cells and ultimobranchial body, which are C cell homologues in fish, amphiban, reptiles and birds. With a variety of monoclonal antibodies developed by the group, she and her associates are accumulating immuno-electron-microscopic observations as well as molecular biological data.

A group lead by Prof. S. Yamashina has been active in the morphological study of the structural construction and functional development of exocrine glands. In the extra-cellular matrices as well as in the intra-cellular events, especially of the association of secretion and Golgi body, the group has developed many painstaking technical methods using transmission electron microscopes, and scanning electron microscopes and confocal laser microscopes to investigate the fine structures. In 1994, Prof. Yamashina was awarded a Seton Prize from the Japanese Society of Electron Microscope.

The department has five electron microscopes of various types in the Electron Microscope Laboratory Center.
Physiology

Number of teaching staffs: 9 (in 2 units)

This department is responsible for 57 didactic lectures of physiology for 2nd-year students, 13 afternoons of laboratory physiology for 3rd-year students and numerous organ-system lectures for 3rd- and 4th-year students. Our laboratory course covers experiments on 9 different topics: 1) contraction and action potential of skeletal muscle, 2) ion transport in intestinal short-circuit current, 3) single-channel recording, 4) sensory receptors, 5) contraction and its autonomy in cardiac muscle, 6) circulatory regulation, 7) electro-cardiogram, 8) electrolyte control in human body fluids, and 9) respiratory function. After the experiments, the students are required to publicly present their findings.

Our research work is done by several groups. Prof. K. Kawahara’s group studies the potassium, ion-channels using patch-clamp method in various organs including kidney, intestine, trachea brain and heart. Most recent publications describe the localization and expression regulation of the potassium channel (Kir6.1 and Kir7.1) proteins in kidney and brain. Prof. T. Kawakami’s group studies the regulation of the axon transport by various chemical agents and conditions. The innovation by the group of a photographic device and a high sensitivity video amplifying microscope made possible, for the first time, the measurement of flow rate of microparticles within the neuro-axons. This method is also employed to study the etiology of neurodegenerative diseases such as Alzheimer’s disease and amyotrophic lateral sclerosis. Assoc. Prof. K. Hasegawa studies the generation of circadian rhythm in various animals including Paramaecium.

This department prides itself of having many students participate in various research activities in the laboratory. Some of the students present their research papers in the scientific meeting within the medical school as well as in the meetings held by academic associations.

Infectious Diseases

Number of teaching staffs: 3

Sponsored by Meiji Seika Kaisha LTD.

Ever since anti-microbial agents became widely available in the 1940s, they have been used to eliminate infection without doing much harm to the cells of treated individuals. This is the major reason that 20th century could be marked as the century of medical revolution. Yet with each passing decade, bacteria that resist antibiotics have become increasingly common. The looming threat of multi-drug resistant bacteria is the latest problem in an international public health. In hospitals, where many different kinds of antibiotics are used everyday, the bacterial strains resisting almost all antibiotics are increasing.

In 1998, a new department of infectious diseases was started with the corporate sponsorship of Meiji-Seika Kaisha LTD, and Prof. K. Sunakawa was invited from the Tokyo Medical Center of the National Hospital to deal with the problem. The department undertakes the educational activities such as lectures on infection diseases, as well as providing consultation and other help to our clinical departments. It also monitors and prevents various kinds of hospital-acquired infections. The department recently opened HIV outpatient clinic.

In research, the group investigated and reported many problems related with the drug-resistant bacteria and their treatment. In particular, the group conducted nation-wide survey of pediatric bacterial meningitis concerning its epidemiology, collection of strains of causative bacteria and evaluate the drug efficacy. The group also have extensive data on the intestinal bacterial flora with and without antibiotics.
Microbiology

This department is responsible for lectures and laboratory experiments in microbiology for our medical students. The lectures cover basic microbiology, bacteriology, and virology. The laboratory experiments for all of our students include sterile manipulation and disinfection of experimental materials, the detection, isolation, and identification of various bacteria, and infection experiments with bacteria such as Salmonella, and infection experiments with influenza virus and polio-virus. Techniques such as binding experiments with complement and with fluorescent-labeled antibody are also carried out. These hands-on experiments are designed for students to understand the basics of microbiology as well as to know how medical laboratories function.

The department focuses its research activities on antibiotic drug-resistant bacteria, i.e., its generation and the mechanisms of drug resistance. Molecular biological, biochemical, and genetic approaches are taken together with many collaborators within Japan and from abroad. Most notable result of our recent research is on the regulation of the production of class C type β-lactamase, or penicillin-degrading enzyme, which is widely distributed among gram-negative bacteria. The gene for this enzyme is located in the bacterial chromosome, and its production is induced by the bacterial cell wall component produced by penicillin attack. These findings regarding how penicillin-resistance is induced, will contribute to the design of new antibiotics that do not induce drug resistance. The research on the mechanism of infection of Human Papillomavirus and innate immunity are examples of other areas of research ongoing in our department.

Parasitology

The department is responsible for lectures and laboratory experiments in parasitology for both our medical students and students of the School of Allied Health Sciences. Students are taught on wide range of parasites including protozoa, trematodes, cestodes, and nematodes. In the experiments, students learn the methods for detection of parasites, and are given opportunities to observe living parasites.

Among the variety of our research activities on the parasite and host relationship, the physiological and biochemical studies on parasitic helminthes are worth noting. The biochemical work on muscles in the body wall of the round worm was reported in 1975, phosphatase activity of tissue-parasitic nematodes in comparison with those of gastro-intestinal nematodes was reported in 1980, and proteolytic activity of several parasitic helminthes in relation to their nutrition and invasion mechanism into host were reported in 1982 and 1996.

The department has been very active in the studies on endemic parasites in foreign countries. Prof. Ito surveyed the endemicity of parasitoses in a number of countries, including China, Guatemala, Sri Lanka, Pakistan, Nepal and Paraguay. Dr. Maki has collected local medicinal plants in Guatemala, Kenya and Mexico that are effective against parasites as well as some historical data on parasitoses and traditional utilization of medical plants. The stay by Chinese visiting professor Zhang in our laboratory led to the confirmation of efficacy of some Chinese traditional medicine on Trichomonas vaginalis.

Biomphalaria glabrata, vector snail of Schistosoma mansoni, raised for research and student experiment.
Immunology

In 1975, a research unit of organ transplantation was started by Prof. N. Kashihara to help the transplantation clinicians at the Kitasato University Hospital, which gained a high reputation in the renal allo-transplantation in Japan. Toward the goal of improving the success rate of transplantations, the group established methods for matching major histocompatibility complex (MHC) between the donor and the recipient. The typing methods include mixed lymphocyte culture, serology, sequence specific oligonucleotide (SSO) hybridization and DNA sequencing, and these methods have led to the identification of many novel MHC types, especially of DR allo types among Japanese population. Over time, Kitasato became one of the centers for MHC typing in Japan, and the team hosted a workshop for the Ministry of Health and Welfare to standardize the typing methods in Japan. This group also hosted the 11th International Histocompatibility Workshop in Yokohama, 1991. In 1992, the unit was transformed into Department of Immunology. 

In 1998, Prof. N. Shinohara took over the leadership, and brought in basic immunological studies of T cell functions in mice. This group has proposed that the production of autoantibodies might be regulated by specific suppression by T cells. Along this line, efforts are being focused on elucidation of physiological significance of cytolytic activity of CD4+ T cells and potential autoreactivity of T cells (see figure).

Potential autoreactivity of mature T cells. From N. Shinohara et al., Immunologist 5:121-126 (1997).

Pharmacology

The Department of Pharmacology is responsible for the instruction of 3rd-year students on the biochemical and physiological effects of active substances, including drugs. Structural motifs of physiological receptors and their relationships to signaling pathways, pharmacokinetics, principles of therapeutics, gene-base therapy, and other general pharmacological topics are covered in general pharmacology course. The drugs affecting various systems in the body are covered in relevant organ-system courses. Students also spend 10 afternoons of laboratory experiments learning about 10 different topics, including cardiovascular pharmacology, psychopharmacology and acute inflammation mediators. Students also become involved in a clinical pharmacology course, which is ongoing at the East Hospital.

Students wishing to participate in research projects in our laboratory can choose from the following projects: a) anti-hypertensive roles of renal kallikrein-kinin system b) regulation of angiogenesis by biologically active substances c) neural emergency system of gastric mucosa d) microcirculation of liver e) airway hypersensitivity, and f) clinical pharmacology.
Department of Pathology undertakes pathology education for our medical students, conducts basic research on etiology and pathogenesis of diseases, and supervise pathological examinations at both Kitasato University Hospital and Kitasato University East Hospital. These two hospitals are large and cover various fields of medicine with total of 1,600 beds and an average of 4,300 outpatients visiting everyday. Consequently, the number of specimens requiring pathological examination is exceptionally high, amounting to 17,000 cases per year, including biopsy specimen and post operational examinations, 30,000 cytology and 170 autopsy cases. In addition to routine histological and cytological diagnoses, we also conduct various other examinations for an accurate pathological diagnosis, including immunohistochemistry, electron microscopy, in-situ hybridization, polymerase chain reaction (PCR)-gene analysis together with single strand conformation polymorphisms (SSCP) analysis and direct DNA sequencing analysis.

All of our staff members are involved in autopsy pathology, surgical pathological diagnosis and cytological diagnosis at the two hospitals. Our staff members specialize in a wide range of expertise such as gastrointestinal pathology, hepatopathology, gynecopathology, cardiovascular pathology, lung pathology, renal and urological pathology, hematopathology, neuropathology, endocrine pathology and otorhinolaryngological pathology. About 70% of the specimens are with cancer, and we have specialists in the field of oncology. We also have pathologists very active in the pathology of inflammation and infection. We regularly exchange personnel with our clinical departments, which not only guarantees informational exchange and collaboration between various departments within our hospitals, but also fosters interdisciplinary development of the field of pathology.

We offer to our 3rd-year students 16 days of instructions in the general study of pathogenesis of diseases and the structural and functional alterations resulting from diseases. Typically, one morning lecture on a particular topic is followed by a whole afternoon session of relevant autopsy and microscopic observation. Some specific pathological cases are presented in the relevant organ-system courses. Our 6th-year students participate in bi-weekly Clinical Pathological Conference (student CPC), where unfortunate cases of deaths at our hospitals are carefully studied by students in groups. Students then present their cases to the entire class and discuss the pathogenesis and the alterations, which result from the disease.

Major topic of our research is cancer, reflecting the high frequency of cancer specimen coming into our department. Using immunohistochemical and molecular biological techniques with histological sections, live specimens and organ cultures, tumorigenesis is studied in relation to oncogene activation or mutation and alteration of cell cycles and adhesion molecules. Chronic inflammation-carcinoma sequence is also analyzed as well as de novo cancer and adenoma-carcinoma sequence in various organs. Due to the large volume of cases coming in, we are able to provide ample educational opportunities to the graduate students and residents in our clinical department.

Pathological examinations of biopsy and surgically removed materials

Cytological examinations
Legal Medicine

number of teaching staffs: 5

This department examines deaths related to legal activities. In Japan, about 15% of deaths are said to be unusual death, some in connection with criminal activities, and some requiring investigations before issuing life insurance. We perform approximately 600 dissections annually and half of these are cardiopulmonary arrest on arrival (CPAOA) at various hospitals. Difficult cases requiring careful investigations are brought in from the coroner’s offices in surrounding communities. Similar departments in most other Japanese universities examine only the cadavers suspected of being involved in criminal cases and we also have been involved in numerous difficult court cases. We, however, examine cadavers not only suspected of criminal origin, but also of sudden or unexpected death. Our expertise in biochemical laboratory examination of body fluid and DNA identification as well as cadaver dissection have proven to be of high standard. With the Department of Cardiology, we are presently undergoing a large-scale investigation on the etiology of sudden heart failure in Japan including consideration of its environmental and genetic background.

The 4th-year students are required to take our lecture series on legal medicine covering topics on medical, social, and legal problems behind deaths. In the practice sessions, students learn about distemper deaths and cadaver phenomena to estimate the time of death, and see abundant examples of autopsies.

Preventive Medicine and Public Health

number of teaching staffs: 10 (in 2 units)

Department of Preventive Medicine and Public Health is essentially composed of two units, one specializing in the fundamentals of epidemiology, medical statistics, and the basic principles of public health and preventive medicine, and the other in environmental and occupational health. Under these units, our 4th-year students learn in didactic environmental medicine lectures, epidemiology, etiology, modes of transmission and the methods of prevention and control of communicable diseases. Students also participate in field trips to water supply stations, sewage disposal processing stations and manufacturing factories. Our 6th-year students spend 2 weeks of public health practical sessions. Notably, the students are stationed in municipal health stations for 4 days, and work with local health professionals to learn various aspects of city’s health issues. This session is the only kind done in any Japanese medical schools, and it has become possible thanks to good relationship established over the years with the governments of Sagamihara city (population 607,000), Fujisawa city (population 376,000), Atsugi city (population 218,000) and Yamato city (population 213,000). We are fortunate in being located in an area with sizable communities. Other parts of 6th-year student sessions are spent at the Center for Clinical Environment Medicine, Center for Preventive Medicine and Center for Oriental Medicine, all of which are in the Kitasato Institute Hospital on the Shirokane campus. During most of the sessions, small group lectures are given to students on occupational medicine, health promotion, medical system, environmental medicine, etc.

Research activities of this department involve epidemiological studies on occupational health problems such as stress-related ailments and hypersensitivities caused by chemical agents. Our long-term (15 years) epidemiological study of pneumoconiosis conducted under the auspice of the Ministry of Health, Labor and Welfare has now developed into nation-wide research on occupational pulmonary diseases. We are currently focusing on the research of an in-vitro evaluation of toxicity of chemicals, using magnetometry.