京都大学大学院
博士課程教育リーディングプログラム

充実した健康長寿社会を築く
総合医療開発リーダー育成プログラム

Training Program of Leaders for Integrated Medical System for Fruitful Healthy-Longevity Society

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はじめに

２０１５年3月３１日

充実した健康長寿社会を築く総合医療開発リーダー育成プログラム（Training Program of Leaders for Integrated Medical System for Fruitful Healthy-Longevity Society: LIMS）は、順調にすべりだしているようにおもわれる。すぐに結果を求めるのは日本人の悪い性癖であるが、可能な限り学習の途中においても、医学的知識を応用した社会への貢献ができるような環境作りを心がけている。

京大病院はじめ、多くの医学部の方々の協力や、広い意味での医療産業を推進するエネルギーのある企業の方の授業などで、履修生の意識改革が起こることを期待するものである。医療産業というと、高度先進医療を支える先端技術と思われがちであるが、むしろ、さまざまな実生活の場面で、医学的な知識を応用して、健康な生活が送れる生活環境を生み出す仕組みを考えることで、これからの長寿社会を安心して迎えることが可能であるとおもわれる。

医療産業を活発化することも重要ではあるが、これからの安全で快適な老後を送る世代にとって、どれくらい、充実した生活を送れるかを、実感できる社会、社会インフラの整備ができるかが、重要である。2015 年度開催される日本医学会総会においても、井村会頭の発案で、これらを実現できる広い意味での医工連携を推進する基盤を作り上げることが計画されている。これは、私達が目指していたものと一致するもので、積極的な協力体制で臨むことになった。

これらの活動を通して、新しい医工連携による産業、政策が実行されれば、充実した長寿社会の実現は難しいものではないと確信している。

プログラムコーディネーター
福山秀直

Preface

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Director of Human Brain Research Center
Professor of Kyoto University Graduate School of Medicine

Training Program of Leaders for Integrated Medical System for Fruitful Healthy-Longevity Society: LIMS has now started without major problems. This program is designed to encourage the students from Engineering or other faculties to study basic medicine for creation of a new medico-engineering collaboration.

We do not target on a narrow sense of medico-engineering collaboration just focusing on the development of machines for advanced medicine. Instead, we aim at the innovation or revolutionary changes in lifestyle. Ingenious integration of small but divers ideas originating from the students' engineering background but also applying their medical knowledge may contribute to improve the living environments for healthy longevity.

In this context, we would like to expand the minds of the students toward a wider sense of "longevity." Supported by the staffs of Kyoto University Hospital as well as the lecturers from various companies located in Japan and overseas, the students will be able to put their medical knowledge into use to consider how people can happily live in the aged society with respect to their health and quality of life.

Professor Emeritus (Kyoto University) Hiroo Imura, the president of the 29th General Assembly of the Japan Medical Congress 2015 Kansai to be held this April, announced his idea to build the necessary foundation to promote cooperation of medicine with various industrial fields for a successful aging society. The LIMS program will cooperate to explore future systems from a standpoint of interdisciplinary education.

I believe these ideas are essential for the implementation of a fruitful healthy-longevity society.

March 31st, 2015.

1.

プログラムの概要

Outline of the Program

充実した健康長寿社会を築く総合医療開発リーダー育成プログラム

１．設立の目的

世界的に人口の高齢化が広がる中、世界最長の健康寿命と先端的研究開発能力という条件を合わせ持つ日本では、高齢化社会の問題を俯瞰し、メディカルイノベーションを通じて充実した健康長寿社会を達成する人材を、世界に輩出することが急務となっている。そこで本プログラムでは、高齢化社会が抱える問題を俯瞰し、Ⅰ.工学技術を医療・支援システムへ適用し、Ⅱ.医学の中に蓄えられた知識を工学に活用するという2方向から、具体的な解決法を創案し、充実した健康長寿社会の構築に向け推進することの出来る「総合医療開発リーダー」を、異分野の研究者を組み合わせた産学横断的な教育プログラムにおいて組織的に育成する。

Ⅰ．真に医学・医療が分かる医工学人材の育成

本プログラムでは、工学系のプログラム履修者に人体解剖学、生理学、病理学などの基礎医学教育と病院内実習を課し、複数分野の教員による綿密な討論・指導を行い、医学部卒業生と同等の医学・医療知識を有する医工学人材を育成する。医療・支援現場の実習や医療倫理学を通じ、利用者にとり負担の少ない「高齢者に優しい」機器・システムを開発するセンスを涵養する。医療現場のニーズや医療経済学・許認可制度の知識に基づき、機器・システムの産業化・市場の予測能力を養う。国際標準化の知識や卓越したコミュニケーション能力を備え、国際標準化機構などで活躍できる人材を育成する。

Ⅱ．医学の中に蓄えられた知識を多分野に発展させるリーダーの育成

世界の他地域に先駆けて高齢化社会を迎える日本で、健康寿命が世界最長であるという背景を活かし、高齢者が自立して社会参加するのに適した社会システムや新産業を創出できる人材を育成する。更に、この“日本モデル”を先達として世界の健康長寿向上を牽引できる人材を育成する。

これらⅠ．及びⅡ.のリーダー人材を輩出し、新たな学際的研究開発の推進を可能とすることによって、豊かな健康長寿社会の構築に貢献することを目的とする。

本プログラムの学問分野は、「医工学」であり、プログラム履修者は、医学研究科、工学研究科、薬学研究科の何れかに属することから、工学部出身者、または生物関係学部出身者の何れかが想定される。ただし、出身学部を限定することはない。工学部出身者は、工学者としての実力を有しかつ医学部学生と同等な人体・生物学の知識を有すること、また生物関係学部の出身者では工学研究が行える工学の専門性の高い知識を取得することを目指す。プログラムは講義、演習・実習と特別研究により構成される。

２．アドミッション・ポリシー

医工連携ということが重要であると言われて久しい。しかし、言葉そのものの意味するところは、医学研究者と工学研究者が協力し合い、あたらしい医療機器なり、医療方法を開発するというところにあり、すでにある研究成果や問題点を協力して解決していくということであった。

歴史をたどると、脳動脈瘤手術で根治療法となるネッククリップができない場合、手が着けようのないものを動脈瘤の上から接着剤で出血しないようにするという発想を脳外科から持ち、工学と共同してビオボンドという、

湿気のある組織でも接着能力のある特殊な接着剤を考案して、脳動脈瘤の手術の幅を広げることに成功している。以前は、工学研究に人体の標本などを持ち込むことは無謀に近い話しであったようであるが、現在では、当然と思われているこのような研究成果も先人の多くの努力によるもので、しかも、研究組織をまたいでの研究という点で重要なものである。

本プログラムでは、このような研究領域を超えた研究を行うだけではなく、互いに専門とする研究領域を持ち、それをもとに新しい発想をするのではなく、「医学研究環境の中で工学を学ぶ」というさらに一歩踏み込んだ発想で、工学系の大学院生の研究の場を医学研究科の中におき、医学研究そのものを行うのではなく、工学的見地から見て新しく医学へ貢献するところがないかを研究する目的意識を持ち、工学の基礎研究のトレーニングを受けつつ、医学の基礎から臨床、介護までを学び、医学・工学の垣根を越えた新しい研究領域を開拓していくことを目的としている。

特に、高齢化が顕著に進んでいる日本で、高齢者医療・介護は長い健康長寿を達成するには必須の条件の一つであるが、単に、病院で行う医療だけではなく、一般家庭にもっとも近い掛かり付け医への支援、長期療養施設のあり方など、医療設備の刷新とともに、工学的手法をもとにして高齢化した社会を支えるためのさまざまな工夫を社会に向かって積極的に発信できる人材を育成して、新しい医工連携の姿が社会に有効に機能できることを示すことを、もう一つの大きな目的としている。

このような新しい考え方をもとに、今回のプロジェクトがスタートし、医学研究科が中心となって、工学研究科や再生医科学研究所のスタッフが協力した体制を作り、上記の目的を達成すべくカリキュラムを工夫している。これまでの大学院と異なりリーディング大学院では社会との接点を重視した人材育成を目的としているので、広く英語による討論・ディベートによる自分の意思の発信能力の養成と、社会を医療の観点から俯瞰する医療経済学など、医工連携だけにとどまらない広い世界的視野に立った人材育成を目指している点で、これからの高齢社会へ資する人材の育成に役立つと信ずるものである。

３．教育カリキュラム

（１）一貫教育

本プログラムは博士課程教育リーディングプログラムとして一貫した大学院教育を行う。本プログラムの履修者の受入過程として、先ず所属研究科となる本学医学研究科（医科学専攻・人間健康科学系専攻）・工学研究科・薬学研究科の修士課程の入学試験または医学研究科（医学専攻）博士課程の入学試験を受験し、合格することを前提とする。ただし、これらの学部や京都大学の出身者である必要はなく、留学生も積極的に受け入れる。

社会人経験者の履修も許可するが、本プログラムではかなりハードな教育プログラムを課すので、学業に専念できる環境作りを所属企業・組織との間で協議のうえ選抜する。

（２）履修科目

開設科目の概要は以下の通りであり、修士課程修了には、指定された必修科目１３単位を必ず修得すること（平成２５年度履修生は、１２単位）が必要である。また、博士後期課程では、インターンシップ（海外インターンシップと企業インターンシップの少なくともいずれか必修）、プレリサーチ、特別研究を修得することが必要である。

基盤科目

工学、薬学、医学・生物学

医工学領域の研究に必要となる工学、医学、薬学に関する基礎知識を習得する。工学部出身者か生物関係学部出身向けの標準履修メニューを提示。それを参考に科目を選択する。

医療倫理

医療倫理について学習する。

数理科学

シミュレーションを中心としたもので、本プログラムでは、医療経済学とともに高齢化社会の将来予測等に必要な重要な科目として位置付ける。

医療経済学

高齢化社会における医療経済学的課題、知的財産、国際標準化の理解力を身に付けさせる。

医療工学特別講義

協力企業から派遣された講師により、医療・健康・ケアなどに関し、最先端の技術や現場の課題等について講義を受け、議論する。

学際応用科目

特別研究で行う研究領域に応じて用意された専門科目

英語 debate

国際的リーダーに不可欠な能力として英語でのコミュニケーション力を養う。

インターンシップ

企業において、研究開発などについて、実践しながら理解し、特別研究に活かす。行政機関、国際機関に短期研修を行い、許認可や国際標準化の仕組み、課題について理解を深める。

プレリサーチ

研究室ローテーションなどを通じ、専門以外の分野に関する理解を広げる。研究者としての基礎能力を養い特別研究の研究計画を作成する。

特別研究

プレリサーチで作成した研究計画に基づいて博士の研究を遂行し、学位取得とリーディングプログラムの修了を目指す。

（３）研究指導

各履修者に対して、指導教員及びメンターを選任し指導に当たる。

指導教員:在籍する研究科の教員のほかに本プログラム担当教授から１名を選任する。

メンター教員：異なる分野からのメンターを少なくとも2名選任する。
指導教員は、学年毎に各履修者について、研究指導記録書を作成する。

（４）本プログラムの修了要件

Ａ．修士課程

①本プログラムが設けるカリキュラムに基づき必要な単位数を修得し、かつ、在籍する研究科が定める修士課程の修了要件を満たすこと。

②進学審査

本プログラムでは、2 年次修了時に博士論文研究基礎力審査（QE）により、中間評価を行う。

1）医科学・人間健康科学・工学・薬科学等、専門分野の知識と能力、及び関連分野の基礎的素養について英語レポートを提出させる。

2）博士論文に関わる研究を行う特別研究課程（3 年次～5 年次）の研究計画（1・2 年次の「プレリサーチ」にて作成）を提出させる。

3）研究計画について口頭試問を行う。プログラム入進学審査委員会が、メンター（プログラム特定教員）2 名、プログラムの指導教授 1 名、プログラム担当の教授 1 名、計 4 名を選任し実施する。

4）英語 debate 力の評価を行う。

これら①の要件を満たし、②の結果に基づき、本プログラムにおける修士課程修了の可否を、入進学審査委員会が総合的に判定する。

基礎学力の習得が不十分と判定された者については、もう 1 年、不足する部分の再履修を行わせる。また、特別研究の研究計画に瑕疵がある場合、成果が十分に見込めないと判断した場合等は、再提出を求める。その際、メンターが必要なサポートを行う。

Ｂ．博士後期課程

博士学位の審査については、学生からの審査請求に始まり、在籍研究科教授会からの依頼を受け、まずプログラムの修了審査委員会で審査を行う。この際、英語での debate 能力の評価を英語を母国語程度話す教員や学内研究者により厳密に行う。次いで、全学の博士課程教育リーディングプログラム運営委員会が修了認定を行う。その結果を、在籍研究科教授会へ報告する。

（５）得られる学位

Ａ．修士課程

修士課程修了者の修士号授与は、各所属研究科の判断に従う。

Ｂ．博士後期課程

所属研究科により、それぞれ次の通りとなる。

博士（医科学）、博士（人間健康科学）、博士（医学）、博士（工学）、博士（薬科学）それぞれに続いて、「本学充実した健康長寿社会を築く総合医療開発リーダー育成プログラムを修了したことを証する」と付記される。

（６）ディプロマポリシー

医学的知識を十分に学習し会得した、医科学・工学・薬学などの実験・研究ができる研究者で、海外の研究施設・企業・公共組織などで活躍できるよう十分な英語力・ディベート力をもち、全世界的に進行する高齢社会の現状と将来を自分で俯瞰的に考察し、多様な人や組織と協力して問題点を解決するために、さまざまな自分の知識と手法を用いることができ、高齢者が安心して生活できる環境を作り上げられる人物になり、かかる分野における日本、アジア、世界のリーダーとなること。

（７）ポートフォリオ

プログラム履修者は、履修・成績・達成度の自己点検、教員による評価を目的として、ポートフォリオを作成することが求められる。履修者は、ポートフォリオを指示された時までに適宜更新し、指導教員等の閲覧に供しなければならない。ポートフォリオは、進学審査・特待生奨励金の継続審査等の評価の一部として利用される。

４．履修者への支援

プログラム履修者には、リーディング博士課程における履修及び学位研究に専念するための以下のような経済支援を行う。

◎特待生奨励金

以下の受給資格をすべて満たす優秀な履修者に対して特待生奨励金を支給する。
支給額及び支給継続については、選抜時及び各学年末に決定され、年度ごとに見直される。
また、奨励金受給者の氏名は受給開始前に学内掲示及びＬＩＭＳホームページにて公表する。

【受給資格】

(1) プログラム履修者選抜試験に合格した本プログラムの履修者
(2) 各種奨学金等の就学支援経費（本学の定める授業料等免除は除く）を受けていない者
ただし、国費留学生等で本奨励金を辞退した者は、他の奨学金を受けながら本プログラムを履修することができる。
(3) 奨励金以外の収入（アルバイトの給与等）を得ていない者
ただし、研究成果の公表に伴う謝金、著作料および TA・RA の給与（本プログラムにおいて本プログラムの実施に不可欠と判断される場合に限り、週5時間を上限とする。）等に限り、これを除外する。
(4) 本学大学院の在籍期間（休学期間を除く）が5年を超えない者
(5) 本プログラムにおける成績等評価において特に優秀と認められる者
(6) 本プログラムが5年一貫の教育研究課程であることを了解する者

【受給資格の喪失条件】受給者が次の各号の一に該当する場合は、その資格を失う。

(1) 上記に定める受給資格を失ったとき。
(2) 受給者からの辞退届が受理されたとき。
(3) 奨励金について提出された書類に虚偽の記載があるとき。
(4) 休学又は退学したとき、および除籍されたとき。
(5) 京都大学通則の規定により懲戒処分を受けたとき。

以上

Training Program of Leaders for Integrated Medical System for Fruitful Healthy-Longevity Society

1. Purpose

In an era of global aging, there is an urgent need in Japan, with its people having the longest healthy life expectancy and with its advanced research and development technology, to foster worldwide human resources able to understand the problems of an aging society, and to lead medical innovation globally supporting a fruitful, healthy-longevity society. Thus, this program will reanalyze the problems of an aging society and systematically mentor "Leaders for Integrated Medical Development Systems" with an industry-university educational program. This program will train researchers from different fields, who can respond to the problems and advance us to the establishment of a fruitful healthy-longevity society, through a bidirectional point of view: I. applying engineering to medical support systems, II. improving engineering with knowledge from the medical sciences.

I. Medico-engineering leaders who fully understand medical practice

This program will provide basic medical education (human anatomy, physiology, pathology) and hospital practice for students with engineering backgrounds, thorough discussion and guidance by teaching-staff from different fields. Consequently, the program fosters medico-engineering leaders with medical knowledge equivalent to medical school graduates. Through hands-on experience in medical/support care and comprehension of health-care ethics, students will cultivate a sense of how to develop "elderly-friendly" devices and low burden systems for the users. Based on their understanding of the specific needs in medical practice, and the knowledge of health economics and the licensing system, students will be able to predict industry and market trends on devices and systems. Students will be trained in international standardization, develop professional communication skills and play globally active roles in settings such as the International Organization for Standardization.

II. Leaders who can extend medical knowledge to different fields

Japan is one of the first countries to face the problem of an aging society. Taking advantage of the world's longest life expectancy, the program will train leaders who can develop new industries and social systems enabling the elderly to engage actively in community life. These leaders will help improve life expectancy globally using this "Japan model" as a precedent.

The ultimate goal of this program is to help in coordinating a fruitful healthy-longevity society by training these leaders with I. and II. , resulting in advances of international research development.

The discipline of this program is "medico-engineering", meaning a collaboration program of the Graduate School of Medicine, Graduate School of Engineering, and Graduate School of Pharmaceutical Science, so we expect that most students will be graduates from the above-related departments, but there is no limitation on the background of their undergraduate departments. Engineering graduates will acquire highly specialized knowledge of the human body and biology, comparable with graduates from the medical department. Biology-related graduates will acquire highly specialized knowledge in engineering, comparable with graduates from the engineering department, and will be able to conduct engineering research. The program comprises lectures, exercises, training and specific research.

2. Admission Policy

The importance of medico-engineering collaboration has been discussed for a long time. However, the intended meaning of the word itself is just that medical and engineering researchers work together to develop novel devices and methods of medical treatment, to apply the results and to overcome existing problems. Looking back into history, when a neck clip could not be used as a radical therapy in cerebral aneurysms, neurosurgeons came up with the idea to seal these inoperable aneurysms with glue. Through cooperation with engineering researchers, "Biobond", a bonding agent which can produce strong adhesion even between moist human tissues, was developed and succeeded in expanding the application of operable aneurysms. The idea of applying engineering research to the human body was considered ridiculous in the past, but it has become widely accepted nowadays due to the tremendous efforts of the pioneers in this field. In addition, this form of interdisciplinary collaboration has become important in terms of research across different research organizations. This program performs not only research extending beyond fields, but goes mutually between different fields, by bringing new ideas from each field, and by applying the concept of "learn engineering in a medical research environment". In this way, graduate students with engineering backgrounds, not only perform medical research in a medical environment, but also seek novel ways in which engineering can contribute to medicine. With basic knowledge in medicine and medical care fostered in this program, together with already cultivated knowledge in engineering, the students will open up a new frontier in medico-engineering research. In particular, the advanced progress of unprecedented aging in Japan requires adequate medical treatment and nursing care as essential conditions to achieve healthy longevity. However, from an engineering point of view, it is necessary to show that this new medico-engineering collaboration will function effectively by training leaders who can actively disseminate their developments to the society by not only simply practicing medical care in hospitals, but also by supporting a family doctor system near each home, reconsidering long-term care facilities, and supporting an aged society with a new medical system.

Under these new concepts, the project has started with a central role of the Graduate School of Medicine in collaboration with staff from the Graduate School of Engineering and the Institute for Frontier Medical Sciences, creating a suitable curriculum to achieve the above-mentioned aims. Unlike any of the existing graduate schools, the Leading Graduates Schools aim at training leaders and put special emphasis on interaction with the society. We believe that these students will develop abilities to express their ideas through discussion and debate in English. They will be able to look at society trends from a medical and medical economics point of view. Finally, they will develop a broad global perspective which is not only limited to medico-engineering cooperation. We believe these leaders will make a contribution to the aging society in the future.

3. Curriculum

(1) Continuous education

This program provides consistent graduate education as "Program for Leading Graduate Schools". In order to be enrolled in this program, first, the students have to take and pass the entrance examination for Master's course of Kyoto University at one of the following Graduate Schools: Graduate School of Medicine (Medical Science Major, Human Health Science Major), Graduate School of Engineering, Graduate School of Pharmaceutical Sciences, or, the entrance examination for the Doctoral Program in Medicine of the Graduate School of Medicine of Kyoto University. However,

it is not required that the applicants are graduates of Kyoto University or any of the above- indicated departments. This program also welcomes students from abroad.

Persons with vocational occupation can also apply for this program. However, because of the intense training course of this program, they will be selected upon discussion with their employers about their devotion to the academic activities.

(2) Subjects to be attended

Master's course: must finish 13 units of the compulsory subjects (For 2013-entered students, 12 units)

Doctoral course: Internship (Overseas or Institute internship (must choose one of the two)), Colloquium, Pre-research, Thesis Research are mandatory.

Basic class

Engineering, Pharmacology, Medicine·Biology

Acquiring basic knowledge in engineering, medicine, and pharmacology is necessary for research in the field of medico-engineering. Students can choose different standard classes, depending on their undergraduate backgrounds (engineering or biology-related).

Medical ethics

Learn about healthcare ethics.

Mathematical Sciences

Will be based mainly on simulations. Along with healthcare economics, this class is important for predicting the future of the aging society.

Health Economics

Learn about problems, intellectual property, and global standardization concerning healthcare economics of the aging society.

Medical Engineering for Society

Receive lectures and hold discussions with lecturers from cooperative companies regarding cutting edge technology in medicine/healthcare and the current problems faced on-site.

Interdisciplinary Application

A specialized course prepared in relation to the student's thesis research.

Debate

Gain English communication skills, which is indispensable for global leadership.

Internship

Learn about research and development through practical experience in companies and apply this experience to thesis research. Short training courses in government offices and international organizations will promote better understanding of licensing and global standardization.

Pre-research

Through laboratory rotation, learn about fields other than their own specialty. Develop basic skills as a researcher and prepare research plans for thesis research.

Thesis Research

Conduct Doctoral thesis research based upon the research plan prepared in the Pre-research period. The final goal is acquiring a Ph.D. degree and graduation from the program.

(3) Research training

A teaching advisor and mentors are chosen to guide each student.

Teaching advisor: A professor of the affiliated graduate school which the students belong to or a professor of the program is chosen.

Mentors: At least two are chosen from different fields.

Teaching advisors and mentors must fill out an annual teaching record for each student.

(4) Eligibility Requirements for completion of the program

A. Master's course

① Students must complete the designated courses and meet the credit requirements in line with the curriculum policy of this program and must meet the requirements for finishing the Master's course within their graduate schools.

② Doctoral Qualification Examination

In this program, at the end of the second year, a Doctoral Qualification Examination (QE) will be conducted as a mid-term evaluation.

1. Students have to submit a report in English on fundamental knowledge and skills in Medical Science, Human Health Sciences, Engineering, Pharmacology and each specialty and related field.
2. Students have to submit a research plan (which is to be prepared during the first and second year "Pre-research" period) related to their thesis research (which will be conducted during the third to fifth year) for Doctoral dissertation.
3. Students have to present their research plan orally. Results will be evaluated by four members of the QE Committee: two mentors of the program-specific staff; one professor of the program (teaching advisor) and another professor of the program.
4. Skills in English debate will be evaluated.

Based on ① fulfillment of eligibility requirement, and ② result of QE, the Committee will make a decision on completion of Master's degree of the program.

Any students who do not meet the above requirements must take an extra year to improve any insufficient knowledge. If the research plan is determined to be flawed or not promising, re-submission will be required. In that case, mentors will give necessary support.

B. Doctoral course

The examination for the Doctoral degree will be started upon students' request, then it will be commissioned by the Professors' faculty meeting of their affiliated Graduate Schools, and a board review of the program will be conducted. During the procedure, native English-speaking staff or university researchers will carefully evaluate the students' English debate skills. If approvable, the all-campus steering committee of the Program for Leading Graduate Schools will certify completion. The results will be reported to the Professors' faculty meeting of their affiliated

affiliated graduate schools.

(5) Academic degrees

A. Master's course

A Master's degree from each affiliated graduate school will be awarded to students who have finished a Master's course.

B. Doctoral course

Different between affiliated graduate schools as follows:

After each Doctoral statement (Medical Science, Human Health Sciences, Medicine, Engineering, Pharmacology), completion of the "Training program of leaders for integrated medical system for fruitful healthy-longevity society" will be certified.

(6) Diploma policy

In order to support and build up new concepts and political directions that help people to live a fruitful life in old age, students with a non-medical background of medical science, engineering, or pharmaceutical science majors need to gain fundamental medical knowledge. In addition to these technical and research skills, the students are required to acquire English proficiency as well as the ability to debate in order to be able to play an active part in international research centers, companies and public organizations. The students are also required to be able to see present and future problems of a globally unprecedented aging society and to be able to use their skills and knowledge in cooperation with people from different backgrounds to solve these problems. The education at LIMS vigorously trains students to become strong leaders who can shape the success of the aging society not only in Japan and Asian countries, but also all over the world.

(7) Portfolio

Each student needs to make a portfolio in which self-evaluation of classes, grades, academic achievements, and evaluation by faculty will be noted. It must be updated regularly for inspection by the teaching advisors and mentors. This portfolio will be used as a part of the evaluation for promotion and the continuation of the student's allowance.

4. Financial Support for program students

Financial support will be given to program students to encourage them to concentrate on classes and thesis research of the Program for Leading Graduate Schools.

Allowance incentives

Outstanding students who satisfy all of the eligibility requirements for recipients will be supported with a monthly allowance. The amount and continuation of allowances depends on the performance during the selection procedure, and academic achievements evaluated by teachers and mentors at the end of each academic year.

The names of recipients will be posted at the campus and on the LIMS homepage.

[Eligibility requirements for recipients]

[1] Those who are successful applicants of this program.

[2] Those who are not receiving financial support from any scholarship or stipend (except for a tuition waiver by Kyoto University). However, students who decline financial support from this program will be able to take training in this program while receiving other scholarships, such as a scholarship from the Japanese government.

[3] Those who are not receiving or expecting to receive any remuneration including wages for part-time work, with the exception of honorarium payments relating to the publication or presentation of research results, copyright fees or royalties, or a Teaching Assistant (TA) or Research Assistant (RA) allowance which is deemed essential to the program (up to 5 hours per week).

[4] Those who have been enrolled for no more than five academic years (not including any period of temporary absence) in a graduate school at Kyoto University.

[5] Those who are deemed to have achieved excellence based on their grades and scores in this program.

[6] Those who agree to continuously pursue their education and research during the 5-year period of this program.

[Loss of eligibility for financial support]

Recipients who fall in one of the following categories will lose their eligibility for financial support:

(1) Those who lose one of [1] to [6] requirements of [Eligibility requirements for recipients] above.

(2) Those who submit a letter of declination of the financial support from this program, and the letter is accepted.

(3) Those who submitted false statements in the application documents of this program.

(4) Those who stop studying, quit university or are expelled from university.

(5) Those who are subjected to disciplinary action, following the Kyoto University General Rules.

プログラム担当者一覧

（平成27年3月31日現在）

	氏　名	所　属	専攻等	職　名	備　考
1	ウエモト シンジ 上本 伸二	医学研究科	医学	教授	プログラム責任者・医学研究科長
2	フクヤマ ヒデナオ 福山 秀直	医学研究科	医学	教授	プログラムコーディネーター・LIMSユニット長
3	ワタナベ ダイ 渡邉 大	医学研究科	医学	教授	
4	ハギワラ マサトシ 萩原 正敏	医学研究科	医学	教授	
5	サイトウ ミチノリ 斎藤 通紀	医学研究科	医学	教授	
6	マツダ ミチユキ 松田 道行	医学研究科	医学	教授	
7	ハガ ヒロノリ 羽賀 博典	医学研究科	医学	教授	
8	イワタ ソウ 岩田 想	医学研究科	医学	教授	
9	ノダ マコト 野田 亮	医学研究科	医学	教授	
10	シノハラ タカシ 篠原 隆司	医学研究科	医学	教授	
11	カネコ タケシ 金子 武嗣	医学研究科	医学	教授	
12	カワノ ケンジ 河野 憲二	医学研究科	医学	教授	
13	オオモリ ハルノリ 大森 治紀	医学研究科	医学	教授	
14	キムラ タケシ 木村 剛	医学研究科	医学	教授	
15	ミシマ ミチアキ 三嶋 理晃	医学研究科	医学	教授	附属病院長
16	ヒラオカ マサヒロ 平岡 眞寛	医学研究科	医学	教授	
17	トガシ カオリ 富樫 かおり	医学研究科	医学	教授	
18	イチヤマ サトシ 一山 智	医学研究科	医学	教授	
19	サカイ ヨシハル 坂井 義治	医学研究科	医学	教授	
20	トイ マサカズ 戸井 雅和	医学研究科	医学	教授	
21	コニシ イクオ 小西 郁生	医学研究科	医学	教授	
22	オガワ オサム 小川 修	医学研究科	医学	教授	
23	サカタ リュウゾウ 坂田 隆造	医学研究科	医学	教授	
24	スズキ シゲヒコ 鈴木 茂彦	医学研究科	医学	教授	
25	ヨシムラ ナガヒサ 吉村 長久	医学研究科	医学	教授	
26	イトウ ジュイチ 伊藤 壽一	医学研究科	医学	教授	
27	マツダ シュウイチ 松田 秀一	医学研究科	医学	教授	
28	フジタ ジュン 藤田 潤	医学研究科	医学	教授	
29	タカハシ リョウスケ 高橋 良輔	医学研究科	医学	教授	
30	ミヤモト ススム 宮本 享	医学研究科	医学	教授	
31	コスギ シンジ 小杉 眞司	医学研究科	社会健康医学系	教授	
32	マエカワ タイラ 前川 平	医学部附属病院	輸血細胞治療部	教授	
33	ホソダ キミノリ 細田 公則	医学研究科	人間健康科学系	教授	
34	カツラ トシキ 桂 敏樹	医学研究科	人間健康科学系	教授	
35	キノシタ アヤエ 木下 彩栄	医学研究科	人間健康科学系	教授	
36	アダチ ソウイチ 足立 壯一	医学研究科	人間健康科学系	教授	
37	シイナ ツヨシ 椎名 毅	医学研究科	人間健康科学系	教授	
38	スギモト ナオゾウ 杉本 直三	医学研究科	人間健康科学系	教授	
39	クロキ ヒロシ 黒木 裕士	医学研究科	人間健康科学系	教授	
40	イチハシ ノリアキ 市橋 則明	医学研究科	人間健康科学系	教授	
41	フタキ トシコ 二木 淑子	医学研究科	人間健康科学系	教授	
42	アライ ヒデノリ 荒井 秀典	医学研究科	人間健康科学系	教授	平成26年12月まで
43	コテラ ヒデトシ 小寺 秀俊	工学研究科	マイクロエンジニアリング	教授	
44	キムラ シュンサク 木村 俊作	工学研究科	材料化学	教授	
45	シラカワ マサヒロ 白川 昌宏	工学研究科	分子工学	教授	
46	アキヨシ カズナリ 秋吉 一成	工学研究科	高分子化学	教授	
47	モリ ヤスオ 森 泰生	工学研究科	合成・生物化学	教授	

（平成27年3月31日現在）

	氏　名	所　属	専攻等	職　名	備　考
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49	中部（ナカベ）　主敬（カズヨシ）	工学研究科	機械理工学	教授	
50	大嶋（オオシマ）　正裕（マサヒロ）	工学研究科	化学工学	教授	
51	神野（カンノ）　郁夫（イクオ）	工学研究科	原子核工学	教授	
52	大江（オオエ）　浩一（コウイチ）	工学研究科	物質エネルギー化学	教授	
53	近藤（コンドウ）　輝幸（テルユキ）	学際融合教育研究推進センター	先端医工学研究ユニット	教授	
54	佐治（サジ）　英郎（ヒデオ）	薬学研究科	薬学	教授	
55	橋田（ハシダ）　充（ミツル）	薬学研究科	薬学	教授	
56	掛谷（カケヤ）　秀昭（ヒデアキ）	薬学研究科	医薬創成情報科学	教授	
57	中山（ナカヤマ）　和久（カズヒサ）	薬学研究科	薬科学	教授	
58	加藤（カトウ）　博章（ヒロアキ）	薬学研究科	薬科学	教授	
59	後藤（ゴトウ）　励（レイ）	白眉センター		特定准教授	
60	岩田（イワタ）　博夫（ヒロオ）	再生医科学研究所		教授	再生医科学研究所長
61	田畑（タバタ）　泰彦（ヤスヒコ）	再生医科学研究所		教授	
62	戸口田（トグチダ）　淳也（ジュンヤ）	再生医科学研究所		教授	
63	安達（アダチ）　泰治（タイジ）	再生医科学研究所		教授	
64	開（ヒラキ）　祐司（ユウジ）	再生医科学研究所		教授	
65	瀬原（セハラ）　淳子（アツコ）	再生医科学研究所		教授	
66	長澤（ナガサワ）　丘司（タカシ）	再生医科学研究所		教授	
67	河本（カワモト）　宏（ヒロシ）	再生医科学研究所		教授	
68	森（モリ）　重文（シゲフミ）	数理解析研究所		教授	
69	岡本（オカモト）　久（ヒサシ）	数理解析研究所		教授	
70	山田（ヤマダ）　道夫（ミチオ）	数理解析研究所		教授	
71	寺西（テラニシ）　豊（ユタカ）	医学研究科	「医学領域」産学連携推進機構	特任教授	
72	石井（イシイ）　加代子（カヨコ）	学際融合教育研究推進センター	健康長寿社会の総合医療開発ユニット	特定教授	

Program Professors

(As of March 31, 2015)

	Name	Graduate School etc.	Devision	Position	Notes
1	Shinji Uemoto	Graduate School of Medicine	Medicine	Professor	Program Director, Dean of Graduate School of Medicine
2	Hidenao Fukuyama	Graduate School of Medicine	Medicine	Professor	Program Coordinator, Director of LIMS Unit
3	Dai Watanabe	Graduate School of Medicine	Medicine	Professor	
4	Masatoshi Hagiwara	Graduate School of Medicine	Medicine	Professor	
5	Mitinori Saitou	Graduate School of Medicine	Medicine	Professor	
6	Michiyuki Matsuda	Graduate School of Medicine	Medicine	Professor	
7	Hironori Haga	Graduate School of Medicine	Medicine	Professor	
8	So Iwata	Graduate School of Medicine	Medicine	Professor	
9	Makoto Noda	Graduate School of Medicine	Medicine	Professor	
10	Takashi Shinohara	Graduate School of Medicine	Medicine	Professor	
11	Takeshi Kaneko	Graduate School of Medicine	Medicine	Professor	
12	Kenji Kawano	Graduate School of Medicine	Medicine	Professor	
13	Harunori Ohmori	Graduate School of Medicine	Medicine	Professor	
14	Takeshi Kimura	Graduate School of Medicine	Medicine	Professor	
15	Michiaki Mishima	Graduate School of Medicine	Medicine	Professor	Director of Kyoto University Hospital
16	Masahiro Hiraoka	Graduate School of Medicine	Medicine	Professor	
17	Kaori Togashi	Graduate School of Medicine	Medicine	Professor	
18	Satoshi Ichiyama	Graduate School of Medicine	Medicine	Professor	
19	Yoshiharu Sakai	Graduate School of Medicine	Medicine	Professor	
20	Masakazu Toi	Graduate School of Medicine	Medicine	Professor	

(As of March 31, 2015)

	Name	Graduate School etc.	Devision	Position	Notes
21	Ikuo Konishi	Graduate School of Medicine	Medicine	Professor	
22	Osamu Ogawa	Graduate School of Medicine	Medicine	Professor	
23	Ryuzo Sakata	Graduate School of Medicine	Medicine	Professor	
24	Shigehiko Suzuki	Graduate School of Medicine	Medicine	Professor	
25	Nagahisa Yoshimura	Graduate School of Medicine	Medicine	Professor	
26	Juichi Ito	Graduate School of Medicine	Medicine	Professor	
27	Shuichi Matsuda	Graduate School of Medicine	Medicine	Professor	
28	Jun Fujita	Graduate School of Medicine	Medicine	Professor	
29	Ryosuke Takahashi	Graduate School of Medicine	Medicine	Professor	
30	Susumu Miyamoto	Graduate School of Medicine	Medicine	Professor	
31	Shinji Kosugi	Graduate School of Medicine	School of Public Health	Professor	
32	Taira Maekawa	Kyoto University Hospital	Transfusion Medicine and Cell Therapy	Professor	
33	Kiminori Hosoda	Graduate School of Medicine	Human Health Sciences	Professor	
34	Toshiki Katsura	Graduate School of Medicine	Human Health Sciences	Professor	
35	Ayae Kinoshita	Graduate School of Medicine	Human Health Sciences	Professor	
36	Souichi Adachi	Graduate School of Medicine	Human Health Sciences	Professor	
37	Tsuyoshi Shiina	Graduate School of Medicine	Human Health Sciences	Professor	
38	Naozo Sugimoto	Graduate School of Medicine	Human Health Sciences	Professor	
39	Hiroshi Kuroki	Graduate School of Medicine	Human Health Sciences	Professor	
40	Noriaki Ichihashi	Graduate School of Medicine	Human Health Sciences	Professor	
41	Toshiko Futaki	Graduate School of Medicine	Human Health Sciences	Professor	
42	Hidenori Arai	Graduate School of Medicine	Human Health Sciences	Professor	Until December 2014
43	Hidetoshi Kotera	Graduate School of Engineering	Micro Engineering	Professor	
44	Shunsaku Kimura	Graduate School of Engineering	Material Chemistry	Professor	
45	Masahiro Shirakawa	Graduate School of Engineering	Molecular Engineering	Professor	
46	Kazunari Akiyoshi	Graduate School of Engineering	Polymer Chemistry	Professor	
47	Yasuo Mori	Graduate School of Engineering	Synthetic Chemistry and Biological Chemistry	Professor	
48	Itaru Hamachi	Graduate School of Engineering	Synthetic Chemistry and Biological Chemistry	Professor	
49	Kazuyoshi Nakabe	Graduate School of Engineering	Mechanical Engineering and Science	Professor	
50	Masahiro Ohshima	Graduate School of Engineering	Chemical Engineering	Professor	
51	Ikuo Kanno	Graduate School of Engineering	Nuclear Engineering	Professor	
52	Kouichi Ohe	Graduate School of Engineering	Energy and Hydrocarbon Chemistry	Professor	
53	Teruyuki Kondo	Center for the Promotion of Interdisciplinary Education and Research	Advanced Biomedical Engineering Research Unit	Professor	
54	Hideo Saji	Graduate School of Pharmaceutical Sciences	Biomedical Sciences	Professor	
55	Mitsuru Hashida	Graduate School of Pharmaceutical Sciences	Biomedical Sciences	Professor	
56	Hideaki Kakeya	Graduate School of Pharmaceutical Sciences	Bioinformatics and Chemical Genomics	Professor	
57	Kazuhisa Nakayama	Graduate School of Pharmaceutical Sciences	Pharmaceutical Sciences	Professor	
58	Hiroaki Kato	Graduate School of Pharmaceutical Sciences	Pharmaceutical Sciences	Professor	
59	Rei Goto	The Hakubi Project		Program-Specific Associate Professor	
60	Hiroo Iwata	Institute for Frontier Medical Sciences		Professor	Director of Institute for Frontier Medical Sciences
61	Yasuhiko Tabata	Institute for Frontier Medical Sciences		Professor	
62	Junya Toguchida	Institute for Frontier Medical Sciences		Professor	
63	Taiji Adachi	Institute for Frontier Medical Sciences		Professor	
64	Yuji Hiraki	Institute for Frontier Medical Sciences		Professor	
65	Atsuko Sehara	Institute for Frontier Medical Sciences		Professor	
66	Takashi Nagasawa	Institute for Frontier Medical Sciences		Professor	
67	Hiroshi Kawamoto	Institute for Frontier Medical Sciences		Professor	
68	Shigefumi Mori	Research Institute for Mathematical Sciences		Professor	
69	Hisashi Okamoto	Research Institute for Mathematical Sciences		Professor	
70	Michio Yamada	Research Institute for Mathematical Sciences		Professor	
71	Yutaka Teranishi	Graduate School of Medicine	Medical Science and Business Liaison Organization	Specially Appointed Professor	
72	Kayoko Ishii	Center for the Promotion of Interdisciplinary Education and Research	Research and Educational Unit of Leaders for Integrated Medical System (LIMS)	Program-Specific Professor	

特定教員一覧

（平成27年3月31日現在）

	氏　名	職　名
1	石井（イシイ）　加代子（カヨコ）	特定教授
2	木村（キムラ）　祐（ユウ）	特定准教授
3	髙折（タカオリ）　恭一（キョウイチ）	
4	西（ニシ）　美幸（ミユキ）	
5	松橋（マツハシ）　眞生（マサオ）	
6	山本（ヤマモト）　浩司（コウジ）	
7	大江（オオエ）　賢治（ケンジ）	特定講師
8	木下（キノシタ）　武彦（タケヒコ）	
9	高橋（タカハシ）　めい子（メイコ）	
10	富塚（トミヅカ）　太郎（タロウ）	
11	東森（ヒガシモリ）　信就（ノブユキ）	
12	樋口（ヒグチ）　ゆり子（ユリコ）	
13	松田（マツダ）　和郎（ワコト）	
14	市村（イチムラ）　敦彦（アツヒコ）	特定助教
15	稲場（イナバ）　直子（ナオコ）	
16	近藤（コンドウ）　健吾（ケンゴ）	
17	佐藤（サトウ）　文規（フミノリ）	
18	滝本（タキモト）　晶（アキ）	
19	Dinh（ディン）　Ha（ハ）　Duy（ユイ）　Thuy（ティ）	
20	鳥井（トリイ）　美江（ミエ）	
21	平井（ヒライ）　康治（ヤスハル）	
22	長谷川（ハセガワ）　拓（タク）	特定助教 （平成27年1月まで）
23	Christian（クリスチャン）　Altmann（アルトマン）	医学研究科特定准教授

事務職員一覧

（平成27年3月31日現在）

	氏　名	職　名
1	戸倉（トクラ）　照雄（テルオ）	特定職員 （平成27年1月まで）
2	野木（ノギ）　淑全（ヨシマサ）	特定職員
3	松田（マツダ）　梢（コズエ）	教務補佐員
4	崎本（サキモト）　真梨子（マリコ）	派遣職員
5	嬉野（ウレシノ）　友里（ユリ）	派遣職員
6	大谷（オオタニ）　真希（マキ）	派遣職員

Program-Specific Staff

(As of March 31, 2015)

	Name	Position
1	Kayoko Ishii	Program-Specific Professor
2	Yu Kimura	Program-Specific Associate Professor
3	Kyoichi Takaori	
4	Miyuki Nishi	
5	Masao Matsuhashi	
6	Koji Yamamoto	
7	Kenji Ohe	Program-Specific Senior Lecturer
8	Takehiko Kinoshita	
9	Meiko Takahashi	
10	Taro Tomizuka	
11	Nobuyuki Higashimori	
12	Yuriko Higuchi	
13	Wakoto Matsuda	
14	Atsuhiko Ichimura	Program-Specific Assistant Professor
15	Naoko Inaba	
16	Kengo Kondo	
17	Fuminori Sato	
18	Aki Takimoto	
19	Dinh Ha Duy Thuy	
20	Mie Torii	
21	Yasuharu Hirai	
22	Taku Hasegawa	Program-Specific Assistant Professor (until January 2015)
23	Christian Altmann	Program-Specific Associate Professor of Graduate School of Medicine

Administrative Staff

(As of March 31, 2015)

	Name	Position
1	Teruo Tokura	Program-Specific Administrative Staff (until January 2015)
2	Yoshimasa Nogi	Program-Specific Administrative Staff
3	Kozue Matsuda	Assistant Administrative Staff
4	Mariko Sakimoto	Assistant Administrative Staff
5	Yuri Ureshino	Assistant Administrative Staff
6	Maki Otani	Assistant Administrative Staff

平成26年度 LIMS履修者（M1）・指導教授・メンター 一覧

（平成27年3月31日現在）

	研究科	専攻	学年	氏名	性別	所属分野	LIMSメインテーマ	研究科指導教授	LIMS指導教授	メンター 職名、（専門分野）	メンター 職名、（専門分野）
1	医学	医科学	M1	松原（マツバラ） 弘幸（ヒロユキ）	男	iPS細胞研究所 臨床応用研究部門 疾患再現研究分野	白血病における現在の治療法	中畑（ナカハタ） 龍俊（タツトシ） 教授 iPS細胞研究所 疾患再現研究	安達（アダチ） 泰治（タイジ） 教授 再生医科学研究所 バイオメカニクス研究領域	滝本（タキモト） 晶（アキ） 特定助教 （発生学）	長谷川（ハセガワ） 拓（タク） 特定助教 （神経生理学）
2	医学	医科学	M1	SAHA Liton Kumar	男	遺伝医学講座 放射線遺伝学	死亡率・疾病率の低下をめざしたがんの効果的治療の確立およびがん治療における化学療法と放射線療法の重要性の評価	武田（タケダ） 俊一（シュンイチ） 教授 医学研究科 放射線遺伝学	平岡（ヒラオカ） 眞寛（マサヒロ） 教授 医学研究科 放射線腫瘍学・画像応用治療学	木村（キムラ） 祐（ユウ） 特定准教授 （高分子化学）	佐藤（サトウ） 文規（フミノリ） 特定助教 （発生生物学・分子生物学）
3	医学	医科学	M1	Aila Johanna	女	高次脳科学講座 高次脳形態学	神経アーキテクチャの加齢変化	金子（カネコ） 武嗣（タケシ） 教授 医学研究科 高次脳形態学	平家（ヘイケ） 俊男（トシオ） 教授 医学研究科 発達小児科学	樋口（ヒグチ） ゆり子（ユリコ） 特定講師 （生物薬剤学）	Dinh（ディン） Ha（ハ） Duy（ユイ） Thuy（ティ） 特定助教 （脳機能イメージング）
4	医学	医科学	M1	MBENZA MBAMBI NAASSON	男	化学研究所 生体機能化学研究系 ケミカルバイオロジー	医薬の規制と健康保険制度の観点における日本との比較を通して、コンゴにおける医療政策の不備を評価することへの貢献	上杉（ウエスギ） 志成（モトナリ） 教授 化学研究所 ケミカルバイオロジー	寺西（テラニシ） 豊（ユタカ） 教授 医学研究科 「医学領域」産学連携推進機構	松田（マツダ） 和郎（カズオ） 特定講師 （神経解剖学・解剖学一般）	平井（ヒライ） 康治（ヤスハル） 特定助教 （神経生理学）
5	医学	人間健康科学系	M1	松本（マツモト） 朋子（トモコ）	女	医療検査展開学講座 基礎検査展開学	再生医療の実現における医療倫理問題・課題について	齋藤（サイトウ） 邦明（クニアキ） 教授 医学研究科 人間健康科学系専攻 基礎検査展開学	前川（マエカワ） 平（タイラ） 教授 医学部附属病院 輸血細胞治療部	松橋（マツハシ） 眞生（マサナ） 特定准教授 （臨床神経生理学）	長谷川（ハセガワ） 拓（タク） 特定助教 （神経生理学）
6	薬学	薬科学	M1	篠田（シダ） 昂樹（コウキ）	男	化学研究所 生体機能化学研究系 生体機能設計化学	時間生物学からみた加齢に伴うバイオリズムの変化と疾患発症・治療に関する研究	二木（フタキ） 史朗（シロウ） 教授 化学研究所 生体機能設計化学	小川（オガワ） 修（オサム） 教授 医学研究科 泌尿器科学	山本（ヤマモト） 浩司（コウジ） 特定准教授 （機械工学）	滝本（タキモト） 晶（アキ） 特定助教 （発生学）
7	薬学	医薬創成情報科学	M1	堂上（ドウジョウ） 久美子（クミコ）	女	医薬創成情報科学講座 システムバイオロジー分野	シフトワーカーがかかりやすい病気の研究	岡村（オカムラ） 均（ヒトシ） 教授 薬学研究科 システムバイオロジー	小西（コニシ） 郁生（イクオ） 教授 医学研究科 婦人科学・産科学	大江（オオエ） 賢治（ケンジ） 特定講師 （人体解剖学・分子生物学）	木下（キノシタ） 武彦（タケヒコ） 特定講師 （応用数学）
8	工学	分子工学	M1	宇野（ウノ） 雅俊（マサトシ）	男	生体分子機能化学講座	サイトカインネットワークの異常に基づく自己免疫疾患の発症機構の予測及び検証	白川（シラカワ） 昌宏（マサヒロ） 教授 工学研究科 生体分子機能化学	岩田（イワタ） 想（ソウ） 教授 医学研究科 分子細胞情報学	西（ニシ） 美幸（ミユキ） 特定准教授 （生化学・発生生物学）	鳥井（トリイ） 美江（ミエ） 特定助教 （慢性・老年看護学（免疫学））
9	工学	分子工学	M1	竹下（タケシタ） 至（イタル）	男	生体分子機能化学講座	DNAメチル化異常解析による発がんリスク評価と生活習慣との相関に関する研究	白川（シラカワ） 昌宏（マサヒロ） 教授 工学研究科 生体分子機能化学	掛谷（カケヤ） 秀昭（ヒデアキ） 教授 薬学研究科 システムケモセラピー・制御分子学	髙折（タカオリ） 恭一（キョウイチ） 特定准教授 （膵臓外科学・低侵襲治療学）	稲場（イナバ） 直子（ナオコ） 特定助教 （神経生理学）
10	工学	高分子化学	M1	末永（スエナガ） 和真（カズマサ）	男	高分子合成講座 重合化学分野	生体分子定量のための有機ー無機ハイブリッド材料を基盤とした機能性光学材料の開発	中條（チュウジョウ） 善樹（ヨシキ） 教授 工学研究科 重合化学	細田（ホソダ） 公則（キミノリ） 教授 医学研究科 人間健康科学系専攻 生活習慣病看護学	髙折（タカオリ） 恭一（キョウイチ） 特定准教授 （膵臓外科学・低侵襲治療学）	近藤（コンドウ） 健悟（ケンゴ） 特定助教 （医用生体工学）
11	工学	合成・生物化学	M1	遠野（エンノ） 宏季（ヒロキ）	男	合成化学講座 機能化学分野	・高齢化に伴って発症する疾患の引き金と、それを抑制する化学物質に関する文献調査 ・生体内における生理活性ガス分子の制御とその臨床応用に関する研究	北川（キタガワ） 進（ススム） 教授 工学研究科 機能化学	松田（マツダ） 秀一（シュウイチ） 教授 医学研究科 整形外科学	髙橋（タカハシ） めい子（メイコ） 特定講師 （ゲノム医学）	鳥井（トリイ） 美江（ミエ） 特定助教 （慢性・老年看護学（免疫学））
12	工学	合成・生物化学	M1	西谷（ニシタニ） 暢彦（ノブヒコ）	男	合成化学講座 物理有機化学分野	・光応答性分子の生体への応用 ・生体中での協同的組織化挙動	松田（マツダ） 建児（ケンジ） 教授 工学研究科 物理有機化学	野田（ノダ） 亮（マコト） 教授 医学研究科 分子腫瘍学	Christian（クリスチャン） Altmann（アルトマン） 医学研究科 特定准教授 （実験心理学）	佐藤（サトウ） 文規（フミノリ） 特定助教 （発生生物学・分子生物学）

平成26年度 LIMS履修者（M2）・指導教授・メンター 一覧

（平成27年3月31日現在）

	研究科	専攻	学年	氏名	性別	所属分野	LIMSメインテーマ	研究科指導教授	LIMS指導教授	メンター 職名、（専門分野）	メンター 職名、（専門分野）
1	医学	医科学	M2	佐久間 真紀（サクマ マキ）	女	生体構造医学講座 形態形成機構学	がん治療への応用を目指したトランスクリプトーム解析	萩原 正敏（ハギワラ マサトシ） 教授 医学研究科 形態形成機構学	森 泰生（モリ ヤスオ） 教授 工学研究科 分子生物化学	山本 浩司（ヤマモト コウジ） 特定准教授 （機械工学）	樋口 ゆり子（ヒグチ ユリコ） 特定講師 （生物薬剤学）
2	医学	人間健康科学系	M2	五明 美香子（ゴミョウ ミカコ）	女	検査技術科学コース 医療画像情報システム学	1. 光超音波顕微鏡による組織光超音波物性の定量的評価に関する研究 2. 粘弾性特性の病理学的診断等への臨床応用	椎名 毅（シイナ ツヨシ） 教授 医学研究科 人間健康科学系専攻 医療画像情報システム学	戸井 雅和（トイ マサカズ） 教授 医学研究科 乳腺外科学	松橋 眞生（マツハシ マサオ） 特定准教授 （臨床神経生理学）	木下 武彦（キノシタ タケヒコ） 特定講師 （応用数学）
3	医学	人間健康科学系	M2	石田 敦子（イシダ アツコ）	女	リハビリテーション科学コース 臨床認知神経科学	1. 独居高齢者の在宅生活安全性のリスク評価ツールとしてのKinectの信頼性や妥当性の検討 2. kinectを使用したIADL動作解析値と身体機能，認知機能との関連性の検討	二木 淑子（フタキ トシコ） 教授 医学研究科 人間健康科学系専攻 臨床認知神経科学	中部 主敬（ナカベ カズヨシ） 教授 工学研究科 熱材料力学	大江賢治（オオエ ケンジ） 特定講師 （人体解剖学・ 分子生物学）	鳥井 美江（トリイ ミエ） 特定助教 （慢性・老年看護学 （免疫学））
4	薬学	薬科学	M2	宮之原 遵（ミヤノハラ ジュン）	男	病態機能解析学講座 生体機能解析学	FAERSを利用した脳血管障害リスク薬剤の検出	金子 周司（カネコ シュウジ） 教授 薬学研究科 生体機能解析学	藤田 潤（フジタ ジュン） 教授 医学研究科 分子病診療学	松田 和郎（マツダ クニオ） 特定講師 （神経解剖学・ 解剖学一般）	平井 康治（ヒライ ヤスハル） 特定助教 （神経生理学）
5	工学	高分子化学	M2	栗原 令（クワバラ レイ）	女	医用高分子講座 組織修復材料学	細胞移植による糖尿病治療と高齢化社会	岩田 博夫（イワタ ヒロオ） 教授 再生医科学研究所 組織修復材料学	木村 剛（キムラ タケシ） 教授 医学研究科 循環器内科学	髙折 恭一（タカオリ キョウイチ） 特定准教授 （膵臓外科学・ 低侵襲治療学）	滝本 晶（タキモト アキ） 特定助教 （発生学）
6	工学	高分子化学	M2	村尾 賢（ムラオ ケン）	男	医用高分子講座 材料機能解析分野	精神疾患のバイオマーカーの探索	伊藤 紳三郎（イトウ シンザブロウ） 教授 工学研究科 材料機能解析	河野 憲二（カワノ ケンジ） 教授 医学研究科 認知行動脳科学	近藤 健悟（コンドウ ケンゴ） 特定助教 （医用生体工学）	長谷川 拓（ハセガワ タク） 特定助教 （神経生理学）
7	工学	合成・生物化学	M2	水藤 拓人（スイトウ タクト）	男	生物化学講座 生体認識化学分野	加齢に伴う健康障害と腸内細菌との関わりについて	梅田 真郷（ウメダ マサト） 教授 工学研究科 生体認識化学	渡邉 大（ワタナベ ダイ） 教授 医学研究科 生体情報科学	西 美幸（ニシ ミユキ） 特定准教授 （生化学・ 発生生物学）	佐藤 文規（サトウ フミノリ） 特定助教 （発生生物学・ 分子生物学）
8	工学	合成・生物化学	M2	山口 一真（ヤマグチ カズマ）	男	生物化学講座 分子生物化学分野	1. 脊髄小脳失調症の分子病理学的知見 2. 脊髄小脳失調症患者のリハビリテーションと介護・生活支援	森 泰生（モリ ヤスオ） 教授 工学研究科 分子生物化学	髙橋 良輔（タカハシ リョウスケ） 教授 医学研究科 臨床神経学	Christian Altmann（クリスチャン アルトマン） 医学研究科 特定准教授 （実験心理学）	稲場 直子（イナバ ナオコ） 特定助教 （神経生理学）

LIMS (M1) Students, Supervisors and Mentors (AY2014)

(As of March 31, 2015)

	Graduate School	Division	Grade	Student	Gender	Department	LIMS Research Issues	Academic Supervisor	LIMS Supervisor	LIMS Mentor position, (research field)	LIMS Mentor position, (research field)
1	Medicine	Medical Science	M1	**Hiroyuki Matsubara**	M	Disease modeling with patient-specific iPSCs, Dept. of Clinical Application, Center for iPS Cell Research and Application	The treatment of leukemia	**Prof. Tatsutoshi Nakahata** Disease modeling with patient-specific iPSCs, Center for iPS Cell Research and Application	**Prof. Taiji Adachi** Biomechanics, Institute for Frontier Medical Sciences	**Aki Takimoto** Program-Specific Assistant Professor (Embryology)	**Taku Hasegawa** Program-Specific Assistant Professor (Neurophysiology)
2	Medicine	Medical Science	M1	**SAHA Liton Kumar**	M	Radiation Genetics	To ensure effective treatment of cancer to reduce mortality and morbidity, recognizing the value of the importance of chemotherapy and radoitherapy in the treatment of cancer	**Prof. Shunichi Takeda** Radiation Genetics, Graduate School of Medicine	**Prof. Masahiro Hiraoka** Radiation Oncology and Image-Applied Therapy, Graduate School of Medicine	**Yu Kimura** Program-Specific Associate Professor (Polymer Chemistry)	**Fuminori Sato** Program-Specific Assistant Professor (Developmental Biology / Molecular Biology)
3	Medicine	Medical Science	M1	**Aila Johanna**	F	Morphological Brain Science	Age-related changes of neural architecture	**Prof. Takeshi Kaneko** Morphological Brain Science, Graduate School of Medicine	**Prof. Toshio Heike** Pediatrics, Graduate School of Medicine	**Yuriko Higuchi** Program-Specific Senior Lecturer (Biopharmaceutics)	**Dinh Ha Duy Thuy** Program-Specific Assistant Professor (Functional Neuroimaging)
4	Medicine	Medical Science	M1	**MBENZA MBAMBI NAASSON**	M	Chemical Biology Laboratory, Institute for Chemical Research	Contribution towards the assessement of the inadequacies of health policy in Democratic Republic of the Congo (DRC) through comparison to Japanese health policy in term of medicines control and health insurance system	**Prof. Uesugi Motonari** Chemical Biology, Institute for Chemical Research	**Prof. Yutaka Teranishi** Medical Science and Business Liaison Organization, Graduate School of Medicine	**Wakoto Matsuda** Program-Specific Senior Lecturer (Neuroanatomy, Anatomy)	**Yasuharu Hirai** Program-Specific Assistant Professor (Neurophysiology)
5	Medicine	Human Health Sciences	M1	**Tomoko Matsumoto**	F	Basic Laboratory Science, Medical Laboratory Science	Study on Problems in Medical Ethics for Realizing Regenerative Medicine	**Prof. Kuniaki Saito** Basic Laboratory Science, Human Health Sciences, Graduate School of Medicine	**Prof. Taira Maekawa** Transfusion Medicine & Cell Therapy, Kyoto University Hospital	**Masao Matsuhashi** Program-Specific Associate Professor (Clinical Neurophysiology)	**Taku Hasegawa** Program-Specific Assistant Professor (Neurophysiology)
6	Pharmaceutical Sciences	Phamaceutical Sciences	M1	**Kouki Shinoda**	M	Biofunctional Design-Chemistry, Division of Biochemistry, Institute for Chemical Research	Association between age-related changes in biorhythm and disease onset; chronobiological study and its application to clinical treatment	**Prof. Shiro Futaki** Biofunctional Design-Chemistry, Institute for Chemical Research	**Prof. Osamu Ogawa** Urology, Graduate School of Medicine	**Koji Yamamoto** Program-Specific Associate Professor (Mechanical Engineering)	**Aki Takimoto** Program-Specific Assistant Professor (Embryology)
7	Pharmaceutical Sciences	Bioinformatics and Chemical Genomics	M1	**Kumiko Dojo**	F	System Biology	The Health Risks of Shift Work	**Prof. Hitoshi Okamura** System Biology, Graduate School of Pharmaceutical Sciences	**Prof. Ikuo Konishi** Gynecology and Obstetrics, Graduate School of Medicine	**Kenji Ohe** Program-Specific Senior Lecturer (Human Anatomy / Molecular Biology)	**Takehiko Kinoshita** Program-Specific Senior Lecturer (Applied Mathematics)
8	Engineering	Molecular Engineering	M1	**Masatoshi Uno**	M	Biomolecular Functional Chemistry	Prediction and validation of the onset mechanism of autoimmune disease based on disorder in the cytokine network	**Prof. Masahiro Shirakawa** Biomolecular Functional Chemistry, Graduate School of Engineering	**Prof. So Iwata** Cell Biology, Graduate School of Medicine	**Miyuki Nishi** Program-Specific Associate Professor (Biochemistry / Developmental Biology)	**Mie Torii** Program-Specific Assistant Professor (Gerontological Nursing (Immunology))
9	Engineering	Molecular Engineering	M1	**Itaru Takeshita**	M	Biomolecular Functional Chemistry	Research on the evaluation of carcinogenic risk using DNA methylation analysis and the relationship between the carcinogenic risk and life style	**Prof. Masahiro Shirakawa** Biomolecular Functional Chemistry, Graduate School of Engineering	**Prof. Hideaki Kakeya** System Chemotherapy and Molecular Sciences, Graduate School of Pharmaceutical Sciences	**Kyoichi Takaori** Program-Specific Associate Professor (Pancreatic Surgery / Minimally Invasive Therapeutics)	**Naoko Inaba** Program-Specific Assistant Professor (Neurophysiology)
10	Engineering	Polymer Chemistry	M1	**Kazumasa Suenaga**	M	Polymerization Chemistry, Polymer Synthesis	Development of Functional Optical Materials for Quantifying Biomolecules Based on Organic-Inorganic Hybrids	**Prof. Yoshiki Chujo** Polymerization Chemistry, Graduate School of Engineering	**Prof. Kiminori Hosoda** Nursing Science for Lifestyle-Related Diseases, Human Health Sciences, Graduate School of Medicine	**Kyoichi Takaori** Program-Specific Associate Professor (Pancreatic Surgery / Minimally Invasive Therapeutics)	**Kengo Kondo** Program-Specific Assistant Professor (Medical Biotechnology)
11	Engineering	Synthetic Chemistry and Biological Chemistry	M1	**Hiroki Enno**	M	Functional Coordination Chemistry Field, Synthetic Chemistry Course	・Literature search on the relationship between age-related diseases in the elderly and the chemical compounds that induce them ・Spatiotemporal control of bioactive gas molecules and their clinical applications	**Prof. Susumu Kitagawa** Functional Coordination Chemistry, Graduate School of Engineering	**Prof. Shuichi Matsuda** Orthopaedic Surgery, Graduate School of Medicine	**Meiko Takahashi** Program-Specific Senior Lecturer (Genomic Medicine)	**Mie Torii** Program-Specific Assistant Professor (Gerontological Nursing (Immunology))
12	Engineering	Synthetic Chemistry and Biological Chemistry	M1	**Nobuhiko Nishitani**	M	Physical Organic Chemistry Field, Synthetic Chemistry Course	・Applying photoresponsive molecules to organisms ・Cooperative assembling behavior in organisms	**Prof. Kenji Matsuda** Physical Organic Chemistry Field, Graduate School of Engineering	**Prof. Makoto Noda** Molecular Oncology, Graduate School of Medicine	**Christian Altmann** Program-Specific Associate Professor, Graduate School of Medicine (Experimental Psychology)	**Fuminori Sato** Program-Specific Assistant Professor (Developmental Biology / Molecular Biology)

LIMS (M2) Students, Supervisors and Mentors (AY2014)

(As of March 31, 2015)

	Graduate School	Division	Grade	Student	Gender	Department	LIMS Research Issues	Academic Supervisor	LIMS Supervisor	LIMS Mentor position, (research field)	LIMS Mentor position, (research field)
1	Medicine	Medical Science	M2	**Maki Sakuma**	F	Anatomy and Developmental Biology	Transcriptome analysis with application in cancer treatment	**Prof. Masatoshi Hagiwara** Anatomy and Developmental Biology, Graduate School of Medicine	**Prof. Yasuo Mori** Molecular Biology, Graduate School of Engineering	**Koji Yamamoto** Program-Specific Associate Professor (Mechanical Engineering)	**Yuriko Higuchi** Program-Specific Senior Lecturer (Biopharmaceutics)
2	Medicine	Human Health Sciences	M2	**Mikako Gomyo**	F	Medical Imaging System Sciences, Laboratory Science Course	・Quantitative assessment of photoacoustic properties of biological tissues by photoacoustic microscopy ・Applying viscoelastic properties for pathology and other clinical diagnoses	**Prof. Tsuyoshi Shiina** Medical Imaging System Sciences, Human Health Sciences, Graduate School of Medicine	**Prof. Masakazu Toi** Breast Surgery, Graduate School of Medicine	**Masao Matsuhashi** Program-Specific Associate Professor (Clinical Neurophysiology)	**Takehiko Kinoshita** Program-Specific Senior Lecturer (Applied Mathematics)
3	Medicine	Human Health Sciences	M2	**Atsuko Ishida**	F	Clinical Cognitive Neuroscience, Rehabilitation Sciences Course	・An investigation of reliability and validity on Kinect as the tool of safety life for older adults ・An investigation of the relationships between IADL motion analysis value, physical function and cognitive function by using Kinect	**Prof. Toshiko Futaki** Clinical Cognitive Neuroscience, Human Health Sciences, Graduate School of Medicine	**Prof. Kazuyoshi Nakabe** Mechanics of Thermal Fluid and Material, Graduate School of Engineering	**Kenji Ohe** Program-Specific Senior Lecturer (Human Anatomy / Molecular Biology)	**Mie Torii** Program-Specific Assistant Professor (Gerontological Nursing (Immunology))
4	Pharmaceutical Sciences	Pharmaceutical Sciences	M2	**Jun Miyanohara**	M	Molecular Pharmacology	Detection of high-risk drugs for cerebrovascular diseases using FAERS	**Prof. Shuji Kaneko** Molecular Pharmacology, Graduate School of Pharmaceutical Sciences	**Prof. Jun Fujita** Clinical Molecular Biology, Graduate School of Medicine	**Wakoto Matsuda** Program-Specific Senior Lecturer (Neuroanatomy, Anatomy)	**Yasuharu Hirai** Program-Specific Assistant Professor (Neurophysiology)
5	Engineering	Polymer Chemistry	M2	**Rei Kuwabara**	F	Reparative Materials, Biomaterials Design	Meaning of treatment of diabetics by cell transplantation in aged society.	**Prof. Hiroo Iwata** Reparative Materials, Institute for Frontier Medical Sciences	**Prof. Takeshi Kimura** Cardiovascular Medicine, Graduate School of Medicine	**Kyoichi Takaori** Program-Specific Associate Professor (Pancreatic Surgery / Minimally Invasive Therapeutics)	**Aki Takimoto** Program-Specific Assistant Professor (Embryology)
6	Engineering	Polymer Chemistry	M2	**Ken Murao**	M	Material Function and Analysis, Biomaterials Design	Investigation of biomarker for mental disorder	**Prof. Shinzaburo Ito** Material Function and Analysis, Graduate School of Engineering	**Prof. Kenji Kawano** Integrative Brain Science, Graduate School of Medicine	**Kengo Kondo** Program-Specific Assistant Professor (Medical Biotechnology)	**Taku Hasegawa** Program-Specific Assistant Professor (Neurophysiology)
7	Engineering	Synthetic Chemistry and Biological Chemistry	M2	**Takuto Suito**	M	Biorecognics Field, Biological Chemistry Course	Study on age-related disease and gut microbiome	**Prof. Masato Umeda** Biorecognics, Graduate School of Engineering	**Prof. Dai Watanabe** Biological Sciences, Graduate School of Medicine	**Miyuki Nishi** Program-Specific Associate Professor (Biochemistry / Developmental Biology)	**Fuminori Sato** Program-Specific Assistant Professor (Developmental Biology / Molecular Biology)
8	Engineering	Synthetic Chemistry and Biological Chemistry	M2	**Kazuma Yamaguchi**	M	Molecular Biology Filed, Biological Chemistry Course	・Molecular pathological study of spinocerebellar ataxia. ・Nursing care and rehabilitation for patients with spinocerebellar ataxia.	**Prof. Yasuo Mori** Molecular Biology, Graduate School of Engineering	**Prof. Ryosuke Takahashi** Neurology, Graduate School of Medicine	**Christian Altmann** Program-Specific Associate Professor, Graduate School of Medicine (Experimental Psychology)	**Naoko Inaba** Program-Specific Assistant Professor (Neurophysiology)

2.

教育カリキュラム及び指導体制

Curriculum and Staff

平成26年度　履修科目表

科目群	科　目		担当者	修士				博士後期						備　考
				1年次		2年次		3年次		4年次		5年次		
				前	後	前	後	前	後	前	後	前	後	
基盤科目	工学	機械工学基礎	中部･安達･山本	2										7月･8月
		医用電子工学	椎名･杉本	2										
		材料化学基礎	近藤･木村祐		2									
		高分子医工学	岩田			2								
		連続体力学	安達		2									
		生物分子解析学	森･西		2									
		画像処理の基礎	杉本･椎名			2								
	薬学	薬物動態学	中山･高倉･橋田･樋口				2							
	医学・生物学	人体解剖学	萩原･金子･大江･松田和	5										必修
		生理学	大森･河野･金子		2									必修（9月～）
		医化学	渡邉	2										4月･3月
		加齢医学	荒井			2								
		再生医学	開･瀬原･田畑･安達				2							
		ゲノムコホート研究	松田文･高橋			2								
	医療倫理	医療倫理	小杉･藤田･福山			1								
数理科学	基礎数学		木下	2										
	シミュレーション概論		木下		2									
医療経済学	医療経済論		後藤･富塚				2							
	知的財産＆国際標準化		寺西			2								
医療工学特別講義	医療工学特別講義Ⅰ		石井		2									（9月～）
	医療工学特別講義Ⅱ		石井				2							（9月～）
学際応用科目	**A. 学際応用科目**													
	1 画像診断学：講義													
	1−1 病理画像診断学		羽賀		1									
	1−2 放射線画像診断学		福山		1									（9月～）
	1−3 MRI 画像診断学		福山											
	2 低侵襲治療学：講義		木村剛･高折		1									
	3 生体材料学・人工臓器学：講義		田畑･松田秀				1							9月･10月
	4 医療情報学：講義		黒田				1							
	5 検査機器学・研究機器学：講義		一山				1							
	6 医療･生活支援システム学：講義		椎名	1										必修 4月･5月
	6−1 生体検査･画像解析法													
	6−2 在宅医療支援													
	6−3 リハビリテーション													

科目群	科　目	担当者	修士				博士後期						備　考
			1年次		2年次		3年次		4年次		5年次		
			前	後	前	後	前	後	前	後	前	後	
学際応用科目	**B. 実習及び病院内研修**												
	1 画像診断学：実習												
	1-1 病理画像診断学	羽賀		1									
	1-2 放射線画像診断学	福山		1									(9月～)
	1-3 MRI 画像診断学	福山											
	2 低侵襲治療学：実習	木村剛・高折		1									
	3 生体材料学・人工臓器学：実習	田畑・松田秀				1							9月･10月
	4 医療情報学：実習	黒田				1							
	5 検査機器学・研究機器学：実習	一山				1							
	6 医療･生活支援システム学：実習・見学	椎名	1										必修 4月･5月
	6-1 生体検査･画像解析法												
	6-2 在宅医療支援機関												
	6-3 リハビリテーション部												
英語 debate Ⅰ		Altmann	1	1									必修
英語 debate Ⅱ		Altmann			1	1							必修
インターンシップ	短期海外インターンシップ	武田・福山											選択必修
	企業インターンシップ	石井・福山											
プレリサーチ													必修
特別研究													必修

網掛けは開講学年・学期、数字は単位数
学際応用科目は、講義及び実習の両方を受講しないと単位は認められない。

Curriculum (Academic Year 2014)

No	Subjects	Lecturer	MC				DC						Remarks
			1st Grade		2nd Grade		3rd Grade		4th Grade		5th Grade		
			1st Sem	2nd Sem	1st Sem	2nd Sem	1st Sem	2nd Sem	1st Sem	2nd Sem	1st Sem	2nd Sem	
1	Mechanics and Dynamics, Fundamental	Nakabe, Adachi, Yamamoto	2										Jul. Aug.
2	Medical Electronics	Shiina, Sugimoto	2										
3	Basic Materials Chemistry	Kondo, Y.Kimura		2									
4	Biomaterials: Materials for preparation of medical devices and regenerative medicine	Iwata			2								
5	Continuum Mechanics	Adachi		2									
6	Molecular Analysis of Life	Mori, Nishi		2									
7	Image Processing Basics	Sugimoto, Shiina			2								
8	Biopharmaceutics	Nakayama, Takakura, Hashida, Higuchi				2							
9	Human Anatomy	Hagiwara, Kaneko, Ohe, W.Matsuda	5										Compulsory
10	Physiology	Ohmori, Kawano, Kaneko		2									Compulsory (Sep.～)
11	Medical Chemistry	Watanabe	2										Apr. Mar.
12	Gerontology, Geriatrics, and Aging Science	Arai			2								
13	Regenerative Medicine	Hiraki, Sehara, Tabata, Adachi				2							
14	Genome Cohort Study	F.Matsuda, Takahashi			2								
15	Medical Ethics	Fukuyama, Kosugi, Fujita			1								
16	Basic Mathematics	Kinoshita	2										
17	Introduction to Numerical Simulation	Kinoshita		2									
18	Health Economics	Goto, Tomizuka				2							
19	Intellectual Property & Global Standardization	Teranishi			2								
20	Medical Engineering for Society Ⅰ	Ishii		2									Sep.～
21	Medical Engineering for Society Ⅱ	Ishii				2							Sep.～
	◆ Interdisciplinary application（1～6）												
	1. Medical imaging: Lecture												
22	1-1 Diagnostic Pathology	Haga		1									
23	1-2 Radiology	Fukuyama		1									Sep.～
24	1-3 MRI introduction	Fukuyama											
25	2. Minimally invasive therapeutics : Lecture	T.Kimura, Takaori		1									
26	3. Biomaterials and Artificial Organs : Lecture	Tabata, S.Matsuda				1							Sep. Oct.
27	4. Medical informatics : Lecture	Kuroda				1							
28	5. Inspection equipment studies Science research equipment : Lecture	Ichiyama				1							
29	6. Medical and life support systems : Lecture	Shiina	1										Compulsory (Apr. May)

No	Subjects	Lecturer	MC				DC						Remarks
			1st Grade		2nd Grade		3rd Grade		4th Grade		5th Grade		
			1st Sem	2nd Sem	1st Sem	2nd Sem	1st Sem	2nd Sem	1st Sem	2nd Sem	1st Sem	2nd Sem	
	1. Medical imaging : Practice												
22	1-1 Diagnostic Pathology	Haga		1									
23	1-2 Radiology	Fukuyama		1									Sep.～
24	1-3 MRI introduction	Fukuyama											
25	2. Minimally invasive therapeutics : Practice	T.Kimura, Takaori		1									
26	3. Biomaterials and Artificial Organs : Practice	Tabata, S.Matsuda				1							Sep. Oct.
27	4. Medical informatics: Practice	Kuroda				1							
28	5. Inspection equipment studies Science research equipment : Practice	Ichiyama				1							
29	6. Medical and life support systems : Practice	Shiina	1										Compulsory (Apr. May)
30	Debate Ⅰ	Altmann	1	1									Compulsory
31	Debate Ⅱ	Altmann			1	1							Compulsory
32	Internship (Abroad)	Takeda, Fukuyama											Compulsory elective
33	Internship (Industrial and public parties)	Ishii, Fukuyama											
34	Pre-research												Compulsory
35	Thesis Research												Compulsory

Number: The number of credits

Note: Students must take both the lecture and practice for "the Interdisciplinary application".

特定教員の配置と活動

京都大学では、博士課程教育リーディングプログラムを学際融合教育研究推進センターの制度を活用して運営している（図1）。LIMS プログラムでは、学際的な教育の促進と個々の履修生に対する多角的な観点からの指導のため、関連分野にわたって特定教員を採用した（図2）。

講義・実習・研修

特定教員（教授・准教授・講師）はプログラム科目を担当し、特定助教も実習・研修の実施を担当した。又次年度以降開講の講義・実習の準備を行った。履修生3回生以降のコロキウム・特別研究については、個々の特定教員の専門分野に応じて担当する予定である。次ページ以降に、具体的な実施状況の一部を記す:

1. 人体解剖学 ---------- 大江　賢治・松田　和郎
2. 生理学 ---------- 松田　和郎・稲場　直子・平井　康治
3. 医療・生活支援システム学（生体検査・画像解析法、リハビリテーション）---------- 近藤　健悟
4. 医療・生活支援システム学（在宅医療支援）---------- 鳥井　美江
5. 英語 debate ---------- Christian Altmann
6. 機械工学基礎 ---------- 山本　浩司
7. 材料化学基礎 ---------- 木村　祐
8. 生物分子解析学 ---------- 西　美幸
9. 薬物動態学 ---------- 樋口　ゆり子
10. 医化学 ---------- 長谷川　拓
11. 再生医学 ---------- 佐藤　文規・滝本　晶
12. ゲノムコホート研究---------- 高橋　めい子
13. 基礎数学---------- 木下　武彦
14. シミュレーション概 論 ---------- 木下　武彦
15. 医療経済論 ---------- 富塚　太郎
16. 低侵襲治療学 ---------- 髙折　恭一
17. 医療工学特別講義Ⅰ、Ⅱ：　（産公学連携の章参照）

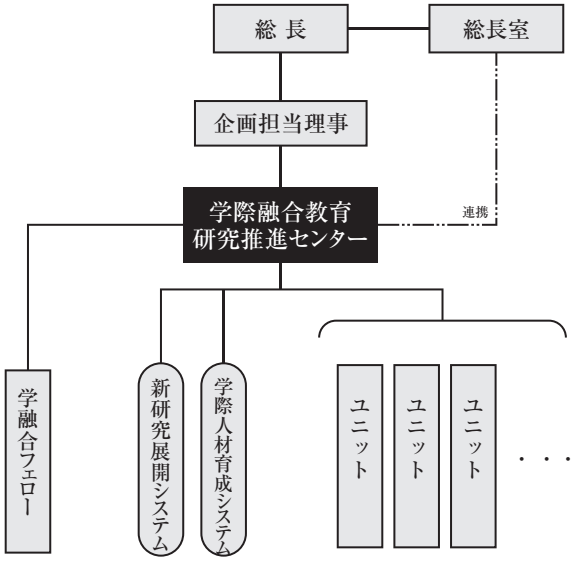
メンター

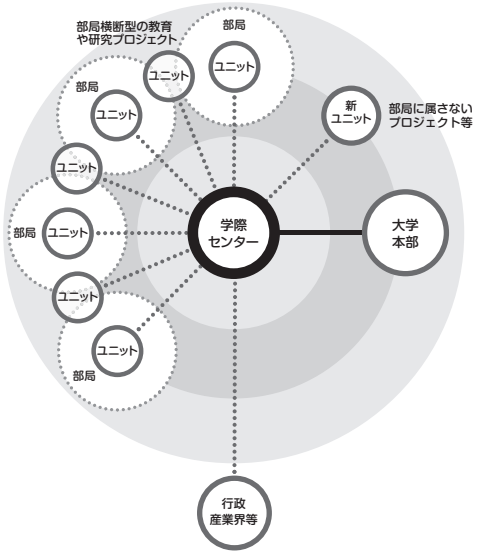
各履修生について、専門分野の指導教員のほか、LIMS プログラムの教育研究課題を学生・指導教員とともに企画し、学生の自主的な課題遂行を支援・助言するため、専門分野と関連を持ちながらも異なる分野から、LIMS 指導教員（教授）1名とメンター2名を設定した。特定教員がメンターの任に当たり、特別研究への準備段階であるプレリサーチについても、助言・指導を行った。

1　学際融合教育研究推進センター・ユニットによる運営

京都大学　学際融合教育研究推進センター
『健康長寿社会の総合医療開発ユニット』（LIMS）の設置

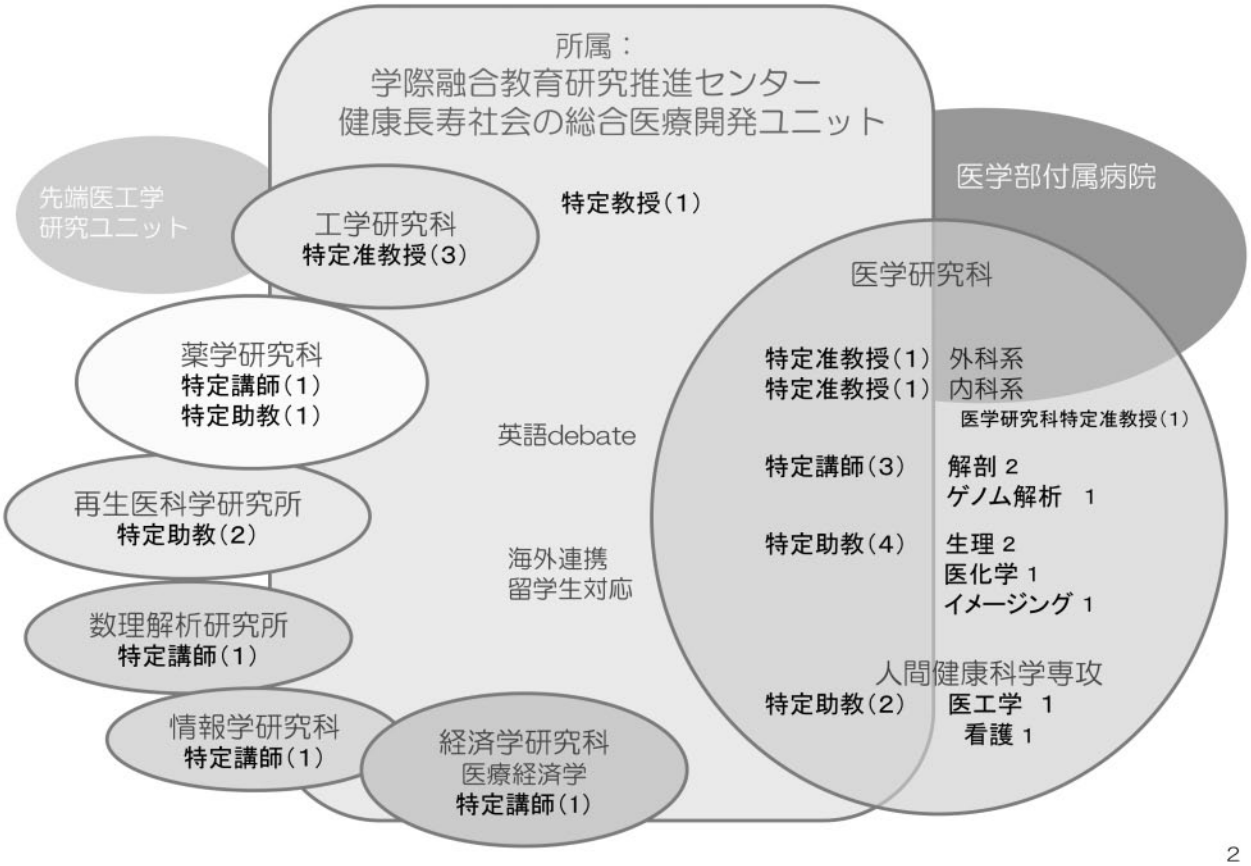
- ユニット内規の制定
- ユニットプログラム教授会、委員会（カリキュラム・人事・広報・入進学審査）による運営
- ユニット所属特定教員の採用
- ユニット事務室によるプログラム事務処理





1

2　特定教員の配置



2

実施状況

1. 人体解剖学

担当者： 萩原　正敏　教授（医学研究科・形態形成機構学）
金子　武嗣　教授（医学研究科・高次脳形態学）
山田　重人　教授（医学研究科・人間健康科学系専攻・運動機能解析学）
青山　朋樹　准教授（医学研究科・人間健康科学系専攻・運動機能開発学）
大江　賢治　特定講師（LIMS）
松田　和郎　特定講師（LIMS）

人体解剖学は、LIMS履修生2年前期の基盤科目であり、超高齢社会において重要となる筋・骨格系講義と運動学を重視した内容である。履修生が、人体解剖学の講義と実習を通して、医工連携に不可欠な人体の「構造」と「機能」の連関を理解してもらうことを目標としている。本年度は、医学部学生の使用する教科書を参考にして講義プリントを適宜配布し、レポート提出による習熟度チェックも行なった。実習では、医学部学生が学習する実際のご遺体に触れさせ、バーチャル画像や樹脂模型を使って、立体的に人体の構造を理解させた。系統解剖を体験させることが、本プログラムにおける人体解剖学の大きな特長である。

2. 生理学

担当者： 大森　治紀　教授（医学研究科・神経生物学）
河野　憲二　教授（医学研究科・認知行動脳科学）
金子　武嗣　教授（医学研究科・高次脳形態学）
松田　和郎　特定講師（LIMS）
稲場　直子　特定助教（LIMS）
平井　康治　特定助教（LIMS）

本育成プログラムの目指すところである『医療現場のニーズに立脚した総合医療システムの開発者並びにこれを統率するリーダー』に求められる医学の基礎知識として、生理学の講義を基盤科目・必修として修士1回生の後期（9-12月）に行った。この講義は、特に工学系出身の学生に対し、医学部卒業生に匹敵する医学・生理学の知識を与えることを目標としている。講義は医学部学生を対象として行われるものと同等のクオリティを目指し、特に重要と思われる以下の内容を厳選して行った。

1. 生命に必要な生体の恒常性とそれを支える神経系について
2. 神経の働きを理解するのに必要な膜興奮性と神経活動、シナプスの構造と働きについて
3. 脳の構造と機能、及び感覚受容について
4. 生命維持に特に重要な心臓・循環及び肺・呼吸について

理解程度の確認のために、履修生には内容ごとにレポートを課し、評価した。

3月には、医学部学生に向けた生理学実習で用いる実験装置を実際に使用しながら、生理学実験を行うための手法、並びに解析方法についての指導を行った。

3. 医療・生活支援システム学（生体検査・画像解析法、リハビリテーション）

担当者：椎名 毅　教授（医学研究科・人間健康科学系専攻・医療画像情報システム学）
齋藤 邦明　教授（医学研究科・人間健康科学系専攻・基礎検査展開学）
杉本 直三　教授（医学研究科・人間健康科学系専攻・先進医療機器開発学）
足立 壮一　教授（医学研究科・人間健康科学系専攻・検査応用開発学）
黒木 裕士　教授（医学研究科・人間健康科学系専攻・運動機能解析学）
山根　寛　教授（医学研究科・人間健康科学系専攻・脳機能リハビリテーション学）
二木 淑子　教授（医学研究科・人間健康科学系専攻・臨床認知神経科学）
加藤 寿宏　准教授（医学研究科・人間健康科学系専攻・脳機能リハビリテーション学）
平松 英文　講師（医学部附属病院・小児科）
近藤 健悟　特定助教（LIMS）

医療の現場において検査や画像解析に関する先進医療機器、また在宅医療介護やリハビリテーションにおいて医療支援システムがどのように応用されているかを理解することを目的とし、講義および実習を行った。

【生体検査・画像解析法】

1. 講義

1.1 オミックス解析による病態解析

臨床検査の医療における役割と新しい診断薬開発の方向性を学んだ。

・個別化医療における臨床検査の役割：先制医療、コンパニオン診断
・新たな診断薬開発のためのオミックス解析による病態解析：プロテオミクス、メタボロミクス、ゲノミクス
・新たな免疫制御因子 IDO：創薬と診断薬開発

1.2 医用画像機器

生体組織の形態や機能を画像化する様々な医用画像機器についての特徴および原理の概要を学んだ。また、それらによって得られる種々の臓器の画像の例、さらに同じ部位を異なる方法で画像化し、それぞれの特徴を比較した。

・様々な臓器の形態画像：胸部 X 線、胃 X 線造影、消化管撮影、冠動脈造影、マンモグラフィ、断層撮影装置、頭部 X 線 CT、心臓3次元 X 線 CT、全身 MRI
・頭部の様々な画像（形態や機能）：X 線 CT、MRI、SPECT、PET、fMRI、脳血管造影、MRA、NIRS
・光、超音波による形態や機能の可視化：サーモグラフィ、眼底写真、眼底　OCT、内視鏡（胃）、内視鏡（大腸）、カプセル内視鏡、内視鏡（血管）、超音波内視鏡、腹部超音波

2. 実習

生体検査法として、フローサイトメトリーについての講義および実習を行った。まず、フローサイトメトリーの原理およびそれによって得られる情報、適用対象についての講義を行った。実習では、フローサイトメーターを用いて血液を計測した。また蛍光標識抗体の有無による結果の違いを観察するなどし、検査装置によって得られる情報について考察した。

3. 学外研修

医用画像機器、検査機器を開発する島津製作所を訪問し、分析装置や画像診断機器等について見学を行った。それぞれの装置の説明を受けるとともに、開発における話を伺う、実際に触れるなどし、様々な機器やその開発、応用について学んだ。また X 線画像診断装置等の画像診断機器の製造過程を見学し、医療機器がどのように製造されているかを学んだ。

【リハビリテーション】

超高齢社会をむかえた我が国において、高齢者リハビリテーションは喫緊の解決すべき課題である。リハビリテーション（理学療法、作業療法）についてその概要を学ぶと共に、リハビリテーションにおける医療・福祉・在宅ケアの統合の重要性を理解し、さらに従来の医工連携の枠組みを超えて、医療現場のニーズに立脚した総合医療システムを開発する医工学の必要性を考察することを目的に講義、実習を行った。

1. 講義

リハビリテーション（理学療法、作業療法）について、その概要を学んだ。

1.1 理学療法

・何が求められているか
・現状認識：高齢化率と障害、疾病、平均在院日数
・回復期リハビリテーション病棟
・病院で完結しないリハビリテーション：維持期リハビリテーションの重要性
・リハビリテーションの語源
・理学療法の対象と領域
・新たな機器開発の時代

1.2 作業療法

・作業療法について：語源、特性、機能、対象、手段、領域
・作業療法でもちいる作業
・歴史、日本および世界における作業療法士数、養成施設数
・作業療法の分類
・精神認知機能領域作業療法
・身体障害領域作業療法
・障害の具体例、リハビリテーションの具体例

2. 実習

京都大学医学部附属病院のリハビリテーション部において、理学療法士、作業療法士に付き、リハビリテーションの臨床で行われている理学療法、作業療法それぞれについて現場の見学を行うことにより講義で学んだリハビリテーションについての理解を深めた。

4. 医療・生活支援システム学（在宅医療支援）

担当者： 荒井 秀典 教授（医学研究科・人間健康科学系専攻・近未来システム・技術創造部門）
鳥井 美江 特定助教（LIMS）

4人に1人が高齢者という超高齢社会である我が国は、高齢者やその家族のニーズは多様化し、介護・医療・福祉分野における対策が急務とされている。厚生労働省は、自立した生活を支援し、高齢者が住み慣れた地域での住宅生活を継続することができるように地域の包括的な支援・サービスの構築（地域包括ケア）を推進している。地域包括ケアを実現するためには、医療分野・介護分野の連携強化、介護サービスの充実、予防の推進、生活支援サービスの確保、住まいの整備などが必要とされている。

在宅医療支援分野では、高齢者への支援や療養生活を見学・体験することで地域医療・介護現場において高齢者やその家族が抱えている問題に触れ、対象者のニーズに沿った医療支援システムの構築や機器開発などの考察を目的として、講義と臨地実習を行った。講義は、高齢者概論、福祉政策を中心に行い、臨地実習では、高齢者施設や公的支援センターの見学、リハビリテーションの体験を行った。

（1）講義

① 高齢社会と背景：国内、諸外国の高齢化の現状や政策、今後の動向と起こりうる問題
② 高齢者の身体的・生理的特徴と変化、社会役割・精神的特徴と変化
③ 高齢者が罹患しやすい疾患
④ 高齢者福祉政策：介護保険制度の概要、介護保険制度創設・施行までの社会的背景、介護保険制度のサービス内容と手続き方法

（2）臨地実習

① 高の原ポシブルデイケアセンター：

生活リハビリに特化した新しいデイサービス施設である。ノルウェー、フィンランドなどの福祉先進国から最新トレーニング機器を導入し、理学療法士が利用者それぞれの目標を設定し、目標達成に必要な筋力トレーニングプログラムを作成し、機能評価をする。実習では実際にプログラムに参加し、予防やリハビリテーションの重要性について学びを深めた。

② 高齢者福祉施設：

介護老人福祉施設（特別養護老人ホーム）、短期入所生活介護・介護予防短期入所生活介護（ショートステイ）、通所介護・介護予防通所介護（デイサービスセンター）が複合した施設である。市内の高校と同じ敷地内にあり、デイサービスセンターにおいては地域の乳幼児と母親も利用していることから高齢者と様々な年代の地域住民とのふれあいの場にもなっている。高齢者の生活を見学する中で、それぞれの施設の特性と地域連携、生活支援サービスについて学びを深めた。

③ 地域包括支援センター、透析施設、鍼灸院

ケアマネジャー、保健師、社会福祉士が連携して地域高齢者の介護・福祉・健康・医療などさまざまな面から総合的に支援する公的相談窓口である。実習では、ケアマネジャーから施設の概要や支援内容、事例紹介を受け、高齢者の現状だけでなく、ケアマネジャーが抱える問題にも触れ、医療・介護分野の連携について学んだ。また、隣接している透析施設、鍼灸院の見学を行い、在宅療養者の生活についても学びを深めた。

5. 英語 debate

担当者： Christian F. Altmann, Program-Specific Associate Professor, Graduate School of Medicine
（英文の頁参照）

6. 機械工学基礎

担当者： 中部　主敬　教授（工学研究科・機械理工学専攻）
安達　泰治　教授（再生医科学研究所）
山本　浩司　特定准教授（LIMS）

本コースの目的は、非機械系の学生が機械工学の基礎となる四力学(機械力学、材料力学、流体力学、熱力学)を中心に学び、医工学や福祉分野における新たなデバイス開発や計測システムの構築に必要となる機械工学的感性を修得することにある。本年度は受講生2名に対し、週1回3時間(2コマ)の講義を7月、8月の2カ月間行った。前半は、上述の四力学を連続体の概念を交えて説明し、数理的な運動方程式や支配方程式と実現象との繋がりに焦点を当てた。具体的には、質量と大きさを持つ物体の変位・変形、あるいは気体や液体の流れといった身近な現象を数理的に解説し、式の持つ物理的意味の説明を行った。後半は前半で学んだ力学原理の応用事例を実際の機器やシステムを用いて紹介し、加えて最新の医療・福祉工学や医工学テクノロジーに関する解説を行った。また、修士2回生を対象とした実習は、生体材料学・人工臓器学の一環として行われた。

7. 生物分子解析学

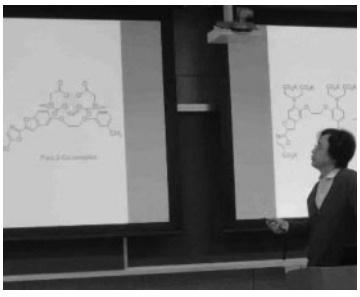
近藤　輝幸　教授（学際融合教育研究推進センター・先端医工学研究ユニット）
木村　　祐　特定准教授（LIMS）
（英文の頁参照）

8. 生物分子解析学

担当者： 森　　泰生　教授（工学研究科・合成・生物化学専攻）
西　　美幸　特定准教授（LIMS）

生物分子解析学の講義は修士1年の後期に行われる。講義は、生物学に馴染みの少ない物理、化学を中心とした高校時の授業の後、大学入学後も生物学の講義の機会が少ない学生を対象にしている。その後のLIMSで提供される医学、薬学の専門科目への橋渡し的な役割を担っている。講義は基礎的な生物学に始まり汎用性の高い高度な機器を使った実習を行った。今年度は、遺伝子とタンパク質の構造と機能、シグナル伝達に関係するタンパク質郡とセカンドメッセンジャーの動態解析に焦点を当てた講義と実習を行った。

1. 遺伝子の機能：講義及び自身の遺伝子型の決定
2. タンパク質の解析：講義及び質量分析の実習
3. カルシウムシグナリングと温度センサー：講義及び培養細胞を使った実習
4. フローサイトメトリー：講義及びセルソーターを使った実習



9. 薬物動態学

担当者： 中山　和久　教授（薬学研究科・薬科学専攻）
髙倉　喜信　教授（薬学研究科・薬学専攻）
橋田　　充　教授（薬学研究科・薬学専攻）
樋口 ゆり子 特定講師（LIMS）

薬物動態学の講義は修士2年の後期に提供される。講義では、薬物の生体内における動態、すなわち吸収、分布、代謝、排泄を理解するのに必要な解剖学的・生理学特徴を解説した後、各過程における薬物動態のメカニズムを講義した。また、薬物の体内動態制御法すなわちドラッグデリバリーシステムについての基本的な概念と実例、さらに、核酸医薬品や細胞性製剤など次世代医薬品のDDS開発について紹介した。また、講義内容の理解を深めることができるように、学生による英語でのショートプレゼンテーションを取り入れた。

・注射により投与された薬物の吸収過程と影響因子、および吸収動態制御法
・皮膚の解剖学的、生理学的特徴、薬物の経皮吸収
・消化管の構造、機能、薬物の消化管吸収
・消化管以外の粘膜部位（直腸、肺、鼻）における薬物吸収
・薬物が各組織に分布する際の支配因子
・血液−脳関門、血液−脳脊髄液関門、胎盤関門の意義と薬物の脳、胎児への移行
・腎臓の構造、機能と薬物の尿中排泄機構
・薬物の胆汁排泄と腸肝循環
・薬物代謝様式とそれに関与する代表的な代謝酵素
・薬物相互作用
・臨床薬物動態学の基礎
・タンパク質医薬品、核酸医薬品のDDSおよび細胞治療用のDDS

10. 医化学

担当者： 渡邉　　大　教授（医学研究科・生体情報科学）
柳田　素子　教授（医学研究科・腎臓内科学）
長田　重一　教授（医学研究科・医化学）
湊　　長博　教授（医学研究科・免疫細胞生物学）
野田　　亮　教授（医学研究科・分子腫瘍学）
長谷川　拓　特定助教（LIMS）

この科目では工学系のバックグラウンドを持つ本プログラム履修生を主な対象とし、現代社会において課題となっている疾患に関する知識を身に着けることを目標としている。具体的には、医学研究科の教授と協力し、疾患のメカニズム及び現在の治療法に関して生化学・分子生物学的側面から解説を行う。主に、医学部の2、3回生が学ぶ範囲を想定しており、分子生物学の教科書的な話から糖尿病や癌など大きな社会問題になっている病気のメカニズムに関して講義を行う。本年度は4月・5月にM1及びM2の学生を対象に実施した。

履修生が疾患に関する知識を身に着けることで、将来新たな治療方法や医療機器の開発に携わる際に役立つことを期待している。さらに、主な対象としている工学系の知識を持つ履修生だけでなく、生物学系のバックグランウドを持つ履修生にとっても身近に起こり得る疾患の側面から生化学・分子生物学を学ぶことは貴重な体験であったと思われる。

11. 再生医学

担当者：岩田　博夫　教授（再生医科学研究所）
開　　祐司　教授（再生医科学研究所）
瀬原　淳子　教授（再生医科学研究所）
田畑　泰彦　教授（再生医科学研究所）
安達　泰治　教授（再生医科学研究所）
末盛　博文　准教授（再生医科学研究所）
山本　雅哉　准教授（再生医科学研究所）
佐藤　文規　特定助教（LIMS）
滝本　　晶　特定助教（LIMS）

最近のiPS細胞をはじめとする幹細胞研究とその臨床応用技術の躍進により、様々な医療分野において再生医学に関連する知識を包括的に理解することがますます重要になってきている。再生医科学研究所は再生医学に関連した基礎生物学、幹細胞生物学だけではなく、工学さらには再生医学応用学を研究対象とした研究所である。2014年度の後期に開講した本講義では、再生医科学研究所の教員により、修士1回生と修士2回生を対象として以下の講義を行った。

- ES/iPS細胞などの多能性幹細胞研究の歴史。ヒト多能性幹細胞の樹立とその性質。臨床応用に向けての技術開発。
- 細胞分化と幹細胞 (I), (II)
- 硬組織の形成と再生 (I) ECM, (II) 成長と分化成熟, (III) 運動器パーツの接続
- 細胞を望む位置に配置して組織の構築を試みる
- バイオマテリアルの定義およびその医療機器とドラッグデリバリーシステム(DDS)への応用
- バイオマテリアルから見た再生医療−再生研究と再生治療−
- 硬組織再生医療における材料工学の重要性
- 体外での生体組織様構造物の作製とその応用
- 再生医療におけるナノテクノロジー
- 骨の再生・再構築の数理バイオメカニクスとスキャフォールド構造設計
- 多細胞組織の形態形成ダイナミクスの数理バイオメカニクス

幹細胞、細胞分化、生体組織の構築、及び材料工学に関する講義では、基礎生物学から再生医学応用学までを一連の講義で学ぶことにより、基礎から応用への繋がりを理解させることに重点をおいた。さらにはバイオメカニクス分野の講義も行い、受講学生が、生物学から工学そして力学と、再生医学・医療に関わる最新の知識を身につけることを目指した。

12. ゲノムコホート研究

担当者： 高橋 めい子 特定講師 (LIMS)

「ゲノムコホート研究」は、ゲノム疫学研究に活用できるゲノム医学・疫学的原理や方法論、また臨床研究への応用等について受講学生に学習し理解してもらうことを目標としている。対象は修士2回生であり、2014年前期から開始した。「予防医学の時代」と言われる21世紀医療の中でゲノム解析の果たす役割や今後のゲノム医学のあるべき姿を、講義とディスカッションを通して理解を深めた。本年度のプログラムでは以下の内容にて講義を構成した。

(1)ゲノム解読によって派生したさまざまな新しい研究領域を学び、その応用としての新規の医療技術について
(2)医学およびゲノム研究の重要性について
(3)コホートデザインやケースコントロール研究について、更にそれぞれの利点と限界について
(4)ゲノム医学研究の推進のための最新技術に関わる基礎知識
(5)バイオインフォマティクス、プロテオミクスやWeb上の データベース利用法

13. 基礎数学

担当者： 木下 武彦 特定講師(LIMS)

本講義は工学系出身の学生との連携を図るため，学部で数学を習っていない学生を主な対象とした基礎数学の習得を目標とした． 具体的には学部・一般教養レベルの微分・積分学および線形代数の概念について解説した． 微分・積分学の内容として，多変数の微分や積分の概念や具体的な計算方法，Taylor 展開法，Fourier 級数などについて解説した． 線形代数の内容として，行列・ベクトルの性質とその演算，連立一次方程式，線形空間，行列式などについて解説した． また，数式処理ソフトウェアの利用方法を解説した．

本講義で扱う内容は豊富なので，証明や演習の計算過程の詳細に時間を掛ける事はできなかった．しかしながら，演習には数式処理ソフトウェアの利用を推奨したため，聴講者の正答率は高かった．

本プログラムにおける医工連携を学生レベルでも推進するため，本講義を通して受講生が最低限の数学的概念を習得する事を期待する．

14. シミュレーション概論

担当者： 木下 武彦 特定講師(LIMS)

本講義では自然現象や社会現象に対するシミュレーション手法を学習した． シミュレーションの手順は主に以下の3つから成る．

1: モデル化：考察の対象となる現象を記述する微分方程式を導出する．
2: 求解：無次元化した方程式を導出し，その解を求める．
3: 可視化：解の可視化および解の性質を考察する．

微分方程式の導出には適切な次元を持つ変数を割り当て，それらの変数間のみたす関係式を導く事が重要となる．また，次元解析を行い，導かれた微分方程式が正しい次元を持つ事を確認しなければならない．無次元化は微分方程式の次元を無次元量にする事と同時に，一般性を失うことなくパラメータを減らす変数変換である． 講義ではこれらの点を強調して説明したため，聴講者の理解度は比較的高かった．

講義では数式処理ソフトウェアを利用して微分方程式を解く方法を紹介した． 微分方程式が解析的に解けない物に対し，数値解法として Euler 法，Runge-Kutta 法，Dormand-Prince 法を解説した．本講義では数式処理および数値計算ソフトウェアとして Python を利用した． 聴講者にはプログラミング未経験者も含まれていたため，Python の基本的な使い方から行列操作，分岐，反復，関数定義，可視化，アニメーションの解説を行った． 数値計算には Python のモジュールを利用したため，聴講者のプログラムの出来は良かった．

講義後半では微分方程式の定性的理論と近似解の誤差解析を行った． 特に，平衡点の安定性および分岐定理を紹介した．また，常微分方程式の解に対する精度保証付き数値計算法を述べた．

15. 医療経済論

担当者： 後藤　　励　特定准教授（白眉センター、経済学研究科）
　　富塚　太郎　特定講師（LIMS）

生命や医療に関する技術革新は、健康の改善や新しい産業の創出を通して社会の厚生の改善に結びつく可能性を持っている。医療制度は、先進国では多かれ少なかれ社会保険料や税といった公的資金が財源となっている。そのため、個々の技術の費用と健康改善に対する効果を示すことが求められている。一方、経済全体を見ると技術の伝搬や産業の創出が経済成長にどのような影響を与えるかが注目される。

医療経済論では、まず医療を取り巻く現状と環境、医療供給制度や医療財政についての概説から始め、技術に関する経済評価、技術革新の経済全体に対する影響を講義形式とディスカッションを通じて理解を深めた 。本年度のプログラムでは特に重要と思われる以下の内容にて講義を構成した。

１．医療概説
２．医療需要
３．医療供給体制
４．医療財源論Ⅰ：概要
５．医療財源論Ⅱ：国際比較と日本
６．医療制度の国際比較
７．保険制度とインセンティブ
８．医療制度改革：国際比較と日本
９．医療技術の経済評価

16. 低侵襲治療学

担当者： 上本 伸二 教授（医学研究科・肝胆膵・移植外科学）
木村　剛 教授（医学研究科・循環器内科学）
宮本　享 教授（医学研究科・脳神経外科学）
坂井 義治 教授（医学研究科・消化管外科学）
小川　修 教授（医学研究科・泌尿器科学）
平岡 眞寛 教授（医学研究科・放射線腫瘍学・画像応用治療学）
髙折 恭一 特定准教授（LIMS）

健康長寿社会の総合医療開発において重要なテーマである低侵襲治療学に関して、以下のとおり講義および実習を、京都大学大学院医学研究科　上本伸二教授、木村剛教授、宮本享教授、坂井義治教授、小川修教授、平岡眞寛教授の協力のもと実施した。

講義については、「肝胆膵・移植外科領域における低侵襲治療（※オリエンテーションを含む）」、「消化器疾患における低侵襲外科治療」、「脳神経外科領域における低侵襲治療」、「がん高精度放射線治療について」、「循環器領域におけるカテーテル治療」、「泌尿器科領域における低侵襲治療」を、医学部 G 棟 LIMS セミナー室および医学部附属病院において行った。

実習

「消化管外科腹腔鏡手術見学」では、同病院において、腹腔鏡手術シミュレーターを使用した腹腔鏡手術を模擬体験し、さらに消化管外科手術を見学した。「肝胆膵・移植外科手術見学」では、侵襲の大きな開腹手術を見学し、低侵襲手術との違いについて、受講生どうしでディスカッションを行った。その他、低侵襲治療学の各実習では、同病院にて以下のとおりの見学を行った。

「脳神経外科手術見学（脳血管内手術および神経内視鏡手術）」：脳血管内治療を見学
「放射線治療計画の実践」：放射線治療のシミュレーションを体験実習
「循環器内科カテーテル治療見学」：虚血性心疾患に対する血管内治療を見学
「泌尿器科手術見学（ロボット支援手術）」：ロボット支援前立腺切除術を見学

Program-Specific Staff – Mission and Activities

In Kyoto University, Leading Graduate School Programs are managed under the auspice of the Center for the Promotion of Interdisciplinary education and Research (C-PIER, Figure 1). In order to implement interdisciplinary education and to instruct each student from diverse standpoints, we recruited program-specific staff from multiple fields related to LIMS Program (Figure 2).

Lecture-Exercise-Training

Among program-specific staff, a professor, associate professors and senior lecturers gives classes and associate professors take charge of exercises and trainings. They also prepared for new classes and exercises for the coming academic year. Person(s) in charge of each student's colloquiums and specific-research are arranged according to specific backgrounds of each member. Actual activities of the staff are shown as follows.

1. Human Anatomy ---------- Kenji Ohe, Wakoto Matsuda
2. Physiology ---------- Wakoto Matsuda, Naoko Inaba, Yasuharu Hirai
3. Medical and life support systems (Biological test and Image analysis, Rehabilitation) ----- Kengo Kondo
4. Medical and daily life support systems (Home medical care support) ---------- Mie Torii
5. Debate ---------- Christian Altmann
6. Mechanics and Dynamics, Fundamental --------- Koji Yamamoto
7. Basic Materials Chemistry ---------- Yu Kimura
8. Molecular Analysis of life ---------- Miyuki Nishi
9. Biopharmaceutics ---------- Yuriko Higuchi
10. Medical Chemistry ---------- Taku Hasegawa
11. Regenerative Medicine ---------- Fuminori Sato, Aki Takimoto
12. Genom Cohort Study ---------- Meiko Takahashi
13. Basic mathematics ---------- Takehiko Kinoshita
14. Introduction to Numerical Simulation ---------- Takehiko Kinoshita
15. Health Economics ---------- Taro Tomizuka
16. Minimally invasive therapy ---------- Kyoichi Takaori
17. Medical Engineering for Society I & II :

(described in the chapter on Industrial-Academic-Government Cooperation)

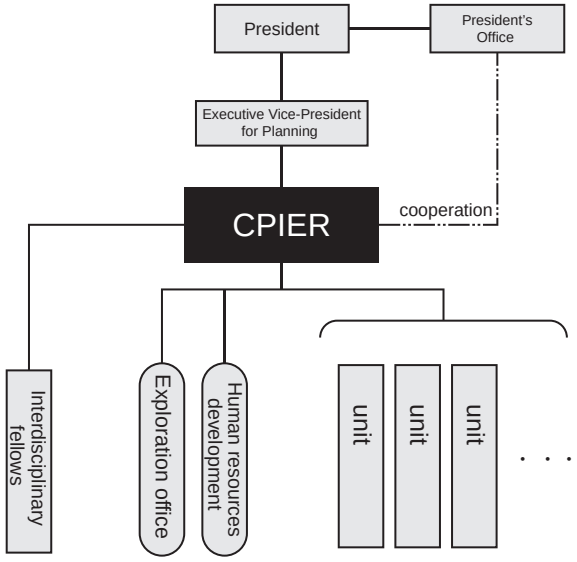
Mentors

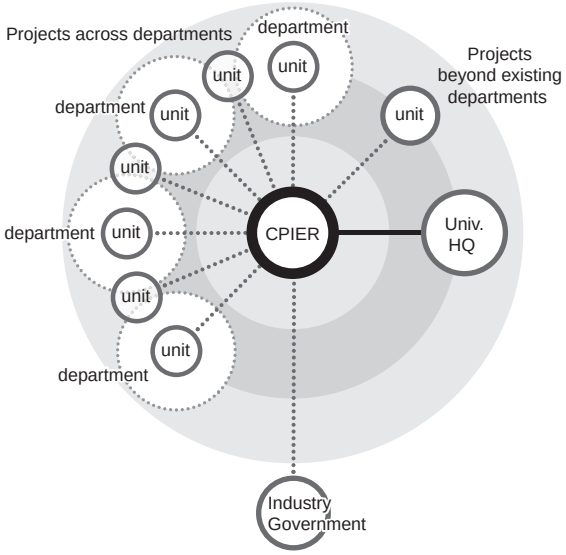
Beside a supervisor in the specific research field of each student, we arranged a LIMS supervisor (professor) and two mentors (program-specific staff) from diverse fields related to but slightly different from the specific field. Four instructors collaborate and help the student to plan training & research theme(s) in LIMS Program. They support and give advices to the student so that the latter can carry out her/his project. The mentors also take charge of the pre-research to prepare for the specific research.

1 LIMS Unit

Center for Promotion of Interdisciplinary Education and Research (CPIER)
> Research and Educational Unit of Leaders for Integrated Medical System (LIMS)

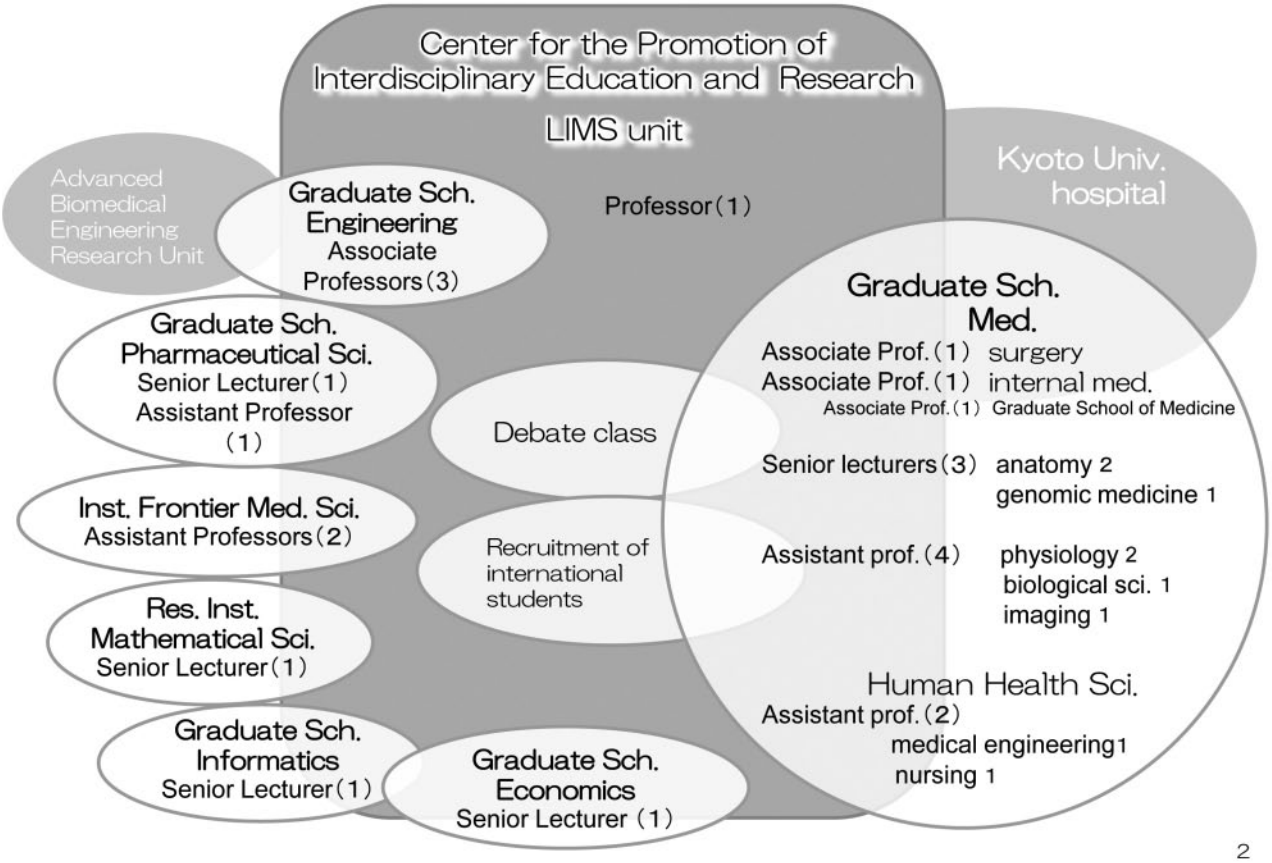
- Making the bylaws to manage the program
- Setting of the unit professorate and committees
  (curriculum, personnel, public relations, admission and promotion)
- Recruitment of program-specific staff
- Administration by the unit office





1

2 Program-Specific Staff



2

Actual Activities

1. Human Anatomy

Instructor: Masatoshi Hagiwara (Professor, Dept. Anatomy and Developmental Biology)
Takeshi Kaneko (Professor, Dept. of Morphological Brain Science)
Shigeto Yamada (Professor, Graduate School of Human Health Sciences)
Tomoki Aoyama (Associate Professor, Graduate School of Human Health Sciences)
Kenji Ohe (Program-Specific Lecturer, LIMS)
Wakoto Matsuda (Program-Specific Lecturer, LIMS)

The human anatomy course is a basic subject for the second grade students of LIMS. We have considered important to teach the musculoskeletal system and kinesiology in detail, which will become essential knowledge in coping with the unprecedented aging society. The students will apply human anatomy to structure-movement coordination, which is essential for medico-engineering collaboration. This year, we have distributed handouts and asked the students to hand in reports about the fundamentals of human anatomy. During practice, the students have learned the three-dimensional arrangement of the human body by touching the cadaver, studying virtual pictures and plastic models. An important feature of this program is to have the LIMS students experience human anatomy in a similar way as medical students do.

2. Physiology

Instructor: Harunori Ohmori (Professor, Graduate School of Medicine/Faculty of Medicine)
Kenji Kawano (Professor, Graduate School of Medicine/Faculty of Medicine)
Takeshi Kaneko (Professor, Graduate School of Medicine/Faculty of Medicine)
Wakoto Matsuda (Program-Specific Senior Lecturer, LIMS)
Naoko Inaba (Program-Specific Assistant Professor, LIMS)
Yasuharu Hirai (Program-Specific Assistant Professor, LIMS)

The lecture course Physiology was provided as the compulsory course to the first year LIMS students from September to December. The course is organized to give the minimum essential knowledge to those who do not have medical background. Knowledge in human physiology is fundamental for understanding of the mechanisms how human can live, and should be the background to learn further the other field of medical sciences in the LIMS program. Accordingly, the Physiology lecture course is organized in the following topics:

1. homeostasis; its concept and examples,
2. fundamentals of neural activities; ion channels, membrane excitability, action potential, and synapse,
3. structure and function of the brain, and sensory reception and motor coordination,
4. cardiovascular system and pulmonary system.

To check and promote the students' understanding, a writing assignment was given after each topic.

In March, we provided some practice of physiology for LIMS students, using the setups, which are also

used in the practice for medical students. The practice is intended to teach students how to conduct experiments and analyze data of physiology.

3. Medical and life support systems (Biological test and Image analysis, Rehabilitation)

Instructor: Tsuyoshi Shiina (Professor, Graduate School of Medicine)
Kuniaki Saito (Professor, Graduate School of Medicine)
Naozo Sugimoto (Professor, Graduate School of Medicine)
Soichi Adachi (Professor, Graduate School of Medicine)
Hiroshi Kuroki (Professor, Graduate School of Medicine)
Hiroshi Yamane (Professor, Graduate School of Medicine)
Toshiko Futaki (Professor, Graduate School of Medicine)
Toshihiro Kato (Associate Professor, Graduate School of Medicine)
Hidefumi Hiramatsu (Lecturer, Graduate School of Medicine)
Kengo Kondo (Program-Specific Assistant Professor, LIMS)

This course aimed to introduce advanced medical equipment used in hospitals and in a home-care setting, and health care support and rehabilitation in hospitals and nursing-care facility through lectures and seminars. Students studied overview and understood the importance of integration of medical, welfare and home-care. Moreover they discussed the demand of medical engineering which develops integrated medical systems based on requirements in medical practice beyond conventional medicine-engineering collaboration scheme.

[Biological test and Image analysis]

1. Lecture

1.1 Apr.11, 2014 Pathological conditionan alysis based on omics

・Role of clinical examination in individualized medicine: preemptive medicine and companion diagnostics
・Pathophysiological analysis by omics for new diagnostic agent development: proteomics, metabolomics, genomics
・IDO: drug development and diagnostic agent development

1.2 Apr. 11, 2013 Medical image equipment

・Morphology images of organs: chest X-ray, radiographic visualization of the stomach, X-rays of the digestive tract, coronary X-ray angiography, mammography, X-ray CT of the head, X-ray 3D CT of the heart, and full-body MRI.
・Various images of head (morphology and function): X-ray CT, MRI, SPECT, PET, fMRI, cerebral angiography, MRA, and NIRS.
・Visualization of morphology and function by light and ultrasound: thermography, fundus photograph, fundus OCT, endoscope (stomach), endoscope (large intestine), capsule endoscope, endoscope (vessel), endoscopic ultrasound, and ultrasound (abdomen).

1.3 Apr. 15, 2014 Seminar

A biomedical testing method, flow cytometry, was introduced. First, principle and applications were lectured. Then, as a practice, blood samples were analyzed using flow cytometer. The results of the samples with and without fluorescence-labeled antibodies were compared. It made the students understood how it works and what are observed.

1.4 Apr. 22, 2014　Extramural seminar

LIMS students visited a developing manufacturer of medical imaging equipment and testing equipment, Shimadzu Corporation, and observed analyzing devices and medical imaging devices. They learned about the devices, their developments and their applications by receiving explanations of the devices, interviewing about development, and touching them. They also learned how to fabricate medical equipment by observing the assembling processes of X-ray imaging devices.

[Rehabilitation]

1. Lecture

1.1 May 13, 2014　Physical therapy

・What is required ?
・Recognition of current situation: population aging rate, disorders, diseases, and average length of hospital stay
・Recovery rehabilitation unit
・Rehabilitation not completed within hospital: the importance of chronic rehabilitation
・Etymology of rehabilitation
・Targets and areas of physical therapy
・New era of developing equipment

1.2 May 16, 2014　Occupational therapy

・Introduction: etymology, characteristics, functions, targets, means, and areas
・Occupation used in occupational therapy
・History, the number of occupational therapist in Japan and the world, and the number of schools
・Classification of occupational therapy
・Occupational therapy in psychiatry
・Occupational therapy in physical dysfunction
・Examples of disorders and rehabilitations

2. May 20, 2014, May 30, 2014　Seminar

Students improved the understanding of rehabilitation by attending physical therapy and occupational therapy at rehabilitation unit of Kyoto University Hospital with physical therapist and occupational therapist, respectively.

4. Medical and daily life support systems (Home medical care support)

Instructor: Hidenori Arai (Professor, Graduate School of Medicine and Faculty of Medicine)
Mie Torii (Program-Specific Assistant Professor, LIMS)

Grade: MC1
Credit: 2
Lecture Forms: Lecture and field trip

In Japan, one in four people are over 65, and we are under pressure to take increased measures to deal with welfare, nursing and medical care needs. The Ministry of Health, Labor and Welfare recommends regional comprehensive support in which older adults can spend the terminal stage of their lives in their own homes and

neighborhoods rather than staying in long-term care facilities. To enhance this support, we need strengthening of coordination with welfare and medical care, full care services, promotion of preventive care, and elderly access features in the home. This course provides the lectures on basic characteristics of elderly patient life and welfare law and policy, and also provides field trips to welfare facilities. We will focus on the present condition of older adults and aim to promote dialogue and consideration how to advance medical support systems and equipment.

April. 18th, 2014 Lecture (1)

A. Background of an aging society: The trend in Japan and other countries

B. The characteristics of older adults:

Progression of physical/ physiological and mental/ social function

C. Diseases associated with older adults

April. 25th, 2014 Lecture (2)

D. Elderly welfare law and policy:

Outline, background and service content of Long-Term Care Insurance Act

May. 2nd, 2014 Field trip (1)

A. Rehabilitation day care center

This center is a novel day care center which specializes in living rehabilitation, using purpose-built machinery introduced from countries with developed welfare service infrastructures. This center provides older adults with physical assessment and muscular workout programs supervised by physiotherapists. In order to understand the importance of prevention and rehabilitation, our students acted as subjects in the program.

May. 9nd, 2014 Field trip (2)

B. Welfare facilities

These composite facilities consist of 1) intensive-care nursing homes; 2) short-term admission for daily lifelong term-care facilities; 3) day-care centers. Local families can use facilities within the day-care centers, designed to foster intergenerational social communication with elderly patients and local families. In order to understand varied care levels, types of healthcare cooperation, life support services and regional exchange, our students observed older adults who lived in various types of facilities.

C. Community General Support Center, Hemodialysis Center, Acupuncture and Moxibustion Clinic

A Community General Support Center is a public consultation center in which care is provided for frail elderly, and welfare, health and medical services are provided by public health nurses and social workers. To understand cooperation with medical and welfare services, our students visited the center and attended a lecture on how their support is provided. They also visited a hemodialysis center, acupuncture and moxibustion clinic to understand life styles of home care patients.

5. Debate

Instructor: Christian F. Altmann, Program-Specific Associate Professor, Graduate School of Medicine

The English Debate course and practice was held in 2014 as a weekly course with the aim to a) improve the students' ability to form and express their opinions in English, in front of an audience with different scientific backgrounds and nationalities, b) improve their ability to respond to questions and to defend their opinion, and c) improve their ability to refute others' arguments.

The first year students of the master's course focused on basic argumentation skills in the summer term of 2014. More specifically, they engaged in discussions of the use of animal models in biomedical research, the health care system in the U.S.A. and worldwide, and the construction of a nuclear power plant, among other topics. In the winter term, students practiced giving presentations of scientific ideas, business and policy proposals. For example, students proposed ideas like check-lists for surgeries, structure-guided drug design, simulation of cellular signaling networks or presented research related to the coevolution of humans and malaria hosts, or self-assembling DNA-bricks.

The second year students of the master's course began with presentation practices in the summer term, talking for example about the regulation of host obesity by gut microbiota, DNA-methylation as a marker for tissue age, or proposing how the elderly could be involved in our children's education. In the winter term, teams of two students proposed an idea which was discussed in a meeting, which – depending on the topic – simulated a science grant committee, a company board or a political TV discussion. Exemplary topics were the introduction of financial education early in elementary school, an automated insulin dispenser coupled to an implanted blood glucose meter, and the use of induced pluripotent stem cells for skin rejuvenation.

6. Mechanics and Dynamics, Fundamental

Instructor: Kazuyoshi Nakabe (Professor, Dept. of Mechanical Engineering and Science)
Taiji Adachi (Professor, Institute for Frontier Medical Science)
Koji Yamamoto (Program-Specific Associate Professor, LIMS)

The course is designed to introduce mechanical engineering, mainly four fundamental dynamics such as Mechanical dynamics, Dynamics for material and structure, Fluid dynamics and Thermodynamics, to students who do not have a background of mechanical engineering. The primary aim is to acquire and refine knowledge of mechanical engineering necessary for developing novel devices or measuring systems in the medico-engineering field. In this year, three hours lecture was given every Tuesday during two months (July & August) for two students. In the first half of this course, those dynamics were explained with the concept of continuum physics, which can help students understand the relation between equations of motion or governing equations and real phenomena. In the lecture, we focused on the physical implications of equations describing each dynamics and theoretically expounded common physical phenomena, such as movement, deformation of objects with mass and shape, and flow of gas or liquid. In the second half, we introduced how those principles of mechanics have been applied to real-world equipments and systems, and also explained about the latest mechanical engineering technologies used in the field of medical or welfare engineering. Practical training of this course for second-year master's students was held as part of the class: Biomaterials and Artificial Organs.

7. Basic Materials Chemistry

Instructor: Teruyuki Kondo (Professor, Advanced Biomedical Engineering Research Unit, C-PiER)
Yu Kimura (Program-Specific Associate Professor, LIMS)

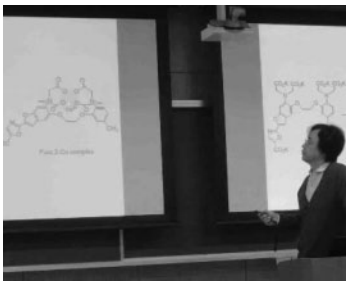
In academic year 2014, an exercise of organic chemistry was performed initially. This exercise was intended to evaluate the actual skills of students. Based on the evaluation, the review about basic organic chemistry was lectured with detailed accounts of the exercise. The review especially emphasized explanations about presuming reaction mechanisms, processes to develop the reaction, and synthesis strategy, especially including retrosynthetic analysis. Then, characteristics and synthetic routes of medicines such as sulfa drug and indinavir were lectured from the viewpoint of pharmacophore, structure-property relationship, mechanism of action and their biodistribution. In contrast, biomaterials as a large bulk material for clinical use have many functional moieties and characteristic properties, such as bioavailability, biocompatibility, antithrombogeneity, or other bioactivities, the lecture summarized these properties with the explanation in molecular level. Also, we put emphasis on understanding not only of basic requirements as biomaterial, but also of the reason why the chemical composition was chosen to use as a biomaterial. The knowledge would be helpful to design novel materials based on a demand in fruitful healthy-longevity society. Through the submitting report after the course, we evaluated students on the proficiency and utilizing ability of obtained knowledge. In addition, a practice in imaging chemical probes on mouse was executed for the first time in this academic year (see photo). Together with students, pigment molecules as a probe were injected *via* tail vein of mice, and the distribution was observed with 3-D photoacoustic CT scanner and fluorescence camera-TV monitor. These experiences would be helpful to prepare further anatomy and physiology courses.

8. Molecular Analysis of life

Instructor: Yasuo Mori (Professor, Graduate School of Engineering, Department of Synthetic Chemistry and Biological Chemistry)
Miyuki Nishi (Program-Specific Associate Professor, LIMS)

To understand analytical methods that clarify roles of molecules in controlling biological functions, fundamenta ltechniques and knowledge will be acquired in this course. Specifically, we will focus on structures of genes and proteins, analyses of dynamics of proteins and 2nd messengers. The target of this course includes those students who are not familiar to living organisms as their subjects of experiments/studies. The course also provides an opportunity to prepare for the later advanced program curriculum of the leading program.

1. Orientation
2. Analysis of genes and determination of DNA sequences
3. Analysis of Proteins
4. Second messenger and thermosensor
5. Cell sorting
6. Presentation and Discussion



9. Biopharmaceutics

Instructor: Kazuhisa Nakayama (Professor, Graduate School of Pharmaceutical Sciences)
Yoshinobu Takakura (Professor, Graduate School of Pharmaceutical Sciences)
Mitsuru Hashida (Professor, Graduate School of Pharmaceutical Sciences)
Yuriko Higuchi (Program-Specific Senior Lecturer, LIMS)

This lecture toward “Biopharmaceutics” will be provided to 2nd-graders. In this lecture, we introduced the anatomical and physiological characteristics of tissues in the body to understand drug disposition processes, including absorption, distribution, metabolism, and excretion. Then, we explained the mechanisms of drug disposition in each process, and provide the basic concept and its application example of drug delivery system (DDS). Short presentation in English by students helped further understanding of lectures.

- Drug absorption after local injection, and factors affecting it
- Anatomical and physiological characteristics of the skin and transdermal absorption of drugs
- Anatomical and physiological characteristics of the gastrointestinal tract and gastrointestinal absorption of drugs
- Rectal, pulmonary and nasal absorption of drugs
- Factors affecting drug distribution in each tissue
- Structure and functions of blood-brain barrier, blood-cerebrospinal fluid barrier and placental barrier, and drug distribution into brain and fetus thorough the barriers
- Anatomical and physiological characteristics of the kidney and renal excretion mechanisms of drugs
- Biliary excretion and enterohepatic circulation of drugs
- Drug metabolism and drug-metabolizing enzymes
- Drug/drug interactions
- Basic of clinical pharmacokinetics
- Drug delivery systems for major protein drugs and nucleic acid drugs and those for cell therapy

10. Medical Chemistry

Instructor: Dai Watanabe (Professor, Dept. of Biological Sciences)
Motoko Yanagita (Professor, Dept. of Nephrology)
Shigekazu Nagata (Professor, Dept. of Medical Chemistry)
Nagahiro Minato (Professor, Dept. of Immunology and Cell Biology)
Makoto Noda (Professor, Dept. of Molecular Oncology)
Taku Hasegawa (Program-Specific Assistant Professor, LIMS)

The aim of this course is that LIMS students, especially those with the background in engineering, acquire knowledge in the common diseases in the modern society. With the help of the faculty in Graduate School of Medicine, the biochemical and molecular biological mechanisms for diseases, as well as the current treatment for diseases, are explained and discussed. In this course, the students are expected to acquire the knowledge that the second- or third-grade medical students learn; the lectures cover from the basics in biochemistry and molecular biology to the mechanism of diseases, especially focused on the disease having social significance, such as diabetes or cancer. In this academic year, the lectures were held in April and May, aimed at M1 and M2 students.

The LIMS students with the engineering background are expected to utilize the knowledge obtained in this course during the future development of new treatments for diseases or medical instruments. Furthermore, even for the students with the biology background, this course provides the great opportunity to study biochemistry and molecular biology from the perspective of the diseases commonly occurring in the society.

11. Regenerative Medicine

Instructor: Hiroo Iwata (Professor, Institute for Frontier Medical Sciences)
Yuji Hiraki (Professor, Institute for Frontier Medical Sciences)
Atsuko Sehara (Professor, Institute for Frontier Medical Sciences)
Yasuhiko Tabata (Professor, Institute for Frontier Medical Sciences)
Taiji Adachi (Professor, Institute for Frontier Medical Sciences)
Hirofumi Suemori (Associate Professor, Institute for Frontier Medical Sciences)
Masaya Yamamoto (Associate Professor, Institute for Frontier Medical Sciences)
Fuminori Sato (Program-Specific Assistant Professor,LIMS)
Aki Takimoto (Program-Specific Assistant Professor,LIMS)

The rapid advances in stem cell biology including iPS cell research and its clinical applications make it more important to comprehensively understand regenerative medicine in the various field of medicine. Institute for Frontier Medical Sciences focuses on the basic and application studies on regenerative medicine including stem cell biology, developmental biology, and tissue engineering. This course started in October, 2014, for the first and second year LIMS students, and provided lectures on the following latest topics:

- History and recent advance of pluripotent stem cell research. Use of human PSCs for cell transplantation therapy.
- Cellular Differentiation and Stem Cells (I), (II)
- Hard tissue development and regeneration (I) ECM, (II) Growth & differentiation, (III) Connections of building blocks
- Cell Lego
- Definition of biomaterials and their applications to medical devises and drug delivery system (DDS)
- Regenerative medicine from the viewpoint of biomaterials – Regenerative research and regenerative therapy –
- The importance of material sciences in hard tissue regenerative medicine.
- In vitro fabrication of tissue-like constructs and their applications
- Nanotechnologies for regenerative medicine
- Modeling and simulation of bone regeneration/remodeling and their application to scaffold design
- Modeling and simulation of multicellular dynamics in tissue morphogenesis

Through the lectures concerning stem cells, cellular differentiation, organogenesis, and biomaterials, we made a special effort to encourage students to find a systematic connection between basic and clinical studies on regenerative medicine. This course also provided a lecture on biomechanics to help students understand the mechanical aspects of developmental phenomenon and locomotive organs, which are latest research topics in developmental biology and regenerative medicine.

12. Genome Cohort Study

Instructor: Meiko Takahashi (Program-Specific Senior Lecturer, LIMS)

"Genome Cohort Studies" provides an intensive introduction to genomic epidemiology and methods for students intending to engage in, collaborate in, or interpret the results of genomic and epidemiologic research. This course is available for second year Master's degree students, and was started in April 2014. Through lectures and group discussions, students will be able to understand the essential roles genomic analyses will play in 21st Century medicine - the era of "preventive medicine". The course covers the following topics:

(1) Various research fields and the novel techniques developed that have emerged in the years since completion of the Human Genome Project.
(2) Understand the importance of medicine and genomic research.
(3) Understand what a cohort design is, comprehend the differences between cohorts and case-control analyses, and appreciate the strengths and weaknesses of the various types of analyses.
(4) Acquire basic knowledge of the latest technologies used in genomic medicine.
(5) Learn the different techniques used in bioinformatics and proteomics, as well as how to handle web-based public databases.

13. Basic mathematics

Instructor: Takehiko Kinoshita (Program-Specific Senior Lecturer, LIMS)

Since the medical students and cooperation with the engineering students are attempted, learning of the basic mathematics for the students who is not learning mathematics in undergraduates was a target. Specifically, this course introduced students to differential and integral calculus and linear algebra at the level of undergraduates. As for Calculus, we explained the concepts of differentiation and integration for functions of many variables, some methods for calculation, Taylor series, Fourier series, etc. In addition, as for linear algebra, we explained the properties of vectors and matrices and their operations, simultaneous linear equations, linear spaces, determinant, etc. Moreover, we learned how to use the formula manipulation system in Python.

Since this course has the very abundant topics, it was not possible to spend time on the detail of calculation process for proofs or practice problems. However, the correct answer rate of audiences was high because using the formula manipulation system was recommended in practice problems.

We expect that audiences acquire minimum concepts of mathematics through this course to promote medicine-engineering collaboration at the student level.

14. Introduction to Numerical Simulation

Instructor: Takehiko Kinoshita (Program-Specific Senior Lecturer, LIMS)

This course introduced methods of numerical simulations for various natural or social phenomena. The process of simulation is three-fold:

1: Modeling: derive a differential equation which models the phenomenon under consideration.

2: Solving: Nondimensionalize the equations and solve them.

3: Visualizing: visualize the solution and analyze its properties.

It is important for modeling to recognize the variables with appropriate dimensions and to derive a relationship between them. It is also important to verify whether the derived equations have appropriate dimensions. Nondimensionalization enables us to reduce the number of parameters without loss of generality as well as to obtain equations for nondimensional quantities. I emphasized these three points in the course, and the students achieved a comprehensive understanding about them.

I taught how to use formula manipulation system in order to solve ordinary differential equations (ODE). Numerical simulation is necessary for analyzing ODEs which are not solvable by quadrature. I taught some numerical methods, the Euler method, the Runge-Kutta method, and the Dormand-Prince method, to solve ODEs.

Python was adopted as the formula manipulation system and the numerical computation software in this course. I taught how to use Python: matrix operations, conditional expressions, loop, user-defined functions, visualization, and animation. Since we used the Python module to analytically or numerically solve ODEs, the source cords of students are well-made.

In the last part of the course, I taught the qualitative theory of ordinary differential equations and the error analysis of numerical solutions. Especially, I introduced the stability and bifurcation theory of equilibria. Moreover, I explained the validated computational method for solutions of ordinary differential system.

15. Health Economics

Instructor: Rei Goto (Program-Specific Associate Professor, Hakubi Center, Department of Economics)
Taro Tomizuka (Program-Specific Senior Lecturer, LIMS)

Innovations in health and healthcare can realize the welfare gain through the improvement of peoples' health and the development of new industry. In developed countries, healthcare system is financed mainly by collective public funds like social insurance and tax. Therefore, it is important to assess costs and effectiveness of health technology from societal perspectives. From industrial perspectives, the impacts of innovations on economic growth are highly counted.

In this course, students acquired knowledge of the strengths and weaknesses of evaluations methods of health technology, as well as the outline of the systems of financing and provision of healthcare.

This course consisted of following topics:

1. Overview and context of health and health care
2. The demand for health care
3. The supply of health care
4. Health care financing 1: overview
5. Health care financing 2: International comparison and Japan's financing
6. International comparison of health care system
7. Health care insurance and incentives
8. Health care reforms: International comparison and Japan's case
9. Principles of economic evaluations in health care

16. Minimally invasive therapy

Instructor: Shinji Uemoto
(Professor, Department of Hepato-Biliary-Pancreatic Surgery and Transplantation)
Takeshi Kimura (Professor, Department of Cardiovascular Medicine)
Yoshiharu Sakai (Professor, Department of Gastrointestinal Surgery)
Osamu Ogawa (Professor, Department of Urology)
Masahiro Hiraoka (Professor, Department of Radiation oncology)
Kyoichi Takaori (Program-Specific Associate Professor, LIMS)

Lectures and practical seminars about minimally invasive therapies have been given under supervisions by Professors Takeshi Kimura, Susumu Miyamoto, Yoshiharu Sakai, Shinji Uemoto, Osamu Ogawa, and Masahiro Ogawa, Kyoto University Graduate School of Medicine.

Lectures included "Minimally invasive surgery in hepato-biliary-pancreatic surgery and transplantation (orientation inclusive)", "Minimally invasive surgery for digestive diseases", "Minimally invasive therapiesin neurosurgery", "High precision radiation therapy for cancer", "Intravascular catheter treatments in cardiovascular medicine", "Minimally invasive surgery in urology" and these lectures were given at the seminar room of LIMS in the G building of Medical Faculty or at the Kyoto University Hospital.

The attendants experienced laparoscopic surgery by themselves with a simulator at the Kyoto University Hospital during the course of "Minimally invasive surgery for digestive diseases" and observed procedures of gastrointestinal surgery at the operation theater of the Kyoto University Hospital later on. Besides, the attendants of the course observed conventional open surgery associated with significant invasiveness during the "Surgery in hepato-biliary-pancreatic surgery and transplantation" and had a group discussion about the comparison between the conventional surgery and minimally invasive surgery subsequently. Moreover, other courses consisted of following contents.

"Minimally invasive therapies in neurosurgery": observation of intravascular therapies for brain vascular diseases.

"High precision radiation therapy for cancer": simulation of radiation therapy planning.

"Intravascular catheter treatments in cardiovascular medicine": observation of intravascular therapies for ischemic heart diseases.

"Minimally invasive surgery in urology": observation of a robotic prostatectomy.

設備備品　Equipment

平成26年度　リーディングプログラム主要設備備品の設置目的

No.	名　称	設置目的
1	液体ハンドリング自動化装置 一式	製薬企業における創薬の現場では大規模解析用ワークステーションが日常的に行われており、アカデミアでも大規模解析用ワークステーションを使用する必要性が高まっているが、通常の大学院教育ではほとんど接する機会がない。バイオテックコンパクトワークステーションEDR-384SXは、様々なプラットフォームに対応した大規模な化合物スクリーニングや網羅的siRNA解析などを可能とする機器である。そこで、この機器を医学研究支援センターに導入し、原理や利用法方を当リーディングプログラムの履修生に教授することにより、アカデミア創薬や大規模解析等を担う人材を育てる。
2	7TMRI装置用 「3rd Order シミングシステム」 一式	現在導入されている7テスラMRI（通常は、3テスラ）は、世界で50台程度しかなく、国内でも、大学院の実習などに使用される施設はないため、7テスラMRIの撮像を見学、実習することは、大変大きな経験になると考えられる。本装置の画像性能向上に寄与する「高性能MRI撮像コイルならびに周辺装置」の購入に予算を振りかえることは、これからの新しい医療装置開発の理解に有用である。
3	光音響 CT スキャナー 一式	本機器は、これまで困難であった小動物の完全な三次元光音響イメージングを行うための最新のシステムである。すなわち、従来の二次元断層画像から合成した三次元画像構成とは異なり、本機器では、高い空間分解能、感度、定量精度、ならびに短時間での三次元光音響イメージングが可能である。さらに、本機器では、超音波検出器の一つが超音波発振子の機能を兼ねており、超音波イメージングを同時に行うことができることから、小動物の各組織に対応付けした三次元光音響イメージングが可能である。従って、まず、本機器を用いた講義（材料化学基礎）において、学生に光音響イメージングの原理を理解・習得させ、次に、実習（材料化学基礎）においては、学生自らが本機器を用いて、低侵襲での担癌マウスの癌部位の血管密度や低酸素状態の光音響イメージング画像を取得し、それを具体例として光音響イメージング法を習熟させる。以上の様に、本機器は、次世代のイメージング技術および装置開発を担う本リーディングプログラム履修学生への講義および実習に最適でかつ不可欠な機器であり、高度ではあるものの、集中的に講義・実習を行うことにより比較的短期間で最先端の生体イメージング法を学ぶことができる。

Major Equipment Installed in Academic Year 2014

No.	Name of Equipment	Purpose of Installation
1	Automatic simultaneous liquid-dispensing workstation	Simultaneous dispensing-type compact workstations are frequently used in pharmaceutical companies for drug development. In spite of the emerging need of this workstation in academia, it is seldom taught in graduate school. Biotech's compact workstation EDR-384SX is capable of handling large platforms of chemical screening or exhaustive siRNA analyses. We wish to install it in the Medical Research Support center and teach the students of the LIMS program the principles and utilization this device. In this way, we can cultivate leaders of academic drug development and large-scale analysis.
2	Three order simming system for 7T MRI	7T MRI is installed around 50 machines in the world, then it is very rare chance to inspect and operate the machine by the program student. Third order sim system will increase the sensitivity and accuracy for MRI, therefore, it will make the students experience more deeper and increase the interesting to the world wide high level scientific machine.
3	Photoacoustic CT Scanner	This diagnosis device can construct three-dimensional photoacoustic images of small animals. Photoacoustic imaging is a latest imaging modality, having many advantages of high spacial resolution, sensitivity, and quantifiability. No imaging device with similar high performances exists at present. In addition, this device has an ultrasound transducer, which enables to obtain the ultrasound images and photoacoustic images simultaneously. In the class of "Basic Materials Chemistry", the LIMS students learn about the basic theory and the principles of photoacoustic imaging. Then, the LIMS students receive in vivo practical training about intravenous injection of contrast reagents to tumor-bearing mouse, as well as photoacoustic imaging of blood vessels density and tumor hypoxia. Accordingly, this device is essential for training of the LIMS students who become the leaders on development of the next generation imaging modalities as well as medical equipments.

3.

国際連携

International Cooperation

平成26年度　外国からの招へい実績一覧

	氏名・所属・職	実施日	実施内容
1	Denis Le Bihan フランス ニューロスピン研究所 超高磁場MRI研究センター 所長	2014年 5月27・29日、 6月4・11・12日	英語debateクラス（特別クラス）
		2014年7月8日 ～10日、17日	
		2014年10月2日、 6日、9日	
		2014年11月20日、 27日、12月1日、4日	
		2015年1月26日、 2月2日、9日	
2	Robert L. Norton アメリカ Fox Rothschild, LLP 弁護士	2014年7月24日	LIMS授業科目「知的財産＆国際標準化」に係る 講義「知財の国際ハーモナイゼーション」
3	Robert Turner ドイツ マックス・プランク 認知神経科学研究所 名誉所長	2014年10月20日 ～10月24日	外部評価　および　LIMS特別セミナー "MRI Hardware: Design Requirements at High Field"、"Functional Brain Imaging at High Magnetic Field"
4	William James Moody アメリカ ワシントン大学 教授	2014年12月 3日・4日	LIMS特別セミナー "Brain Development, Plasticity, and Aging: A continuum of mechanisms (1,2)"
5	Nace L. Golding アメリカ テキサス大学オースティン校 准教授	2015年3月19日	LIMS特別セミナー "Hearing; Physiology and aging"（連続講義）
6	Michael Hideki Myoga ドイツ マックスプランク研究所 教授		
7	R. Michael Burger Jr. アメリカ リーハイ大学 准教授		

Lecturers from Abroad in Academic Year 2014

	Name/Title/Affiliation	Date	Purpose of visit
1	Denis Le Bihan Director NeuroSpin CEA-Saclay Center France	May 27, 29, June 4, 11, 12, 2014	English debate class (special class) for LIMS Students
		July 8, 10, 17, 2014	
		October 2, 6, 9, 2014	
		November 20, 27, December 1, 4, 2014	
		January 26, February 2, 9, 2015	
2	Robert L. Norton Lawyer Fox Rothschild, LLP USA	July 24, 2014	Lecture entitled "International Harmonization of IP" for LIMS Intellectual Property & Global Standardization Class
3	Robert Turner Director Emeritus Max Planck Institute for Human Cognitive and Brain Sciences Germany	October 20 - 24, 2014	External evaluation for LIMS Program and two lectures: "MRI Hardware: Design Requirements at High Field" and "Functional Brain Imaging at High Magnetic Field"
4	William James Moody Professor Department of Biology Washington University USA	December 3, 4, 2014	LIMS Special Seminar "Brain Development, Plasticity, and Aging: A continuum of mechanisms (1,2)"
5	Nace L. Golding Associate Professor Section of Neurobiology University of Texas at Austin USA	March 19, 2015	LIMS Special Seminar (Lecture series) "Hearing; Physiology and aging"
6	Michael Hideki Myoga Research Professor Max-Planck-Institut for Neurobiologie Germany		
7	R. Michael Burger Jr. Associate Professor Dept. of Biologibal Sciences Lehigh University USA		

Reports for Inviting Lecturers from Abroad

1) Hidenao Fukuyama (Professor)

Robert Turner has retired his position of Max-Planck Institute, Leipzig early 2014. He visited Kyoto University for evaluating our program as well as giving lectures on MRI physics. He was appointed as the reviewer of our program since our program starting, and inspected the lectures and discussed with the students.

Professor Turner is one of the leaders on MRI physics, which is very essential for building up MRI. His lectures was somewhat difficult for the students, but might be inspired by the world wide top level researcher. This kind of impact will be good for the young students. He stayed in Kyoto and discussed with us on regard to future MRI.

Denis LeBihan is the director of Neurospin, where is the largest MRI research center in Europe. He visited several times to Kyoto and did English debate with the students. This debate is tough for the students, because he is a strong speaker against any issues. I think the students would have an impression that the leader of the world is tough and very difficult to persuade him/her to our opinion.

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2) Yutaka Teranishi (Professor)

「知的財産＆国際標準化」講義
タイトル：「知財の国際ハーモナイゼーション」
講師：**Robert L. Norton** 弁護士
参加者：約 30 名

内　容

知財と国際標準に関して、米国の事例を元にお話しをしていただいた。とりわけ、米国特許法が先発明主義から先出願主義へと大きく変更された点、さらに、特許訴訟頻発にともなう経済活動の停滞の弊害を抑制するための対応策など説明があった。先発明主義において、発明の証明の根拠を争うInterference の手続きが廃止されたことが、大きな改変ポイントである事が指摘された。

またアメリカでは、バイ・ドール法の施行から３０年以上が経ち、アカデミアの研究成果・技術移転の成功例も多く蓄積されているが、これらの交渉のポイントなども、実務に携わる弁護士の経験から詳しく説明をしていただいた。

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3) Harunori Ohmori (Professor)

Special lecture by Professor WJ Moody, Washington University, Seattle
December 3-4, 2014

Professor **William J Moody** talked about the brain development, plasticity and aging as a continuous phenomena of neuronal activity. Also the talk progressed to the phenomena how exercise, reduced intake of foods and rich living environment could contribute to enhance neurogenesis and synaptic plasticity.
On the second day the talk started with the story about the cell death, then to plasticity of neurons, with particular emphasis on BDNF as a central factor to control all the process of neurogenesis, synaptic plasticity. Aging affects the BDNF production and reduces neuronal synaptic plasticity. In contrast, exercise enhances BDNF production and can cope the aging effects; a short time exercise of just 15 min three times a week could maintain the intelligence of senile persons. Having rich living environments is particularly important after the age of retirement, such as to meet and talk with people, to read a book as for a cognitive enrichment, to walk for exercising, but not to be alone all day long. The lecture is well organized and integrated to the central story focusing on the cellular activity of roles of calcium influx through NMDA receptors and roles of BDNF in development, synaptic plasticity and aging. During the lecture, students asked Dr. Moody many questions on various aspects of the lecture, and the classroom was active and was quite different from the usual lecture of generally quiet atmosphere.

Hearing: Physiology and aging
March 19, 2015

On the topics of hearing, 4 lectures were made in series. Dr. H Ohmori (Kyoto University) first talked about cochlear mechanisms, and the pattern of afferent and efferent innervations. His talk was the introduction for the audience on the physiology and aging of hearing, and explained unique nomenclatures used in hearing physiology.

Dr. **N Golding** (Texas University, Austin, Texas, USA) talked on the central mechanism of hearing focusing on the tonotopic organization, also talked about distinct features of coding of sound temporal information and coding of sound intensity information. The talk extended how the central auditory system extracts information about sound location; a spectral distortions by the outer ear as cues for sound source elevation, interaural time differences (ITDs) as cues for horizontal sound source localization, and interaural level differences (ILDs), created by head shadowing of high frequency (> 2 kHz) sounds, were also discussed as a cue for horizontal sound localization.

Dr. **M Myoga** (Max-Planck Institute, Munich, Germany) talked about encoding the auditory space, starting by a message that the representation of auditory space in the brain is unique compared to other senses such as visual or somatosensory systems where space is mapped directly onto the sensory epithelia. Only frequency is mapped onto the cochlea, thus spatial auditory information must be extracted entirely in the brain.

Dr. **M Burger** (Lehigh University, Pennsylvania, USA) talked mainly about the therapy for hearing loss, specifically in relation to cochlear implants. He talked that the success of cochlear implants for restoring hearing function, and subsequently, the language ability is highly dependent on 1) the age at which deafness occurs 2) the age at which implantation is achieved. He also discussed some basic findings in humans regarding the critical developmental period for language acquisition. Finally, he discussed a possibility of central auditory implants and the potential for stem cell remedies for hearing loss.

All the lectures were well organized.

平成26年度 海外渡航一覧

	出発日	日数	目的地	氏　　名	所属	職名	渡航目的
1	2014/4/27	7	インドネシア・ ジョグジャカルタ、 バンドン、 ジャカルタ	石井　加代子	健康長寿社会の総合医療開発ユニット （LIMS）	特定教授	ガジャ・マダ大学、バンドン工科大学、インドネシア大学を訪問し、プログラムの広報活動・学生勧誘活動（学生対象のプログラム紹介セミナー）
2	2014/4/27	6	インドネシア・ ジョグジャカルタ、 バンドン	Dinh Ha Duy Thuy	健康長寿社会の総合医療開発ユニット （LIMS）	特定助教	ガジャ・マダ大学、バンドン工科大学を訪問し、プログラムの広報活動・学生勧誘活動（学生対象のプログラム紹介セミナー）
3	2014/5/14	12	イギリス・ ロンドン、ケンブリッジ オランダ・ ロッテルダム	武田　俊一	医学研究科 放射線遺伝学	教授	Queen Mary University of London, King's College London, MRC Laboratory of Molecular Biology, Erasmus MC を訪問し、履修生のインターシップ先開拓のための打合せ
4	2014/8/28	9	イギリス・ ブライトン、ロンドン フランス・ モンペリエ ドイツ・ バート ナウハイム	武田　俊一	医学研究科 放射線遺伝学	教授	University of Sussex, Queen Mary University of London, Institute of Human Genetics, Max Planck Institute for Heart and Lung Research を訪問し、履修生のインターンシップ先開拓のための打合せ
5	2014/10/18	7	ドイツ・ ベルリン	石井　加代子	健康長寿社会の総合医療開発ユニット （LIMS）	特定教授	M8 Alliance World Health Summit 2014 に参加し、プログラムの企画運営に係る広報活動及び国際連携の開拓
6	2014/11/6	5	インドネシア・ ジョグジャカルタ	石井　加代子	健康長寿社会の総合医療開発ユニット （LIMS）	特定教授	International Conference on Biomedical Engineering, Technology and Application にて講演を行い、国際連携推進プログラムの広報・学生勧誘
7	2015/2/26	15	カナダ・ バンクーバー アメリカ・ ベセスダ	武田　俊一	医学研究科 放射線遺伝学	教授	University of British Columbia および National Institute of Health (NIH) を訪問し、履修生のインターンシップ先開拓のための打合せ

Activities in Foreign Countries (Academic Year 2014)

	Date of Departure	Days	Destination	Name	Position	Affiliation	Objective
1	April 27, 2014	7	Jogjakarta, Bandung, Jakarta, Indonesia	Kayoko Ishii	Program-Specific Professor	LIMS	Public relation activities for LIMS Program and introduction / presentation to students at University of Gadjah Mada, Institut Teknologi Bandung, and University of Indonesia
2	April 27, 2014	6	Jogjakarta, Bandung, Indonesia	Dinh Ha Duy Thuy	Program-Specific Assistant Professor	LIMS	Public relation activities for LIMS Program and introduction / presentation to students at University of Gadjah Mada and Institut Teknologi Bandung
3	May 14, 2014	12	London, Cambridge, UK Rotterdam, Netherlands	Shunichi Takeda	Professor	Radiation Genetics, Graduate School of Medicine	Meetings for LIMS Students Internship at Queen Mary University of London, King's College London, MRC Laboratory of Molecular Biology, and Erasmus MC
4	August 28, 2014	9	Brighton, London, UK Montpellier, France Bad Nauheim, Germany	Shunichi Takeda	Professor	Radiation Genetics, Graduate School of Medicine	Meetings for LIMS Students Internship at University of Sussex, Queen Mary University of London, Institute of Human Genetics, and Max Planck Institute for Heart and Lung Research
5	October 18, 2014	7	Berlin, Germany	Kayoko Ishii	Program-Specific Professor	LIMS	Public relation and international cooperation activities at M8 Alliance World Health Summit 2014
6	November 6, 2014	5	Jogjakarta, Indonesia	Kayoko Ishii	Program-Specific Professor	LIMS	Public relation activity for LIMS Program and introduction / presentation to students at International Conference on Biomedical Engineering, Technology and Application
7	February 26, 2015	15	Vancouver, Canada Bethesda, USA	Shunichi Takeda	Professor	Radiation Genetics, Graduate School of Medicine	Meetings for LIMS Students Internship at University of British Columbia and National Institute of Health (NIH)

4.

学生の活動

Student Activities

受賞

履修生が未来の夢アイデア・コンテストで最優秀賞を受賞

(1)LIMS 履修生 M１の松本朋子・遠野宏季・西谷暢彦の三氏が日本経済新聞社主催第７回「企業に研究開発してほしい未来の夢」アイデア・コンテスト（愛称：テクノルネサンス・ジャパン）藤森工業部門にて最優秀賞を受賞しました。“課題テーマ：未来の包む価値とは？”というテーマに対し、専攻分野の異なる LIMS の仲間たち（医学・工学・薬学）と快適な充実社会を実現するためのアイデアをぶつけ合い、作品を作り上げました。この貴重な経験の中で、この上ない達成感と充実感を皆で味わうことができました。

(2)コンテストについて

日本経済新聞社主催第７回「企業に研究開発してほしい未来の夢」アイデア・コンテスト（愛称：テクノルネサンス・ジャパン）とは、理工系教育支援企画として、大学生、修士課程・博士課程大学院生、高等専門学校生（3 年生以上および専攻科）の個人またはチーム（チームは５名まで）を参加資格とし、参加企業の募集テーマと技術を元に、「企業に研究開発をして欲しい未来の夢」を提案するコンテスト。理工系学生が日ごろの研究のなかで、「企業が持つ最先端技術があればこんなことができるかも」「こんな製品があれば未来はすてきになるはず」と思い描くアイデアと企業の技術や事業を組み合わせたらどんな画期的なことができるかを考える場で、参加企業が示す各社の募集テーマと技術情報をもとに、「企業に研究開発してほしい未来の夢」の提案を募集。参加企業各社の技術者・研究員、役員が学生の提案を審査し、一次書類審査の後、最終審査では、学生によるプレゼンテーションと質疑応答により競い合いました。

参考サイト：http://nikkei-techno.jp/

LIMS Students won the first prize at Idea Competition of Nikkei Techno Renaissance Japan

Course-wide interdisciplinary group of LIMS MC2 students, Mr Nobuhiko Nishitani, Ms Tomoko Matsumoto and Mr. Hiroki Enno, won the first prize of Fujimori Kogyo (Zacros) award at the Scientific Idea Competition organized by Nikkei Shinbun, one of the quality newspapers in Japan. The theme of the competition for the Fujimori Kogyo (Zacros) award was "The value of Wrapping in the future?". Through the process to develop their work and the achievement of the prize, the students experienced an excellent sense of fulfillment and achievement.

About the contest:
The competition was the 7th open idea competition for undergraduate and postgraduate students studying Science and Technology regarding a "dream for future corporate research & development". Participating companies issued the themes and their original technologies for the competition subscription. The groups of students chose the theme and submitted their presentation about the proposals how the technologies that the companies developed can be integrated with their novel ideas, and create innovative productions. Technicians, researchers and executives of the companies judged the student submissions through proposal materials, presentations and Q&A session.

site : http://nikkei-techno.jp/

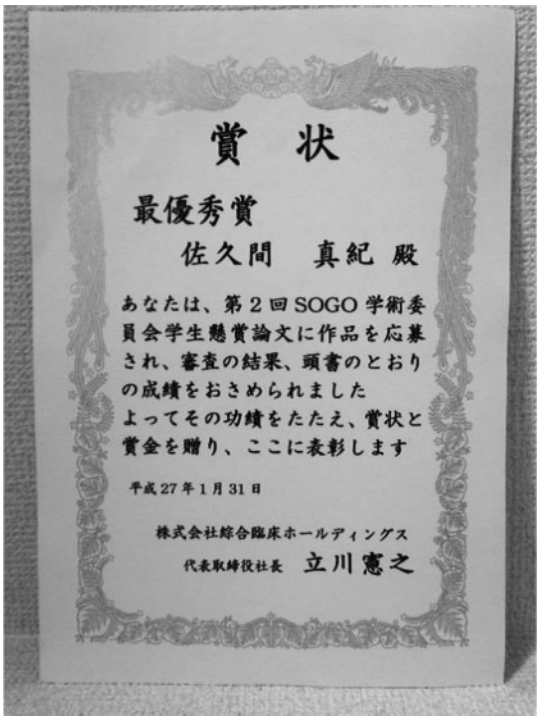
受賞

第２回 SOGO 学術委員会学生懸賞論文　最優秀賞を受賞して

医学研究科　生体構造医学講座　形態形成機能学
佐久間　真紀

秋学期に LIMS の医療経済学の授業を履修しました。こちらで、単純に技術的に高度な医療や、最新の研究成果を取り入れた医療によって、「進歩」はしたと言えるかもしれないが、医療の進歩は経済的な負担を増やすだけで少子高齢化社会が直面する様々な問題は解決しないという、あまり考えたことのなかった考え方に出会いました。確かに研究を進めることで、今まで治らなかった病気が治るようになることは素晴らしい成果ですが、実際にこの治療法のコストによっては、「技術的に可能である」ことと「現実的」であることは別であることも確かです。既に厳しい財政状況のなかで、革新的で高額な医療を行うことで、さらなる寿命の延長を達成し、さらに医療費を膨らませるという方向性は、社会的な要請に応えていることになるのかはなかなか難しいところだと思います。このように考えているとき、たまたま所属する研究室の棟に少子高齢化と医療をテーマにした学生懸賞論文を募集しているとの大きなポスターを見つけたので、LIMS の医療経済学で学んだことをもとに、自分で少子高齢化における医療を考えてみようと思い、作文しました。

内容としましては、まず少子高齢化の医療といったときに、医療財政が立ちいかなくなる危険性をはらんだ人口構造であることが問題であり、経済効率を重視した医療が必要であることをまず述べ、経済効率を重視した医療がどのようなものかについて議論しました。一番コストがかからないのは医療を提供しないことですが、私たちが目指しているのは限られた資源の中でどのような医療を提供すれば、将来世代にわたって、最大限の幸福をうみだすことができるかであり、私たちが一番に考えなければいけないのが、何をもって最大限の幸福とするかであります。だれもが最高の医療を尽くしたサービスを受けられるのが理想ですが、そういうわけにもいかなくなっている社会では、医療技術を適切に評価し、コストに見合う効用の得られる医療を選択し、安価でできる生活習慣の改めを促し予防を進める、最終的には延命第一の価値を転換し、どのような生き方、死に方が幸せなのかを考え直す必要があるといったことをまとめました。


賞　状

最優秀賞

佐久間　真紀　殿

あなたは、第２回SOGO学術委員会学生懸賞論文に作品を応募され、審査の結果、頭書のとおりの成績をおさめられました
よってその功績をたたえ、賞状と賞金を贈り、ここに表彰します

平成27年1月31日

株式会社綜合臨床ホールディングス
代表取締役社長　立川憲之

今回の懸賞論文を書いてみて、LIMS では医療経済の授業だけでなく、加齢医学や様々な公開講義、企業講師のお話などを通して、様々な角度から少子高齢化の問題に対応するための試みを学ばせていただき、それらが医療システムのなかのどのパーツなのかを自分のなかで整理することができました。この過程で、医療システムの全体像も少しずつでも把握することができ、その中で自分がどういう立ち位置で関わっていきたいのか、いくべきかなど考えるきっかけになりました。

平成26年度 履修生の学外活動 【外国】

	出発日	日数	目的地	氏　　名	所属	学年	渡航目的
1	2014/6/25	8	フランス・ ボルドー	佐久間　真紀	医学研究科 医科学専攻	修士課程 2年	RNA club June 2014へ参加し、LIMSメインテーマ「がん治療への応用を目指したトランスクリプトーム解析」に係る口頭発表および情報収集
2	2014/12/5	6	アメリカ・ サンフランシスコ	松原　弘幸	医学研究科 医科学専攻	修士課程 1年	The American Society of Hematology 2014へ参加し、LIMSメインテーマ「白血病における現在の治療法」に係る情報収集
3	2015/1/7	5	台湾・台北	粂原　令	工学研究科 高分子化学専攻	修士課程 2年	第6回日本-台湾ナノメディシンシンポジウムに参加し、LIMS研究課題「細胞増殖因子等の徐放により皮下に作製した免疫特典部位への膵島移植」に係るポスター発表
4	2015/2/6	6	アメリカ・ サンフランシスコ	五明　美香子	医学研究科 人間健康科学系専攻	修士課程 2年	SPIE. Photonics West 2015に参加し、LIMSメインテーマ「光超音波顕微鏡による組織光超音波物性の定量的評価に関する研究」に係る情報収集

Student Activities in Foreign Countries (Academic Year 2014)

	Date of Departure	Days	Destination	Name	Grade, Affiliation	Objective
1	June 25, 2014	8	Bordeaux, France	Maki Sakuma	M2, Medical Science, Graduate School of Medicine	Oral presentation and information collection for LIMS Research Issue: "Transcriptome analysis with application in cancer treatment" at The RNA Club June 2014
2	December 5, 2014	6	San Francisco, USA	Hiroyuki Matsubara	M1, Medical Science, Graduate School of Medicine	Information collection for LIMS Research Issue: "The treatment of leukemia" at The American Society of Hematology 2014
3	January 7, 2015	5	Taipei, Taiwan	Rei Kuwabara	M2, Polymer Chemistry, Graduate School of Engineering	Poster presentation for LIMS Research Project: "Transplantation of islets into immune privileged site prepared by sustained release of growth factor under the skin" at The 6th Japan-Taiwan Symposium on Nanomedicine
4	February 6, 2015	6	San Francisco, USA	Mikako Gomyo	M2, Human Health Sciences, Graduate School of Medicine	Information collection for LIMS Research Issue: "Quantitative assessment of photoacoustic properties of biological tissues by photoacoustic microscopy" at The SPIE. Photonics West 2015

平成26年度 履修生の学外活動 【国内】

	出発日	日数	目的地	氏　名	所　属	学年／職名	目　的
1	2014/4/22	1	京都市	SAHA Liton Kumar、Aila Johanna、MBENZA MBAMBI NAASSON、松本朋子、篠田昂樹、宇野雅俊、竹下至、末永和真、遠野宏季、西谷暢彦、五明美香子(M2)（以上11名）	医学研究科、薬学研究科、工学研究科	修士課程1年	島津製作所（本社・三条工場）にて、学際応用科目「医療・生活支援システム学」における医用画像機器開発現場の見学実習
				椎名　毅　（引率）	医学研究科人間健康科学系専攻・医療情報システム学	教授	
				近藤　健悟　（引率）	健康長寿社会の総合医療開発ユニット（LIMS）	特定助教	
2	2014/5/2	1	奈良市	松原弘幸、SAHA Liton Kumar、Aila Johanna、MBENZA MBAMBI NAASSON、松本朋子、篠田昂樹、堂上久美子、宇野雅俊、竹下至、末永和真、西谷暢彦、五明美香子(M2)、菜原令(M2)　（以上13名）	医学研究科、薬学研究科、工学研究科	修士課程1年	高の原ポシブルデイケアセンターにて、学際応用科目「医療・生活支援システム学」における運動特化型デイケアの見学実習
				鳥井　美江　（引率）	健康長寿社会の総合医療開発ユニット（LIMS）	特定助教	
3	2014/6/17	5	横浜市	石田　敦子	医学研究科・人間健康科学系専攻	修士課程2年	第16回世界作業療法士連盟大会・第48回日本作業療法学会に参加し、LIMSメインテーマ「独居高齢者の在宅生活安全性のリスク評価ツールとしてのKinectの信頼性や妥当性の検討」に関するポスター発表および情報収集
4	2014/6/27	1	東京都	(1)松本朋子、(2)篠田昂樹、(3)遠野宏季	(1)医学研究科・人間健康科学系専攻、(2)薬学研究科・薬科学専攻、(3)工学研究科・合成・生物化学専攻	修士課程1年	「中長期研究インターンシップ実施に向けた学生・教職員・企業担当者の集い」に出席し、インターンシップに係る意見交換・情報収集
				山口　一真	工学研究科・合成・生物化学専攻	修士課程2年	
				石井　加代子	健康長寿社会の総合医療開発ユニット（LIMS）	特定教授	
5	2014/11/7	2	千葉市	宮之原　遵	薬学研究科・薬科学専攻	修士課程2年	第34回医療情報学連合大会に参加し、LIMS研究課題「電子カルテを用いたテキストデータマイニング」に係る情報収集
6	2014/11/12	2	東京都	篠田　昂樹	薬学研究科・薬科学専攻	修士課程1年	「細胞を創る」研究会7.0に参加し、LIMSメインテーマ「臨床と分子生物学からみた加齢によるバイオリズムの変化と疾患の関連性の知見」に係る情報収集
7	2014/11/15	2	鹿児島市	宮之原　遵	薬学研究科・薬科学専攻	修士課程2年	第9回日本リハビリテーション医学会専門医会学術集会に参加し、LIMS研究課題「電子カルテを用いたテキストデータマイニング」に係る情報収集
8	2014/11/16	3	東京都	遠野　宏季	工学研究科・合成・生物化学専攻	修士課程1年	第36回日本バイオマテリアル学会大会に参加し、LIMSメインテーマ「高齢化に伴って発症する疾患の引き金と、それを抑制する化学物質に関する文献調査」に係る情報収集
9	2014/11/16	3	東京都	菜原　令	工学研究科・高分子化学専攻	修士課程2年	第36回日本バイオマテリアル学会大会に参加し、LIMS研究課題「細胞増殖因子等の徐放により皮下に作製した免疫特典部位への膵島移植」に係る口頭発表および情報収集
10	2014/11/20	3	仙台市	村尾　賢	工学研究科・高分子化学専攻	修士課程2年	電子情報通信学会研究会に参加し、LIMS研究課題「統合失調症のバイオマーカーの探索」に係る情報収集
11	2014/11/25	3	横浜市	竹下　至	工学研究科・分子工学専攻	修士課程1年	第37回日本分子生物学会年会に参加し、LIMSメインテーマ「DNAメチル化異常解析による発がんリスク評価と生活習慣との相関に関する研究」に係る情報収集
12	2014/11/25	3	横浜市	宇野　雅俊	工学研究科・分子工学専攻	修士課程1年	第37回日本分子生物学会年会に参加し、LIMSメインテーマ「サイトカインネットワークの異常に基づく自己免疫疾患の発症機構の予測及び検証」に係る情報収集
13	2014/11/25	3	横浜市	堂上　久美子	薬学研究科・医薬創成情報科学専攻	修士課程1年	第37回日本分子生物学会年会に参加し、LIMSメインテーマ「シフトワーカーがかかりやすい病気の研究」に係る情報収集
14	2014/11/27	1	横浜市	(1)松本朋子、(2)遠野宏季、(3)西谷暢彦	(1)医学研究科・人間健康科学系専攻、(2,3)工学研究科・合成・生物化学専攻	修士課程1年	日本経済新聞社主催第7回「企業に研究開発してほしい未来の夢」アイデア・コンテスト（テクノルネサンス・ジャパン）藤森工業賞　最終審査会にて発表
15	2014/11/29	3	横浜市	宮之原　遵	薬学研究科・薬科学専攻	修士課程2年	第33回日本認知症学会学術集会に参加し、LIMS研究課題「電子カルテを用いたテキストデータマイニング」に係る情報収集
16	2014/12/6	2	東京都	村尾　賢	工学研究科・高分子化学専攻	修士課程2年	第5回脳表現型の分子メカニズム研究会に参加し、LIMS研究課題「統合失調症のバイオマーカーの探索」に係る情報収集
17	2014/12/10	3	京都市	宇野　雅俊	工学研究科・分子工学専攻	修士課程1年	第43回日本免疫学会学術集会に参加し、LIMSメインテーマ「サイトカインネットワークの異常に基づく自己免疫疾患の発症機構の予測及び検証」に係る情報収集
18	2015/3/18	4	横浜市	菜原　令	工学研究科・高分子化学専攻	修士課程2年	第14回日本再生医療学会総会に参加し、LIMS研究課題「細胞増殖因子等の徐放により皮下に作製した免疫特典部位への膵島移植」に係る口頭発表および情報収集

Student Activities in Japan (Academic Year 2014)

	Date of Departure	Days	Destination	Name	Affiliation	Grade/ Position	Objective
1	April 22, 2014	1	Kyoto	SAHA Liton Kumar/ Aila Johanna/ MBENZA MBAMBI NAASSON/ Tomoko Matsumoto/ Kouki Shinoda/ Masatoshi Uno/ Itaru Takeshita/ Kazumasa Suenaga/ Hiroki Enno/ Nobuhiko Nishitani/ Mikako Gomyo(M2)	Graduate School of Medicine/ Pharmaceutical Sciences/ Engineering	M1	Visiting Shimadzu Corporation (Head Office and Sanjo factory) and observing development of medical image equipment for LIMS Medical and Life Support Systems class.
				Tsuyoshi Shiina (Leader / Conductor)	Medical Imaging System Sciences, Human Health Sciences, Graduate School of Medicine	Professor	
				Kengo Kondo (Leader / Conductor)	LIMS	Program-Specific Assistant Professor	
2	May 2, 2014	1	Nara	Hiroyuki Matsubara/ SAHA Liton Kumar/ Aila Johanna/ MBENZA MBAMBI NAASSON/ Tomoko Matsumoto/ Kouki Shinoda/ Kumiko Dojo/ Masatoshi Uno/ Itaru Takeshita/ Kazumasa Suenaga/ Nobuhiko Nishitani/ Mikako Gomyo(M2)/ Rei Kuwabara(M2)	Graduate School of Medicine/ Pharmaceutical Sciences/ Engineering	M1	Visiting "Takanohara Possible Day Care Center" and observing day-care for LIMS Medical and Life Support Systems class.
				Mie Torii (Leader / Conductor)	LIMS	Program-Specific Assistant Professor	
3	June 17, 2014	5	Yokohama	Atsuko Ishida	Human Health Sciences, Graduate School of Medicine	M2	Poster presentation and information collection for LIMS Research Issue: "An investigation of reliability and validity on Kinect as the tool of safety life for older adults" at The 16th International Congress of the World Federation of Occupational Therapists in collaboration with the 48th Japanese Occupational Therapy Congress and Expo
4	June 27, 2014	1	Tokyo	(1) Tomoko Matsumoto (2) Kouki Shinoda (3) Hiroki Enno	(1) Human Health Sciences, Graduate School of Medicine (2) Pharmaceutical Sciences, Graduate School of Pharmaceutical Sciences (3) Synthetic Chemistry and Biological Chemistry, Graduate School of Engineering	M1	Information collection and exchange of ideas for LIMS Internship Program at the joint workshop: "Meeting of Students, Faculty Staff, and Companies for Medium- and Long-Term Research Internship Program"
				Kazuma Yamaguchi	Synthetic Chemistry and Biological Chemistry, Graduate School of Engineering	M2	
				Kayoko Ishii	LIMS	Program-Specific Professor	
5	November 7, 2014	2	Chiba	Jun Miyanohara	Pharmaceutical Sciences, Graduate School of Pharmaceutical Sciences	M2	Information collection for LIMS Research Project: "Text data mining using electronic medical records" at the 34th Joint Conference on Medical Informatics
6	November 12, 2014	2	Tokyo	Kouki Shinoda	Pharmaceutical Sciences, Graduate School of Pharmaceutical Sciences	M1	Information collection for LIMS Research Issue: "Association between age-related changes in biorhythm and disease onset; chronobiological study and its application to clinical treatment" at The Japanese Society for Cell Synthesis Research 7.0
7	November 15, 2014	2	Kagoshima	Jun Miyanohara	Pharmaceutical Sciences, Graduate School of Pharmaceutical Sciences	M2	Information collection for LIMS Research Project: "Text data mining using electronic medical records" at The 9th Scientific Meeting of the Japanese Board-certificated Physiatrist Association
8	November 16, 2014	3	Tokyo	Hiroki Enno	Synthetic Chemistry and Biological Chemistry, Graduate School of Engineering	M1	Information collection for LIMS Research Issue: "Literature search on the relationship between age-related diseases in the elderly and the chemical compounds that induce them" at The 36th Japanese Society for Biomaterials
9	November 16, 2014	3	Tokyo	Rei Kuwabara	Polymer Chemistry, Graduate School of Engineering	M2	Oral Presentation and information collection for LIMS Research Project: "Transplantation of islets into immune privileged site prepared by sustained release of growth factor under the skin" at The 36th Japanese Society for Biomaterials
10	November 20, 2014	3	Sendai	Ken Murao	Polymer Chemistry, Graduate School of Engineering	M2	Information collection for LIMS Research Project: "Investigation of biomarker for mental disorder" at The Institute of Electronics, Information and Communication Engineers(IEICE)
11	November 25, 2014	3	Yokohama	Itaru Takeshita	Molecular Engineering, Graduate School of Engineering	M1	Information collection for LIMS Research Issue: "Research on the evaluation of carcinogenic risk using DNA methylation analysis and the relationship between the carcinogenic risk and life style" at The 37th Annual Meeting of the Molecular Biology Society of Japan
12	November 25, 2014	3	Yokohama	Masatoshi Uno	Molecular Engineering, Graduate School of Engineering	M1	Information collection for LIMS Research Issue: "Prediction and validation of the onset mechanism of autoimmune disease based on disorder in the cytokine network" at The 37th Annual Meeting of the Molecular Biology Society of Japan
13	November 25, 2014	3	Yokohama	Kumiko Dojo	Bioinformatics and Chemical Genomics, Graduate School of Pharmaceutical Sciences	M1	Information collection for LIMS Research Issue: "The Health Risks of Shift Work" at The 37th Annual Meeting of the Molecular Biology Society of Japan
14	November 27, 2014	1	Yokohama	(1) Tomoko Matsumoto (2) Hiroki Enno (3) Nobuhiko Nishitani	(1) Human Health Sciences, Graduate School of Medicine (2,3) Synthetic Chemistry and Biological Chemistry, Graduate School of Engineering	M1	Presentation at the final review of the Fujimori Kogyo (Zacros) award, Scientific Idea Competition organized by Nikkei Shinbun: "The 7th Nikkei-Techno Renaissance Japan"
15	November 29, 2014	3	Yokohama	Jun Miyanohara	Pharmaceutical Sciences, Graduate School of Pharmaceutical Sciences	M2	Information collection for LIMS Research Project: "Text data mining using electronic medical records" at The 33rd Annual Meeting of Japanese Society for Dementia Research
16	December 6, 2014	2	Tokyo	Ken Murao	Polymer Chemistry, Graduate School of Engineering	M2	Information collection for LIMS Research Project: "Investigation of biomarker for mental disorder" at The 5th Comprehensive Brain Molecular Mechanism
17	December 10, 2014	3	Kyoto	Masatoshi Uno	Molecular Engineering, Graduate School of Engineering	M1	Information collection for LIMS Research Issue: "Prediction and validation of the onset mechanism of autoimmune disease based on disorder in the cytokine network" at The 43rd Annual Meeting of the Japanese Society for Immunology
18	March 18, 2015	4	Yokohama	Rei Kuwabara	Polymer Chemistry, Graduate School of Engineering	M2	Oral Presentation and information collection for LIMS Research Project: "Transplantation of islets into immune privileged site prepared by sustained release of growth factor under the skin" at The 14th Congress of the Japanese Society for Regenerative Medicine

Student Activity Report
(M1 Students)

Annual Report 2014

Department of Medical Science
Graduate School of Medicine
Hiroyuki Matsubara

(1) Pre-research

Subject: NK cells derived from iPS cells for a clinical application

- **The idea in the study**

Immunological research has contributed to many discoveries in treatments for cancers. Currently, the majority of cancer treatments depend on anticancer drugs which are liable to be accompanied with many side effects by influencing normal cells. To cover this problem, we thought immunotherapy using the Natural Killer (NK) cells is useful, because they can attack cancer cells that have acquired mechanisms to escape from immune cells.

- **NK killer assay**

In 2014, I tried to create the NK killer assay system using NK cells from PBMC (Peripheral Blood Mononuclear Cell) (Fig. 1). K562, a leukemia cell-line, co-cultured with NK cells for 2 hours at 37℃, and analyzed cytotoxicity of NK cells using FACS. As shown in Fig. 1, K562 cells were labeled with PKH2 Green Fluorescent Cell Linker to identify each cell. The cytotoxic activity of NK cells was confirmed by increased number of DAPI+ cells in PKH-labeled K562 cells co-cultured with NK cells. (Fig. 2).

- **Participation in academic meeting**

I attended American society of hematology 2014 (2014.12.06-09).

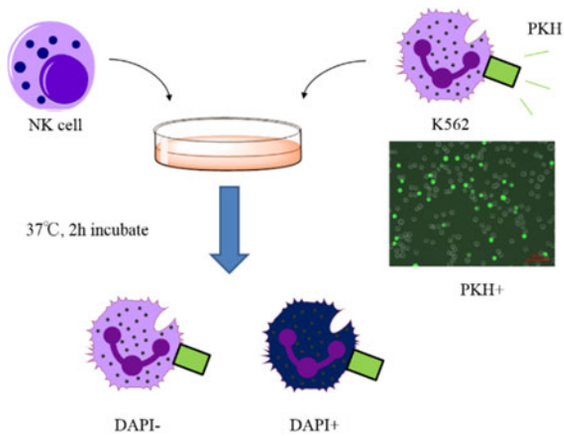


Fig.1 NK killer assay

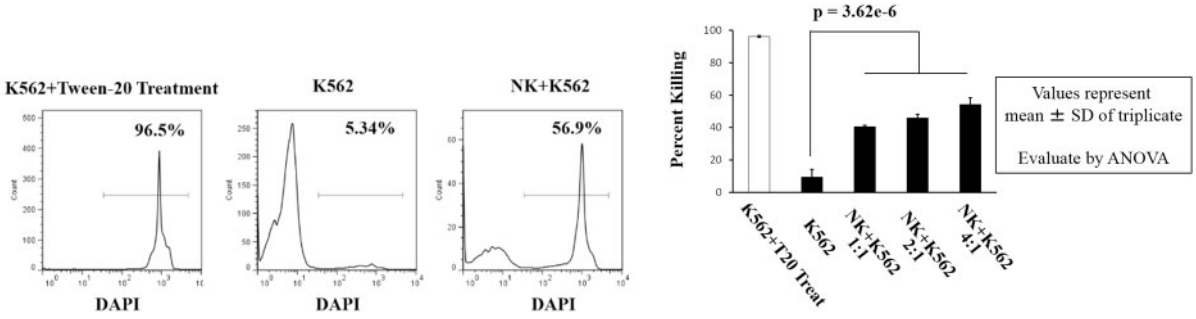


Fig.2 Killing potential of NK cells derived from PBMC

(2) Lecture and Training

In 2014, I took classes of English Debate, Human Anatomy, and Physiology. It was very valuable experience by observing and understanding the structure of the human body by Human Anatomy class in particular. Through the lectures and seminars of Medical and life support systems, I could learn a lot of things about medical front.

Annual Report 2014

Department of Medical Science
Graduate School of Medicine
SAHA Liton Kumar

(1) Academic

I have been introduced with basic knowledge in medical field by studying human anatomy and physiology throughout this year. I participated the theory and practice classes of medical and life support systems which gave me an idea about the current health care system and existing problems in health care system in Japan. I got a provoking idea about the Japanese model to improve public health care all over the world. I attended some classes of medical engineering for society I course and it seems quite interesting to me. By participating debate class my communication and presentation skill has been improved.

(2) Research

Topic: Establishment of in vitro micronucleus assay using DNA repair deficient human lymphoblastoid TK6 cell line to detect genotoxic chemicals

Here is the objective, summary and progress so far of my research under LIMS program:

Today, U.S. and EU chemical manufacturers comply with a massive amount of data collection, reporting and other regulatory requirements, many of which are vital to ensuring the health and safety of chemicals. In the chemical sector, innovation and chemistry are inextricably linked. From applied technology in medical devices, aerospace, energy efficiency, computing, cars, fuels and more, chemistry enables technological advancements that drive further innovation, create jobs and enhance safety in our everyday lives. The REACH Regulation represents a major piece of chemical legislation in the EU and requires manufacturers and importers of chemicals to assess the safety of their substances.

Epidemiology suggests that most cancers are induced by environmental factors. The use of screening tests which are dependent upon chemical interaction with DNA has greatly facilitated the identification of probable chemical carcinogens. Interpretation of the test results is never easy, in terms of human risk assessment, and is further complicated by the presence of other chemicals in an environmental context. The issue of risk assessment of genotoxic and carcinogenic substances is relevant for chemicals used or present in foods, nonfoods, industrial applications, and is one that poses significant challenges to the risk managers. Biomarkers of genotoxic effects include: DNA-adducts including oxidative damage to the DNA, which may be detected by the comet assay, chromosomal aberrations, sister chromatid exchanges, increased frequency of micronuclei. A number of short-term genotoxicity tests that differ in biological system (prokaryotic, eukaryotic, in vitro, or in vivo) and endpoint (gene mutation, chromosome aberration, DNA damage, etc.) have been developed and optimized over the years. Because no single test is capable of detecting all genotoxic chemicals, a battery of tests covering different targets and endpoints and using different systems is used for regulatory evaluations [ICH, 1995]. Due to the development of highly sensitive analytical techniques, the use of biomarkers becomes increasingly important in exposure assessment since it provides more exact information on actual internal exposure (target dose) to an agent. (Angerer et al. 2007, Boogaard 2007, Calafat et al. 2006, Needham et al. 2007, Pirkle et al. 2005, Yang et al. 2006b).Improving the quality of these assessments will lead to significant benefits for everyone. It will help drive better public health decisions based on accurate information and better use of public and private sector resources that can be refocused on protecting the public and the environment and on promoting jobs and innovation.

Most DNA repair-deficient mutants are hypersensitive to DNA damaging agents, which led us to realize that these strains could be used as an assay system to identify putative genotoxins with greater sensitivity than existing assays. We propose the development of new

methodologies to perform IVMN (In vitro micronucleus) assay using DNA repair deficient TK6 cell line. The issue of false-positive results in the standard in vitro genotoxicity assays and challenges with follow-up testing are recognized as a critical issue in the global genetic toxicology community. One approach to address this issue is to develop improved *in vitro* genotoxicity assays. Our focus has been on the use of DNA repair deficient TK6 models for development of a new more sensitive, physiologically relevant and *in vitro* MN assay with greater specificity.

We are proposing the use of panel of DNA repair TK6 mutants in the following pathway: Rad54 and Ligase4 (HR and NHEJ, respectively); Fancd2 (Inter-strand closslink repair); Rev3, Rad18 (TLS) and XRCC1 (Base excision repair).We are planning to use human TK6 cell line because this cell line has some greater advantages than other cell line in terms of genotoxicity test and the findings would be physiologically relevant to assessment of risk of genotoxin to human health.

In this year, I have learned how to make gene disrupted human cell using TALEN and CRISPR/CAS9 technology. I have also learned several research technique of molecular biology. The generation of XRCC1 deficient and FANCD2 deficient human TK6 B cell line is under progress.

Generation of human FANCD2$^{-/-}$TK6 B cells

To disrupt *FANCD2*, guide RNA targeting first codon using Zhang CRISPR tool (F Ann Ran et al., 2013) and gene-targeting constructs were generated.The gene-targeting constructs were generated from genomic DNA of TK6 cells by amplifying with the primers for the 5′-arm and for the 3′-arm. Genomic PCR products were combined with neomycin resistance (*neo*^{R}) and puromycin resistance (*puro*^{R}) marker genes. 6 μg of CRISPR and 2 μg each of gene-targeting vectors were transfected into 4×10^{6} TK6 cells using Neon transfection system (Life Technologies, US). After electroporation, cells were released into 20 ml drug-free medium. 48 hours later, cells were seeded into 96-well plates for selection with both neomycin and puromycin antibiotics for two weeks.

The *FANCD2* gene deficient clones will be confirmed by western blot analysis.

Generation of human XRCC1$^{-/-}$ TK6 B cells

To disrupt *XRCC1*, TALEN expression plasmids and gene-targeting constructs were generated. The gene-targeting constructs were generated from genomic DNA of TK6 cells by amplifying with primers for the 5′-arm and for the 3′-arm. Genomic PCR products were combined with histidinol D resistance (*his*^{R}) and blasticidin S resistance

(*bsr*^{R}) marker] genes. 6 μg each of TALEN expression plasmids and 2 μg each of gene-targeting vectors were transfected into 4×10^6 TK6 cells using Neon transfection system (Life Technologies, US). After electroporation, cells were released into 20 ml drug-free medium. 48 hours later, cells were seeded into 96-well plates for selection with both histidinol and blasticidin antibiotics for two weeks.

The *XRCC1* gene deficient clones will be confirmed by western blot analysis.

Learning Acquisition of the Integrated Medical System

Department of Medical Science
Graduate School of Medicine
Aila Johanna

To allow for better evaluation, the report is segmented based on the objectives of Training Program of Leaders for Integrated Medical System.

(1) Society-directed medicine and healthcare system

Population aging is a demographic tendency that requires countries to restructure their strategies. Although this occurs worldwide, Japan has the most surprising growth rate of aging population. Courses such as the Medical and Life Support System introduced the issues any aging society faces, and how the national health system and social welfare organizations need to equip the elderly population to optimize their activities of daily living and minimize health problems. The field trips conducted gave students a chance to observe the operation of physical rehabilitation and elderly care centers.

One important lesson is how to actually view the breach of the issue. The course taught us which data should be looked at to judge the demographic impact of an aging society. The dependency ratio, for one, is used to measure the burden of dependents which has to be supported by the working population. Calculated as the ratio of the number of nonworking population per 100 persons of working population, with the ‘working population’ be generalized as people aged 15 to 64 years old. Another data is the potential support ratio, which is defined as the working population divided by the number of persons aged 65 and above. This data is used to predict the support base at hand. From this information, one could assess the demographic impact of aging in other countries despite differences in economic or socio-demographic profiles. For example, the data for dependency ratio and potential support ratio in

Indonesia are presented in figure 1 and 2, respectively.

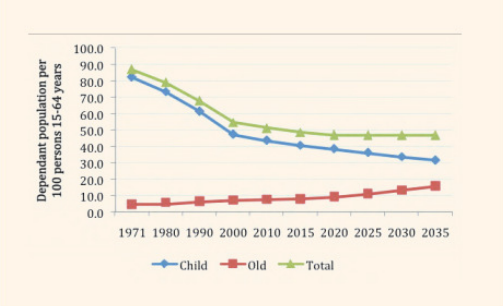


Figure 1. Past and projected trends in Dependency Ratio in Indonesia

Source: Adioetomo SM, Mujahid G. Indonesia on the threshold of population ageing. UNFPA 2014.

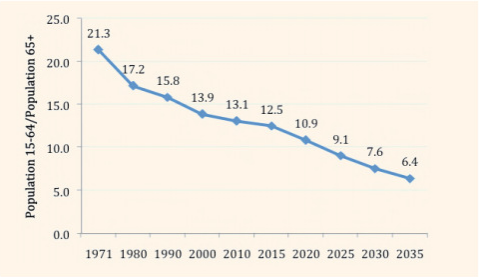


Figure 2. Past and projected trends in Potential Support Ratio in Indonesia

Source: Adioetomo SM, Mujahid G. Indonesia on the threshold of population ageing. UNFPA 2014.

Specific health problems associated with aging were also learned throughout the program, from classes and seminars. Since aging is associated with the functional decline of many organ systems of the human body, health problems in geriatric population are usually multiple and therefore hard to completely obliterate. This puts an emphasis on improving general quality of life in geriatric science.

(2) Industrialization, innovation, and intellectual rights

Learning about innovation and industry development in the course Medical Engineering for Society, a chance to try for its application came through the Nikkei Science Idea Contest. The contest is held annually through industry cooperation, in which each technology-based company gives its own topic. Participation was taken for the one brought by Zacros (Fujimori Kogyo Co., Ltd) on the topic of proposing new function of wrapping for a comfortable life in future prosperous society. Along with four other students of LIMS training program, ideas for such innovation were subsequently discussed. Following the result of the competition, discussion for patent proposals were also carried out.

(3) Health economics and policy

Health insurance system was learned through a course where students discuss the

comparison between the insurance systems of several countries. Some health policies related to the burden of an aging nation was also delivered through the course in first semester.

English Debate course provided us the opportunity to practice structuring a policy proposal. This allowed for the understanding of what aspects one should compare and contrast between the countries / areas encompassed within the pilot study, and the country / area intended as the target for the policy.

(4) Collaborations for healthcare systems

An upcoming activity is to take participation in the World Health Summit Regional Meeting 2015 in Kyoto, Japan. The conference shall discuss the current measures in geriatric care and the reshaping of healthcare that would be better suited to a rapidly aging society. Another agenda to be assessed is the physical and mental health issues related to disasters and environmental hazards, which shall broaden my scope of health-related concerns of the society today.

ANNUAL REPORT

Department of Medical Science
Graduate School of Medicine
MBENZA MBAMBI NAASSON

(1) Introduction

As a first year Master student (M1) of LIMS program, I learned and acquired knowledge and skills regarding different courses that I selected.

Especially, human Anatomy course, which helped everybody work on dead bodies. And also physiology for mastering the body's function through different organs and system. Kinesiology course for muscles, bones and joints functioning.

Medical life support for which we visited rehabilitation day care center, Welfare Institution and Community General Support Center and Consultation Center providing advice to elderly patients. From these visits I learned how to help elderly people recover their ability lost.

English debate course, which helped boost my communication skills. Biopharmaceutics, which helped me refresh and learned the leading edge improvements in DDS (drug delivery system) by focusing on Targeting through pharmacokinetic processes ADME (Absorption, Distribution, Metabolism and Excretion).

(2) Research Progress

First, I wanted to work on tuberculosis in DRCongo and I was advised by my supervisors and mentors to work on project that does not involve a lot of laboratory experiments and does not require me to go to DRCongo for collecting samples since I am already involved in a laboratory based research project. Then I decided to work on learning from Japanese health care insurance system for improving DRCongo health insurance system.

Because Japan's health care system is characterized by universal coverage, free choice of health care providers by patients, a multi-payer, employment based system of financing, and a predominant role for private hospitals and fee-for-service practice.

Virtually all residents of Japan are covered without regard to any medical problems (so-called predisposing conditions) or actuarial risk of succumbing to illness. Thus making it a good health care insurance system to learn from.

LIMS activity has broadened my horizons remarkably

Department of Human Health Sciences
Graduate School of Medicine
Tomoko Matsumoto

(1) Participating in "the Meeting on Carrying out the Internship System for Students, Faculty, an Staffs of both university and company" sponsored by the Ministry of Economy, Trade and Industry.（2014.June）

In this meeting we had a workshop to discuss on several problems involved the long and middle term internship system. This workshop consisted of Staffs of company and government, students and faculty and staffs of university. Through this meeting discussions on problems and solutions of the long and middle term internship could be deepened from several distinct views.

My group in which I played the facilitator obtained the most approval among the participant. What I felt by the discussion of this meeting is the difficulty of exchanging opinions among persons who have different situations and viewpoints. But on the other hand, I think the possibility to find the new solution through such an experience that we can exchange various opinions with the diversity. Moreover this meeting was a precious and wonderful opportunity for me because of an interchange with other faculty, staffs, and students of the Leading Graduate Program of other universities.

(2) Participating in “Science Idea Contest named テクノルネサンス” sponsored by The NIKKEI and Winning a First Prize

In this summer, I gathered several LIMS members and discussed the subject, “what is the value of wrapping for future?” And then we built up the idea and applied for Science Idea Contest hosted by The Nikkei. In result we could win the first prize. By this experience I felt the importance of intellect concentration in various field. Moreover we want to produce this novelty item on commercial basis, and then make innovations in the society for the future.

(3) Participating in a lot of LIMS lectures

Generally speaking, students of the graduate school have a tendency to get their horizons and knowledge narrow, specialized their study field. However in this LIMS program there are many lectures in various fields such as Engineering, Medical Science, Pharmacology and so on. Therefore we can learn various fields of study. I have also taken lots of lectures in LIMS and experienced various practical studies. For example, I participated in Medical Engineering for Society, Minimally invasive therapeutics, Special class lectured by professor of other Universities, Physiology, Basic Materials Chemistry and so on. Now I have appreciated for LIMS program to get me widen my horizon thanks to LIMS program And I could also experience more special studies.

I talk about most valuable experience in LIMS lectures, Minimally Invasive Therapeutics. In this class, I could experience in the real medical treatment site and then learned what it is performed there and how doctors is doing in surgical treatments. For example I knew the differences between "endoscope and laparoscopic surgical operation system" and "Surgery support system and surgical robot system". These two systems have a same point to use the endoscope in surgical treatment. On the other hand they are very difficult of a viewing field and the way of surgical treatment. I surprised these differences and felt there were much points to be improved. I realized the importance of "Seeing is believing" strongly.

Figure : Surgical robot system

Therefore I want to make full use of my knowledge and experience which I learned in the LIMS program.

Annual Report

Department of Pharmaceutical Sciences
Graduate School of Pharmaceutical Sciences
Kouki Shinoda

(1) Pre-research

Theme: 'Association between age-related changes in biorhythm and disease onset; chronobiological study and its application to clinical treatment'

It is well known that biorhythm can change during aging. Recently, it has been reported that this change is related to various diseases. As the research of LIMS program, I am trying to clarify the correlation between age-related changes in biorhythm and disease onset from a viewpoint of chronobiology and molecular biology. In the future, I hope to propose new devices or way of better living for improving QOL of elderly people.

In this year, based on documents and articles, I investigated diseases related to biorhythm, especially circadian rhythm, and found that it is suggested that diseases such as sleep-disorder, high blood pressure and bronchial asthma are related to biorhythm change. Moreover, it was reported that a disorder of the circadian rhythm by working during night-time had an influence on the melatonin secretion and it could become the onset factor of breast cancer and mental diseases. Some modifications of drug release and drug administration systems to relieve disease symptoms varied with circadian rhythm were also

reported, such as a controlled release formulation of antiasthmatic drug ‘theophylline’ and ‘chrono-pump’. It is thought that these reports are closely related with my research theme in LIMS program.

To study the basic chronobiology, its history, and the latest experimental technologies, I took part in ‘CBS2014, Chronobiology Summer School in 2014 in Sapporo’ and ‘Sapporo Symposium on Biological Rhythm’. I learned how the change of the light and dark condition influenced circadian rhythm and why the suprachiasmatic nucleus were regarded as the center of the circadian clock.

To expand my knowledge of molecular biology, I attended ‘the Seventh Annual Meeting of the Japanese Society for Cell Synthesis Research’. It was thought that the approach to synthesis or control cells was useful for controlling rhythmic changes in cellular level and applying it to therapy. I was able to obtain important viewpoints for my research theme.

I am going to push forward documents investigation about the association of aging and the biorhythm.

(2) Practices and Lectures

I was able to take classes in a wide range of fields such as medicine, engineering, debate in English and the lecturers from the companies. I would never be able to study these, belonging only to Faculty of Pharmaceutical Sciences. Especially, in human anatomy class, we were able to observe the corpse directly and learn the basic structures of human body comparing those listed in a textbook one by one. I realized preciousness of the life again. I hope I could make use of this experience when I study on life science and engage myself in a medical industry in the future.

In Medical and life support systems, we visit hospitals, day-care center and several companies. Through the field trips to the work sites of physical therapists and the occupational therapists and to the daycare center, I learned the various needs in the medical sites. In addition, I obtained information about the device development and the technical use in the medical industry by visiting Shimadzu Corporation which develops and is selling CT and MRI.

In Medical Engineering for Society I, I had opportunities to take lectures on various topics directly connected with the business, such as standardization and intellectual property rights, to development of medical equipment and the material. I was able to learn about the current reality of medical and care fields and a way of thinking, about research and development as a business, which would be hard to get in the laboratory.

Next year, I keep studying medicine and engineering, aiming to suggest a new business model to meet the needs of longevity society and to connect them with my research theme in LIMS program.

Pathological Treatment for Shift Workers by Elucidation of Molecular Mechanisms of Body Clock Homeostasis

Department of Bioinformatics and Chemical Genomics
Graduate School of Pharmaceutical Sciences
Kumiko Dojo

(1) What I have learned throughout this year

In the 21st century, the population of shiftworkers and midnight workers is increasing. According to the survey by the Ministry of Health, Labor and Welfare in 2007, 27% of laborers are working as shiftworkers and midnight workers. Due to rotating shiftwork and work at midnight, phase relationships between internal circadian rhythms and the external day/night cycle are unfitted. Shiftworkers have the increased risk of dyslipidaemia, hypertension, diabetes, and vascular disease[1-4]. Elucidation of the causes of pathological treatment for shiftworkers and treatment for them have not been taken into action.

As starting my research, "the health risks of shiftwork", I looked into the papers to understand what had been currently known/unknown of the relationship between shiftworkers and shiftwork-related diseases. I also attended the 37th Annual Meeting of the Molecular Biology Society of Japan and learned cutting-edge studies of chronobiology related with shiftworker-related disease. For example, shiftworkers have higher possibility to get cancer. Breast cancer has been extensively researched on this issue. Women who are older than 50 and have worked as shiftworkers for more than three years have more risks to get breast cancer by 4.3 times. It is said that lack of melatonin which is secerned at night leads to cancers[5]. Another group reported relations between forebrain and depression. The mouse anxiety-/depression-like behavior is significantly perturbed in mice which lack circadian rhythmicity of clock genes in the forebrain and jet-lag halts rhythmicity of clock gens circadian rhythm. Therefore, shiftworkers perturbed themselves' oscillation pattern in gene level. Throughout this year, I got the newest information of jet-lag and shiftwork.

(2) Future Plan

The aim of my research is to reveal the cause of high-risk shiftworker-related disease at the molecular level, and to develop a novel way to prevent it. As a model of shiftworkers, there is an experiment that mice are settled in a chronic jet-lag. For example, Davidson reported that half of old mice died after one month under 6 hours jet-lag environment every

4 days compared to the few dead young mice[5]. Although this experiment is very interesting, the cause of death has not been revealed. Therefore the coping ways were not mentioned either. One of the reasons preventing advancement in this field was the difficulty to develop mice lacking jet-lag symptoms, and thereby it was hard to compare with wild mice, and to specify causes of diseases. In 2013, the laboratory I am currently attending reported the development of a mouse model (V1aV1b double knock out mouse; V1aV1b DKO) which lacks symptoms of jet-lag in both advancing and delaying ways. When imitating the jet-lag situation, wild type mice need 10 days to reentrain themselves to the new light/dark environment. On the other hand, V1aV1bDKO mice reentrained immediately to the new environment. As the annual goal for next year, I am going to put wild type mice and V1aV1bDKO mice under chronic jet-lag condition for a while and search how clock genes' and metabolic genes' expression at suprachiasmatic nucleus (SCN) and peripheral organs change, and whether V1aV1bDKO mice live longer than wild type mice. As analyzing these signal transduction, I would like to develop compounds to prevent the death of wild type mice under chronic jet-lag. The achievement of this study will lead development of medicine which prevents especially elderly shiftworkers to get shiftwork-related diseases. I hope my research will serve as a hint to establish a fruitful healthy-longevity society.

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Annual Report

Department of Molecular Engineering
Graduate School of Engineering
Masatoshi Uno

(1) Themes of research in LIMS Program

"Prediction and validation of the onset mechanism of autoimmune disease based on disorder in the cytokine network"

(2) Background

Nowadays, autoimmune diseases have accounted for a large proportion in incurable disease groups designated by Ministry of Health, Labour and Welfare. Generally, they are regarded as being caused by disorder of immune system, for example, systemic lupus erythematosus, rheumatoid arthritis, scleroderma and so on [1]. However, pathogenesis in the autoimmune disease has not been elucidated and therapeutic strategies are remission by symptomatic treatment. One disease of the largest number of patient in autoimmune disease is rheumatoid arthritis (RA) and there are 0.7~0.8 million patient of RA in Japan. Main symptoms of RA are inflammation in the joints and joint deformation caused by inflammation. Recently, a researcher found signaling molecule in Osteoclast differentiation system called RANKL [2]. Osteoclast is key factor of joint deformation and RANKL is involved in immune signaling molecular system. These results suggest that RANKL contributes joint deformation. In fact, medicines of anti -inflammatory cytokines antibodies (anti-TNF-α,anti-IL-6) were dramatically effective. But, there are no medicines which can effect all patients and cure radically. So, development of eradicative medicine of RA has been expected.

(3) Study

Purpose of this research is analysis of RA's molecular mechanism for suggestion of treatment method. So I focus on molecular network of cytokines in RA, and I am going to construct its simulating system. Moreover I am going to evaluate effect of single nucleotide polymorphism in genome-wide association study and search treatment target with this simulating system. Similar researches have existed, but most targets of these researches are cancer[3]. So I aim to construct a simulation system that targets the cytokine system with a focus on IL-6 system which involved in RA strongly and other autoimmune diseases in this study. It is another goal to reflect the simulation system by biochemically evaluating a change by SNP found simultaneously genome analysis.

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Epigenetic modification by protein engineering

Department of Molecular Engineering
Graduate School of Engineering
Itaru Takeshita

(1) Technique for sequence-specific DNA methylation

Epigenetic error is implicated in many diseases like cancer, leukemia, and neurodegenerative diseases. And it is known that it is also related to cell differentiation.

Here, I will introduce an idea that protein engineering may be able to regulate DNA methylation pattern depending on DNA sequence. This idea is that epigenetic protein (DNA methylase or demethylase) and sequence-specific DNA binding protein (cas9 or TALEs) are fused together, and it can be used as epigenetic modification tool.

(2) Application and future plan

I am thinking of three application of this technique.

First, we can prepare models of epigenome-related disease. As I described above, it is reported that aberrant DNA methylation patterns cause many kinds of diseases. If we use this technique for cells or animals, we can understand the relationship between epigenetics and diseases in detail.

Second, it has potential to be used as a cell differentiation inducer for iPS cells. Epigenetic modification is important for cell differentiation even in the case of iPS cells. This technique may enable us to induce cell differentiation in a different way.

Third, this tool can be applied to gene therapy. For example, if we make a vector which codes for cas9 and DNA demethylase, we can cause demethylation on a target gene. Up to now, though low molecular methylase inhibitor is used as an anticancer drug, it has side effects because of its nonspecific inhibition. It is estimated that this therapy help to decrease such side effects. In addition, this does not recombine genes but modifies only DNA methylation patterns. Therefore, I believe that an ethical problem is not so large.

As described above, this technique has potential to be applied to medical research and medical treatments, and it may play an essential part to solve epigenome related diseases.

In the future, I have to decide which epigenetic protein / DNA binding protein is competent for this technique at first. And then, I will evaluate its activity in vitro, and confirm whether it works or not in cell or model animals.

Development of Functional Optical Materials Based on Organic – Inorganic Hybrids for Quantitative Detection of Biomolecules

Department of Polymer Chemistry
Graduate School of Engineering
Kazumasa Suenaga

(1) Development of chemosensors with aggregation-induced emission-active polymers

We develop the stimuli-responsive chemosensors based on the emissive polymers (Figure 1). For example, we report thermally-responsive emission changes of the water-soluble polymers containing the aggregation-induced emission (AIE)-active organoboron dye. The polymers composed of poly(*N*-isopropylacrylamide) (P(NIPAm)) were modified with the boron ketoiminate dye which can show the AIE property. Before heating, the slight emission was observed from the solution of the synthesized polymers at room temperature. The bright green emission was obtained from the solution by heating above 40 °C. The temperature-sensitive emissive polymers can be prepared based on the AIE-active materials. In addition, we also prepared the films with the AIE-active copolymers composed of fluorenes and the sulfide-substituted boron diiminates and evaluated the changes in the optical properties by the oxidation. By soaking the film samples of the polymer in the H_2O_2 solution, the significant increase of the emission intensity was observed by oxidation. The quantum yields increased up to 3-times larger by oxidation at the sulfide groups. This would be attributed to the facilitating charge transfer (CT)-emissive fluorescence between the fluorene units and the boron diiminates having the enhanced electron-withdrawing ability by replacing from the sulfide to the sulfoxide groups. These materials should be a suitable platform as a bioprobe for longitudinal monitoring the bio-related reactions.

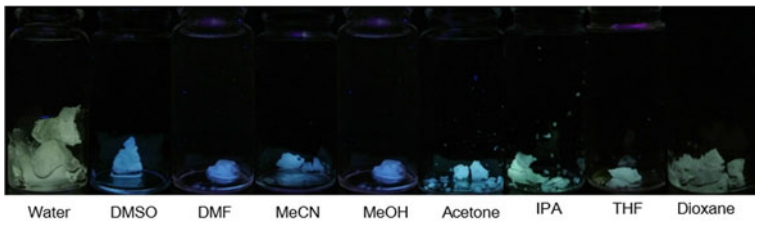


Figure 1. Chemosensors for evaluating protein cohesion.

(2) Development of mechanofluorochromic materials based on AIE-active complex

Mechanofluorochromic (MFC) compounds that show the switchable-photoluminescent properties in response to mechanical stress have received a great deal of attention from both fundamental research fields of solid state photochemistry and applications for optical devices and sensors. However, there are few examples to offer organic MFC molecules because most of the organic emissive dyes generally showed extremely-weak emission in the solid states by

the concentration quenching. Therefore, there is still large difficulty in the development of MFC compounds based on organic molecules. To overcome this problem, the AIE-active molecules which show the strong emission only in the aggregation and solid states are promising candidate. Indeed, some MFC materials with strong solid-state emission have been developed based on the AIE-active molecules. We have presented opto and/or electronic properties of the series of organoboron complexes and polymers. In particular, some boron ketoiminate derivatives exhibited the AIE properties, and highly-emissive solid materials were obtained. In addition, various optical properties such as emission color and stimuli-responsiveness can be modulated by the substituent effects. Next challenge is to realize the MFC properties based on the AIE-active organoboron complexes.

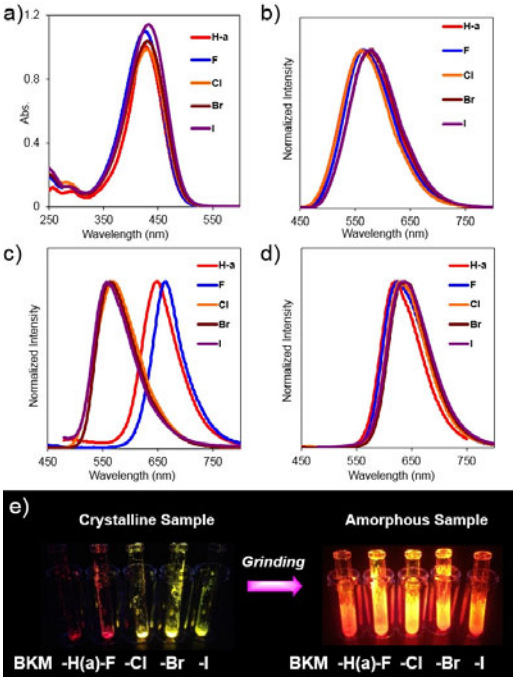


Figure 2. a) UV−vis absorption and b) PL spectra of BKM-H(a) and halogen-substituted boron ketoiminates in THF (c = 1×10^{-5} M). PL spectra of BKM-H(a) and halogen-substituted boron ketoiminates in c) crystalline and d) ground states. e) Photograph of the boron ketoiminates in the crystalline and amorphous states under UV irradiation.

In this research, boron ketoiminates with MFC properties including a bithiophene unit are presented. We synthesized a series of boron ketoiminates with various functional groups at the ends of molecules and investigated the relationship between the substituent effects and the optical properties. Initially, we prepared a variety of boron ketoiminates and investigated the substituent effects on the optical properties by altering the end groups in the compounds. It was found that the synthesized boron ketoiminates exhibited AIE properties. In addition, MFC properties were also observed (Figure 2). Interestingly, the hypsochromic and the bathochromic shifts of the emission bands were individually observed from boron ketoiminates depended on the chemical structures of the end groups. From the X-ray diffraction and differential scanning calorimetry analyses, it was confirmed that the MFC property of boron ketoiminates should be derived from a phase transition between crystalline and amorphous states. Notably, the direction of the peak shifts of the emission band can be controlled by selecting the substituents. In particular, we found that the size of the substituents should be responsible for the color changes in MFC behaviors. The direction of the peak shifts of the emission bands was controlled by the degree of the steric hindrance of the end group. Finally, we demonstrated the dynamic and reversible controls of emission colors by the external stimuli.

Literature search on the relationship between age-related diseases in the elderly and the chemical compounds that induce them

Department of Synthetic Chemistry and Biological Chemistry
Graduate School of Engineering
Hiroki Enno

(1) Diabetes

There are two main reasons why elderly people easily get diabetes. One reason is that aging itself affects glucose tolerance badly. Another is that they have difficulty in managing their health by themselves, leading to diabetes as lifestyle diseases. Here, the medicines for diabetes whose physiological mechanisms are understood are summarized.

1.1 Metformin

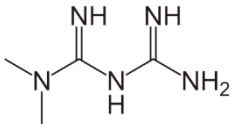


Fig. 1 Metformin

This compound is transferred into liver cell by OCT1, which impedes mitochondrial Complex I and suppresses gluconeogenesis in the liver. It is proposed that Metfolmin activates AMPK (AMP-activated protein kinase) and accelerates suppression of gluconeogenesis. However, even for AMPK knockdown mice, the suppression of gluconeogenesis is observed, which suggests there are other mechanisms involved.

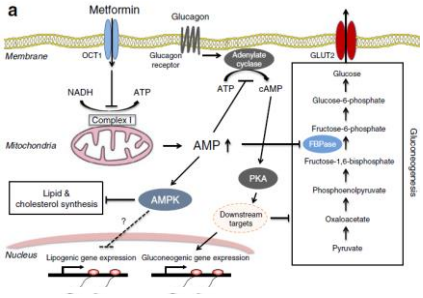


Fig. 2 Mechanisms of Metfolmin

1.2 Sulfonylurea

Sulfonylurea, which has sulfonylurea functional group in its structure, can bind to the potassium channel SUR1 subunit and close the channel. This induces the depolarization of cell membranes and the inflow of calcium ion into the cell. This mechanism finally leads to insulin secretion.

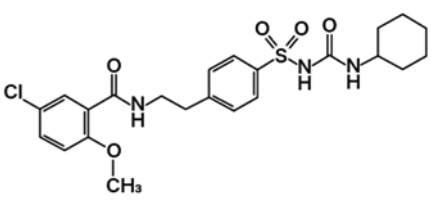


Fig. 3 Sulfonylurea

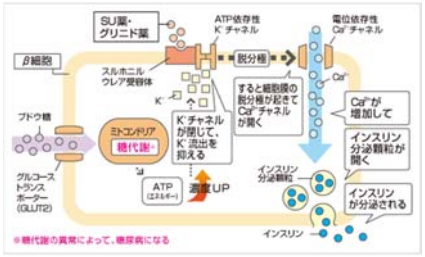
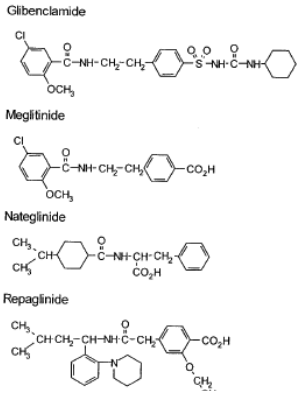


Fig. 4 Mechanisms of Sulfonylurea

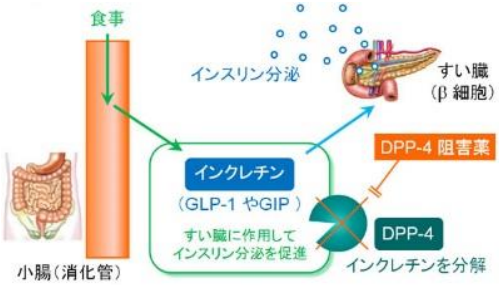
1.3 Meglitinides (glinides)



The reaction mechanism of meglitinides is almost the same as sulfonylurea even though meglitinides do not have sulfonylurea functional group. Meglitinides bind to sulfonylurea receptor with weaker affinity compared to sulfonylurea so the amount of insulin secretion remains the same even after a meal.

Fig. 5 Meglitinides (Glinides)

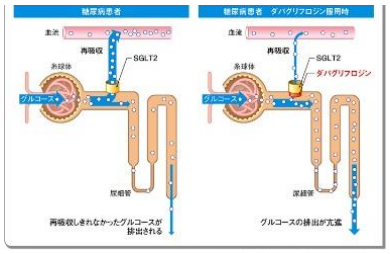
1.4 DPP-4 inhibitor



DPP-4 inactivates incretin, which promotes insulin secretion. DPP-4 inhibitor suppresses DPP-4 and increases endogenic activated incretin concentration to decrease the blood sugar.

Fig. 6 Mechanisms of DPP-4 inhibitor

1.5 SGLT-2 (sodium-dependent glucose transporter 2) inhibitor



SGLT-2 locates around proximal convoluted tubule and resorbs 90% of glucose after the filtration of glomerulus. SGLT-2 inhibitor interrupts the resorption by SGLT-2 and exhausts glucose into the urine, which reduces blood sugar.

Fig. 7 Mechanisms of SGLT2 inhibitor

1.6 α-glucosidase inhibitor

α-glucosidase is an enzyme to hydrolyze α-1,4-glucosido bond in sugar and accelerates the absorption of the sugar. α-glucosidase inhibitor suppresses this system and prevents blood sugar from increasing.

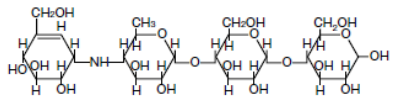
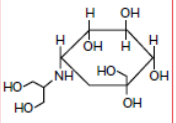
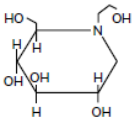
一般名	アカルボース	ボグリボース	ミグリトール
商品名	グルコバイ錠®，OD錠®	ベイスン錠®，OD錠®	セイブル錠®
構造式			
規格	50 mg，100 mg	0.2 mg，0.3 mg	25 mg，50 mg，75 mg

Fig. 8 α-glucosidase inhibitor

(2) Alzheimer's Disease (AD)

Amyloid cascade hypothesis is one of the famous disease-developing mechanisms. Amyloid β (Aβ) protein and tau protein are widely accumulated on the brain of the patients and regarded as the cause of AD. However, the mechanisms and the cure are still under investigation. So here the treatments that are relatively well-known as well as medicine currently being developed are summarized below.

2.1 General medicine

In general, Cholinesterase (ChEl) such as donepezil and galantamine is used for patients with early stage AD. This ChEl inhibits acetylcholinesterase and increases acetylcholine. The binding site for Galantamine on the acetylcoline receptor is different from that for acetylcoline, and Galantamine binding reinforces the effects of acetylcoline binding to the receptor.

For middle stage AD patients, NMDA receptor antagonist is used additionally. This blocks NMDA open channel and improves a signal-noise ratio of neurotransmission.

2.2 Aβ immunotherapy

Active immunity: AN1792 vaccine caused autoimmunity meningitis for 6% administrated group and so the phase II trial was canceled in 2002. Even though a decrease of the senile plaque was observed, the same degree of cognitive decline was observed as in the placebo group. Currently three vaccines (ACC-001, CAD106, UB311) are in phase II trial.

Passive immunity: Solanezumab, which recognizes an epitope from the 13^{th} to 28^{th} amino acid in the Aβ protein, has a high affinity to Aβ oligomer. Although this did not pass the endpoint of phase II trial, the suppression of cognitive decline was observed when compared to the placebo group.

2.3 γ-secretase activity inhibitor

γ-secretase cuts not only APP (amyloid precursor protein) but also an aspartic acid protease, a membrane protein complex and an amyloid precursor peptide, which produces Aβ. One of the γ-secretase activity inhibitor, semagacestat, was expected to inhibit γ-secretase and proceeded to phase III trial. However, the trial was canceled because it caused cognitive declines and skin cancers.

2.4 BACE1 (beta-site APP cleaving enzyme 1) inhibitor

A673T, which was characterized as a genetically protective factor to AD, is regarded to suppress the BACE1 and inhibits outbreak of AD. Now one of the BACE1 inhibitor, MK-8931 is in phase II/III trial.

2.5 Aβ coagulation inhibitor

Scyllo-inositol is regarded as Aβ coagulation inhibitor to making a nontoxic

complex with Aβ after passing through blood-brain barrier. Though significant improvements of cognitive function were not observed, phase III trials are currently being planned.

2.6 Tau-related medicine

Tau is considered to induce nerve cell death in amyloid hypothesis. One of the Tau coagulation inhibitors, methylthionium chloride, was shown to suppress cognitive decline in phase II trial.

(3) Cancer

In general, the risk of getting cancer increases with age. The symptoms of cancer are unclear in the elderly compared to the young, so it is difficult to detect cancer at an early stage. Here several kinds of efforts to cure cancer are summarized.

3.1 Radiation therapy

Generally speaking, cancer cells follow the Bergonie-Tribondeau's law and have high sensitivity to radiation. However, when metastasis occurs in the early stages of cancer, the survival rate of the patient is low even if local cancer cells are treated. In order to improve the radiation therapy efficiency, the following three methods are commonly used.

[Oxygen effect]

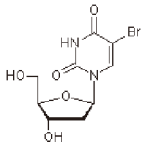
Oxygen reacts with water under X-ray irradiation and produces reactive free radical species, which enhances the reactivity of the cancer cells.

[Thermotherapy]

Thermotherapy affects hypoxic cells more than normal cells, which means that it can selectively damage cancer cells. It can also compensate for the disadvantage of radiation therapy because thermotherapy can give more damages to the cells in S-phase which are less reactive against radiation therapy.

[Radiation sensitizer]

5-bromodeoxyuridine



This compound is similar to the DNA precursor "thymine" and can be incorporated to DNA and enhance radiation sensitivity.

Fig. 9 5-bromodeoxyuridine

misonidazole

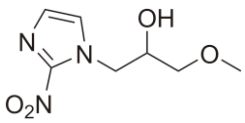


Fig. 10 misonidazole

This compound has high electron affinity and slower metabolic speed than oxygen. So this compound easily reaches the hypoxic cells far from the capillary and enhances radiation sensitivity.

3.2 Immunotherapy

[Antibody production-inducing agent or supplements from outside]

1. Patients are vaccinated to produce antibodies against cancer in their body

2. Antibody against a specific cancer is made outside the body and vaccinated to the patients.

[Reinforcement of natural immunity]

1. Natural products which activate immune systems are given to the patients.

2. Genetically modified proteins which activate immune systems such as NK activation are given to the patients.

3. Lymphocytes of the patient are collected and incubated to reinforce NK activation before they are given back to the patients.

4. Genes that activate natural immune systems are transferred to certain cells.

[Reinforcement of acquired immune system]

1. Compounds which are good for inducement and activation of cytotoxicity T lymphocytes are given to the patients.

2. Adoptive immunotherapy

3. Genes that activate acquired immune systems are transferred to certain cells.

[Inducement of acquired immune system]

1. Cancer cells themselves or chemically modified cancer cells are given to patients as vaccines.

2. Cancer-related antibodies are prepared artificially and given to the patients as vaccines.

3. Dendric cells are given to the patients to induce cancer-specific T cells in their bodies.

4. Cancer-related antigen genes are transferred to the cells and induce cytotoxic T lymphocyte.

3.3 Gene therapy

Viruses are used as a vector and immune-related genes are transferred to the cells. In Japan, some gene therapies such as CG-CSF and interferon are being attempted.

3.4 RNA interference; RNAi

RNAi is a method to knockdown specific DNA using double-strand RNA. In general, double-strand RNA induces the interferon response that reacts nonspecifically to foreign genetic material in mammalian cells, so knocking down DNA using RNAi was believed to be difficult. However, in recent years, it has been discovered that short double-strand RNA can be applied to knockdown specific DNA.

3.5 Molecule-targeted cure

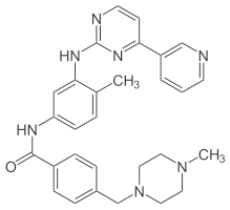
[Molecular-targeted cure]

This cure affects specific characters of cancer cells and controls the molecular abnormality which is essential to produce cancer cells. Expected goal of this cure is not only eradication of cancer cells but also the symbiosis with cancers, improvements of QOL and conditions of patients. However, there can be side effects for molecular-targeted cure because of the crosstalk between each molecule in physiological conditions.

[Target molecules]

Every process such as self-duplication, apoptosis, DNA repair, histone deacetylation, metastasis, differentiation, and vascularization is included. From a molecular functional point of view, the targets can be divided into ligands, receptors, intracellular signaling molecules, and drug transporters.

[An example of a successful targeted therapy]



Imatinib is used to treat chronic myelogenous leukemia. This compound is developed from more than 300 synthetic analogs which inhibit the abnormal tyrosine kinase only in cancer cells.

Fig. 11 imatinib

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Department of Synthetic Chemistry and Biological Chemistry
Graduate School of Engineering
Nobuhiko Nishitani

The Aim of the LIMS program

The Training Program of Leaders for Integrated Medical System for Fruitful Healthy-Longevity Society (LIMS) aims to produce medico-engineering students who can address the problem of the unprecedentedly rapidly aging society in Japan. The LIMS students are required to understand the social needs in medical care and contribute to the establishment of a fruitful society with people enjoying their long life and well-being.

In this program, it was possible to survey a whole range of medical and life support systems. I realized that there were a lot of problems in hospitals or rehabilitation facilities, and felt a need to propose a solution to them.

The first prize of the 7th Techno-Renaissance Japan

In the winter of 2014, I and four other LIMS students from different research fields won the first prize of the 7th Techno-Renaissance Japan. The Techno-Renaissance Japan is a competition intended to promote inventions by combining the techniques of manufacturing corporations and flexible ideas of science students. I thought that it would be a good opportunity to form an idea into reality and decided to apply for the competition. I made up a team with Ms. Aila JOHANNA (medicine), Ms. Tomoko MATSUMOTO (medicine), Ms. Kumiko DOJO (pharmaceutical sciences), Mr. Hiroki ENNO (engineering). We proposed a product to promote elderly people's health and rehabilitation, and our idea received the first prize.

The competition was organized by Nikkei, Inc, and this time, it was sponsored by five Japanese manufacturing corporations: Three Bond Co., Ltd., Dai Nippon Printing Co., Ltd., Denso Corp., Toray Industries, Inc., and Fujimori Kogyo Co., Ltd. Each of them presented the contest themes according to their corporate ideas and purposes. Our team chose Fujimori Kogyo Co., Ltd. whose theme was "the future value of wrapping," and we had a common wish to design a product that has a new value of wrapping and helps people of all ages, especially the aged, lead a vigorous and fruitful life.

Until now, material values, such as cost, benefit and efficiency, have been more important than spiritual or emotional values in product development. In most hospitals and rehabilitation facilities, they often provide only minimum equipment, mechanical instruments, and dreary

rooms. However, we knew from lectures and study tours to clinics that both patients and hospitals really need more human-oriented instruments for treatment and rehabilitation.

In our product design, we focused on “walking” that is one of the most basic movements of humans. We proposed the idea that would make walking more pleasurable. Our idea is to increase the motivation to walk by stimulating one’s curiosity and creativity. In medical facilities, creative activities are often used to improve physical functions, and the motor functions of handicapped children are made better by the playground equipment. In rehabilitation programs, patients usually repeat monotonous and tiring movements. We thought that our idea would be a good way to motivate the patients to walk. If walking becomes fun, they become more active in their rehabilitation and more aware of the importance of exercise. In the LIMS program, the project is underway to obtain a patent for our idea.

Moreover, if this idea is put to the widespread use in our society, more people will find pleasure in the act of walking and want to go out. Walking will increase their creativity, social activities and communication, and it will finally result in revitalizing local communities. This means that our proposal has possibilities in producing “a happier society wrapped in our idea.”

Future cooperation with people from different fields

It was also good for me to have met with news media, manufacturing companies, and students from other universities at the competition and the award ceremony. Talking with people from business corporations, I realized that they need leaders who can make new proposals. In this competition, I applied what I had learned, discussed with people from different research fields, and proposed new idea and value to the society. It was a very valuable experience for me.

All of the subjects I learned in the classes of the LIMS program contributed to the success of our team: Human Anatomy, Physiology, Medical and Life Support Systems, Medical Engineering for Society, and English Debate. I have learned the construction and functions of the human body, the actual situations of hospitals and rehabilitation facilities, and the history of the development of medical and therapeutic devices. If any of these had lacked, we could not have succeeded in shaping and proposing our idea. I would like to appreciate the support from the staff of LIMS, Fujimori Kogyo Co., Ltd, Nikkei, Inc., all the participants in the Techno-Renaissance Japan, and my teammates.

Student Activity Report
(M2 Students)

Genome information and reducing medical expenses

Department of Medical Science
Graduate School of Medicine
Maki Sakuma

(1) Oral presentation at 6th Bordeaux RNA Club Workshop

One of the components of the integrated medical system for super-aged society would probably be genomic information. Sequencing individual genomes may tell us who is more likely to get a certain disease, respond to drugs in a different way, and will be very useful in planning each individual a personalized prevention plan for diseases and treatment. In the super-aged society, prevention and efficient treatment to cut back on national medical expenses are imperatives. With this in mind I did research in the field of bioinformatics and dealt with data produced by next generation sequencers. My research investigated the difference in response between human and mouse against a small chemical compound TG003, which is a potential drug for *Duchenne* muscular dystrophy for certain patients, in order to find the targeting sequence of the compound. Through this we obtained the result that “weak exons” (exons that have fewer, shorter signals or signals that are far from the consensus sequence for its recognition) tend to respond more to TG003, and with the support of LIMS, I was able to go to France and was selected to orally present my research to the audience of experts in RNA at 6th Bordeaux RNA Club Workshop. The results presented at this conference have been expanded and were submitted for publication in *BMC Biology*. This research was an invaluable experience in that I was able to really see that difference in sequence indeed affects response to a drug (we also did a cross-species transfection experiment to confirm that the difference originates from difference in sequence and not cell environment). Although our comparison was between human and mouse and our main interest was to decipher the targeting rules of a specific compound against rare diseases, the findings of our research add further to the assertion that sequencing individual genome and understanding how variants affect drug response is necessary for efficient use of medical resource.

(2) **First prize in Sogo Rinsho Holdings Paper Competition on “Medicine in the age of low birth rate and aging society”**.

Attending LIMS program classes gives us the chance to explore current issues related to the ageing society, and opens our eyes on where our own research stands in the whole picture of our society. One of the classes I took that was directly related to thinking of ways to reduce medical expenses was medical economics. Through the discussions and

lectures of this class, I developed my own opinion on how the medical expenses should be managed in Japan and submitted this paper to Sogo Rinsho Holdings student paper competition, and won first prize at the student competition.
http://www.sogo-holdings.jp/ronbun/

(3) **Leaving the program**

Participating in the LIMS program has been an incredibly supportive and intellectually stimulating experience for me. Discussing with fantastic researchers not necessarily related to my field, getting their feedback in my career and research, and attending lectures of different discipline on regular bases and occasionally would have otherwise been very difficult. However, after being in the field of research and completing the master's program, I came to the conclusion that becoming a medical doctor would maximize my potential in contributing to building an integrated medical system for the super-aged society, and hence with sincere gratitude to all the members of the program I decided to leave the program. Thank you again very much for your support.

Activities in LIMS Program

Department of Human Health Sciences
Graduate School of Medicine
Mikako Gomyo

(1) Introduction

I have finished my second year of LIMS program in this March. Since I decided to study at LIMS program, I have experienced many things involved in my research activities. LIMS provides us with the opportunity to investigate another research theme, learn many kinds of subjects, and have a supervisor and mentors to consult on every topic. I really appreciate much cooperation of all people involved in this program.

In this section, the outline of this report is described as follows. In section 2, the motivation for LIMS program research is mentioned. I have two LIMS research themes as a challenging photoacoustic subject and a clinical issue of ultrasound, and the current course of the second one is introduced in section 2. Section 3 presents the progresses and prospects of photoacoustic examinations. Section 4 states my experiences I learned from various classes in LIMS and an international conference.

(2) Research Theme for LIMS program

I have learned medical subjects in my school from the clinical point of view. I entered my laboratory in the beginning of fourth grade in the undergraduate course and started my research about ultrasound. I was fortunately assigned the theme aiming at clinical use as I had wished. While I have been content with my research and tried hard, I got interested in other devices for diagnoses by gathering much information related to medical imaging. Meanwhile, since I began to study the basis of ultrasound after joining the laboratory, I had been tough on studying the basics of physics and computer mathematics while sparing time to read papers involved in the latest ultrasound researches. LIMS program my supervisor introduced attracted me on the issue both of research and of study.

My research purpose is to improve quality of life for all people by finding diseases in much earlier stages. I would like to research in this program especially for the elderly people because I engage in the research for the female or life-related diseases. Since I am also interested in the research objects which are different from my research about ultrasound in my laboratory, LIMS program is suitable for me and provided a great opportunity to manage my new interest. I considered many ways and devices to seek the feasibility of enhancing health of the diseased and aged over much discussion with my mentors in LIMS and supervisors in my laboratory. I finally selected photoacoustic technology as the theme for LIMS program to diagnose the elderly earlier and titled as follow: “Quantitative assessment of photoacoustic properties of biological tissues by photoacoustic microscopy”. The safety and effective method used in clinical practices and care facilities is sure to enhance quality of life for each person in this aging society with increasing patients and medical costs.

I set the clinical theme as the second research theme for LIMS program: “Applying viscoelastic properties for pathology and other clinical diagnoses”. I proposed the method of mapping viscoelastic properties, and it is applied to human tissue mimic phantom made of agarose and gelatin at the moment. In the course of determining viscoelastic properties of each phantom, I obtained opportunities to give presentations or to be adopted in the annual conference of the Japan Society of Ultrasonics in Medicine and other three conferences from May 2014 to February 2015. I am going to establish validity of the proposed method and to demonstrate on extracted human organs or tumors for pathology or other clinical diagnoses.

(3) Research Progress in LIMS

Photoacoustic technology means the fusion technique of optics and acoustics and enables to take both advantages of optics and acoustics that are functional imaging and measurement depth respectively. At present, photoacoustic technology is under study and has not applied to clinical use. I attempt to seek what kind of challenging problems

remains. Many researchers involved in photoacoustic technology have graduated with a degree in engineering, and then my medical point of view can be effective for solving the challenging problems.

In many kinds of methods based on photoacoustic technology, I focused on Photoacoustic Microscopy (PAM) to demonstrate its availability for clinical use in the near future. Photoacoustic tomography, for example, has been used to examine cerebral vasculature (**Fig. 1**) and oxygen saturation of mice (**Fig. 2**) and is under clinical investigation [1, 2]. PAM has especially higher resolution compared with other photoacoustic technology such as photoacoustic tomography [3], and therefore I adopted it to elucidate photoacoustic properties of human tissue. I designed and assembled PAM in the experiment room. Since I did not have any knowledge of the photoacoustic field, I looked up many literatures and selected the basic design of PAM. It was based on the method originated from L. V. Wang's group for optical-resolution photoacoustic microscopy (OR-PAM) (**Fig. 3**) [3], and modified for our laboratory's space to be as small as possible (**Fig. 4**). Although currently most photoacoustic systems need large spaces to place, I assume that the photoacoustic imaging system I will work for should be portable in order to be effective even in small clinics or nursery houses for the future.

I ordered and assembled each part of PAM I designed, and some of them beyond the budget were borrowed from my belonged laboratory and will be purchased the next semester. During the course of assembling, there were some problems that assembling was difficult because of precise adjustments and components ran short and needed custom orders due to the design amendment. I have learned many lessons from these processes including designing, ordering, and assembling a device as my first experience.

Fig.1 *In vivo* PAT images of rat brain acquired. Differential image of before and after three sequential administrations of nanoshells. Field of view: 20 × 20 mm; ΔA_e: differential optical absorption. [1]

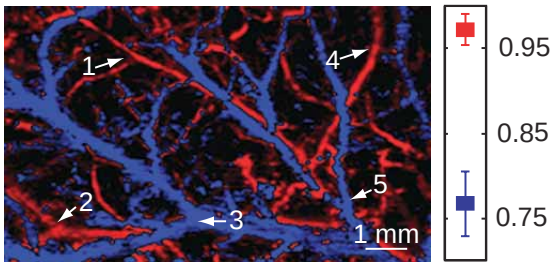

Fig.2 Functional imaging of saturation O_2 *in vivo* in a rat. Four different images were acquired by four wavelengths (578 nm, 584 nm, 590 nm and 596 nm) and the calculated sO_2 values are shown in the color bar. [2]

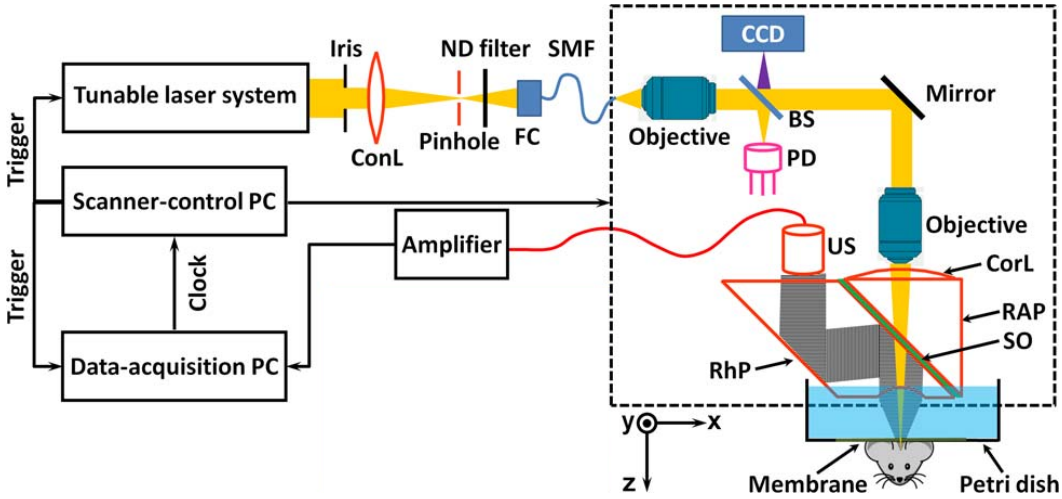

Fig. 3 Schematics of OR-PAM. ConL, condenser lens; ND, neutral density; FC, fiber collimator; SMF, single-mode fiber; CCD, charge-coupled device; BS, beam splitter; PD, photodiode; CorL, correction lens; RAP, right-angle prism; SO, silicone oil; RhP, rhomboid prism; US, ultrasonic transducer. [3]

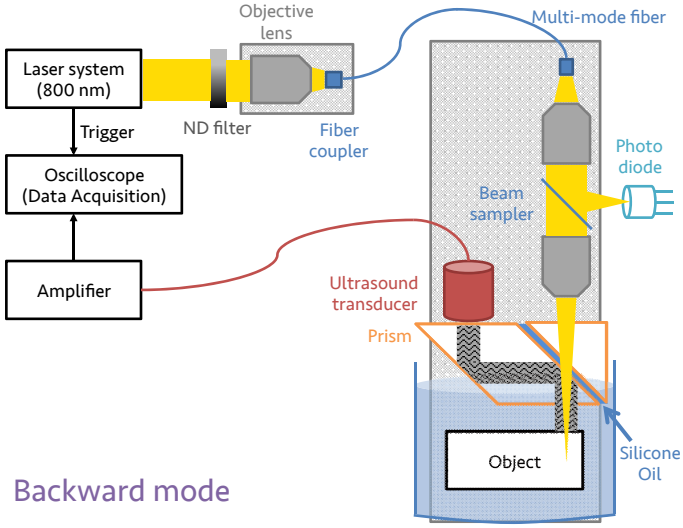

Fig. 4 Diagram of OR-PAM on the backward mode. Almost all components on one base (grayed square) for smaller space and easy to carry. Less limitation of objects such as thickness for backward mode compared to forward mode.

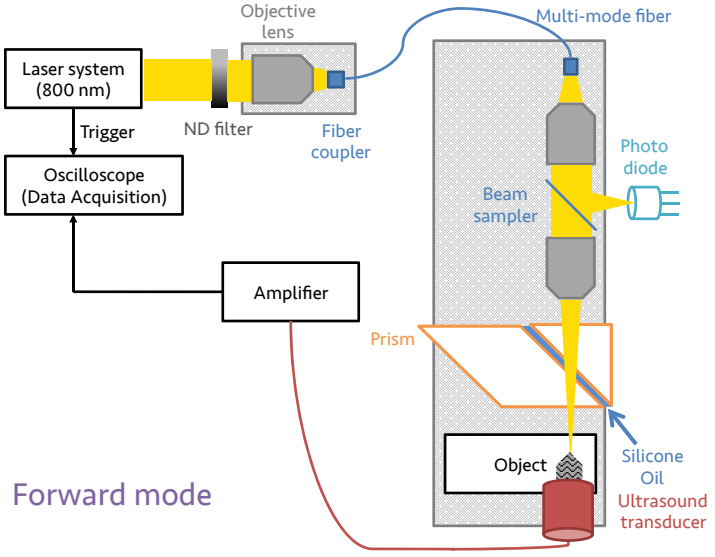

Fig. 5 Diagram of OR-PAM on the forward mode. Measurement for stronger signal compared to backward mode due to placing ultrasound transducer underneath an object.

I could start to experiment after assembling, and I checked whether each component worked well step by step as shown in **Table 1**. During the course of components tests, I designed the forward mode (**Fig. 5**) to assess ultrasound transducer ability to receive photoacoustic signal. Since it is necessary for the forward mode to set a transducer underneath an object, objects should be thin enough to reach sound signal for the transducer. This mode has an advantage to neglect the refraction rate and attenuation of prisms. Although the forward mode does not need prisms, in this case for the backward mode, prisms (with silicone oil for acoustic-optical coaxial alignment) were setup. The results of no signal as a comparison and the forward mode are shown in **Fig. 6 and 7**, respectively. While no significant signal could be observed in the control data with no light signals, 22.26 mV peak-to-peak intensity was obtained in the forward mode data.

After that I found out on the backward mode (**Fig. 4**) the ultrasound transducer could not acquire any sound signals derived from an object because a generated sound signal seemed too weak. Some considerable causes are that the sound signal efficiency was not sufficient to reach the transducer through prisms, an object whose light-to-sound conversion efficiency was much stronger should be used, and basically amount of light was insufficient at the current value. Although I had tried to solve each cause in many ways, sound signal could not be caught.

Table 1 Components tests of PAM

Components	Purpose / Operation	Results
(1) Fiber	1. Location of the first objective lens and fiber Use laser pointer (visible light)	Success
	2. Strength through fiber Set photodiode at the end of single / multi mode fiber	Single mode: in sufficient Multi mode: sufficient (>6 V)
(2) Light path	1. From the end of fiber to prism Adjust location and distance between objective lenses and prisms	Appropriate focus (3-4 V)
	2. From the end of fiber to photodiode Adjust beam sampler	Appropriate refraction
(3) Ultrasound transducer	1. Reception of sound Use another hydrophone to emit sound signal	Sufficient (1-40 mV)
	2. Reception of photoacoustic signal Set ultrasound transducer and object underneath prisms [*Forward mode*]	Sufficient (<30 mV)
(4) Objects	1. Rubber of a syringe 2. Blackened synthetic resin	Weak (<1 mV) Fair (<20 mV)
(5) PAM signal	Set all components [*Backward mode*]	No significant signals

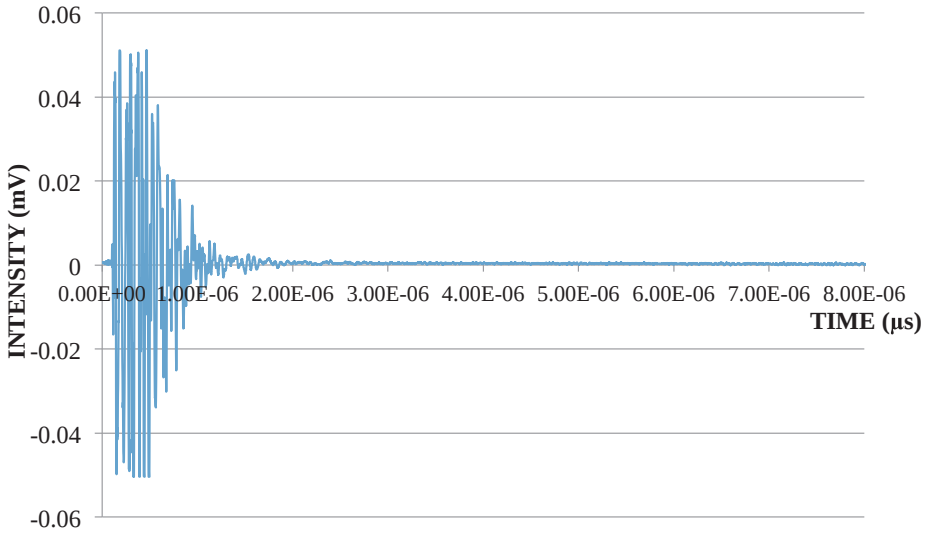

Fig. 6 PAM data on the forward mode with interrupting laser path as a comparison experiment. No signals after electrical noises from 0 μs to 1.6 μs.

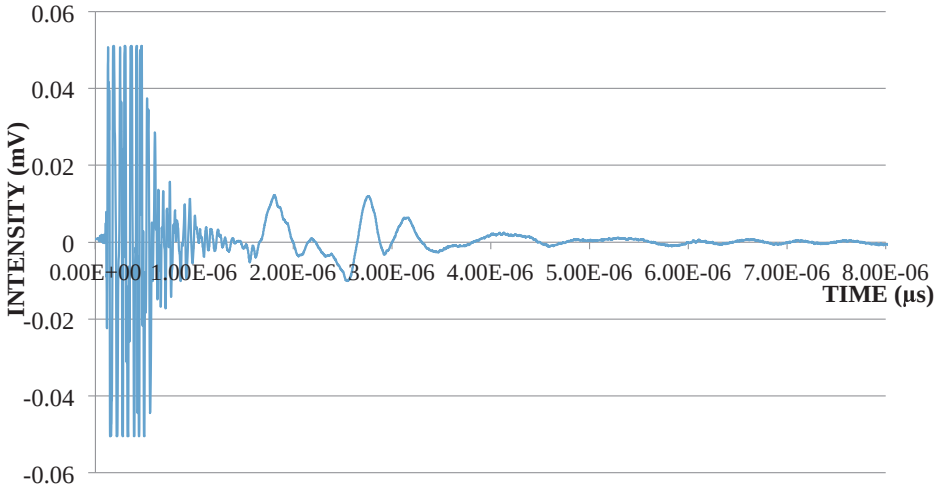

Fig. 7 PAM data on the forward mode. 22.26 mV peak-to-peak intensity from 1.8 μs to 2.6 μs after electrical noises from 0 μs to 1.6 μs.

These results suggest that PAM I assembled can be valid for elucidating a photoacoustic property of an object using this forward mode when several wavelengths are modified and an object is moved laterally. After experiments of the forward mode success, I will get back to the backward mode and begin to measure more complicated structure compared to the forward mode.

In the near future, I plan to invent the equipment which is effective for early diagnoses in the medical sites. At present, I consider the photoacoustic device I assemble to be used in dermatology because some kinds of dermatological diseases are diagnosed with visible to the naked eye and depending on examiners. This safety and effective method will contribute on quality of life for all people in this aging society with increasing patients and medical costs.

(4) Experiences in Lectures, Practical Classes, and Conference

I have learned much more things than I had expected before joining LIMS program. I

have desired to obtain diversified perspectives and gain knowledge about which forms the basis for my research. My hope for LIMS has been realized for this one and a half year.

Lectures LIMS provided for us were fully informative and highly interesting for me. Furthermore, interactive assignments were very effective for me because I had to check how much I could understand new fields for me from time to time. I could found intellectual bases of especially physics and computer mathematics because these two teachers gave me kind instructions for me in person when I asked them. These subjects are really helpful for me in that the concept of tensor in continuum physics is essential for improving 3D ultrasound system and that the technique of computer programming is always utilized for my daily research. I have not had an opportunity to attend many subjects we could take as a LIMS student such as medical economics or special lectures by businesspersons.

Practical work courses attracted all participants including me. I could enhance my recognition about current situations by visiting nursery homes and the facility for the latest medical equipment. I was really interested in anatomy practice using the actual human body with the different background students. The greatest firsthand experience for me in practical classes was to see surgery in operating rooms. The class aimed at treatment with fewer invasions than usual, which corresponds to my interest. I strongly felt that I would like to go on researching and invent the medical device contributing to early diagnosis.

I could have the opportunity to attend the international optics conference, “SPIE Photonics west”, held in U.S. and take workshops about informal presentation and paper writing. It is said to be the largest conference involved in optics including photoacoustics; there were 4,728 presentations and over 1,250 companies last year (a statistics of this year has not published). I was really impressed with many latest and innovative reports, and there were many contents for providing me with my research ideas. I have learned mainly about the photoacoustic technology at the sessions of “Multimodal Biomedical Imaging”, “Optical Elastography and Tissue Biomechanics”, and so on. The measuring objects of photoacoustic technology appear to be expanding these years, and I got interested in the applied technique for dermis as a clinical subject. Besides, I could have a talk with the prominent professor I met before in an international ultrasound conference, and I got to know he was involved in the fusion technique of optics and ultrasound as well and felt a great potential in the fusion technique like photoacoustics. In the whole-day workshop, the lecturer who has published several books about academic presentation and writing provided us with interactive discussions. I could make fellows who belong to SPIE student club, and we promised each other that Kyoto University would join the student club next time. Therefore I have a keen desire to go back to the conference again with my publication related to photoacoustics. All things in this conference highly motivated me for LIMS program.

Acknowledgements

I wish to express my sincere thanks to profound gratitude to my LIMS supervisor Dr. Masakazu Toi, Professor of Graduate School of Medicine at Kyoto University, and my LIMS mentors Dr. Masao Matsuhashi, and Dr. Takehiko Kinoshita, for their invaluable guidance, advice, supervision and constant encouragement during the course of this program. I thank all members of Medical Imaging System Sciences Laboratory for their corporation and great deal of helpful advice for my research work.

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What I have learned in the Master's Program and what to do in the Doctoral Program

Department of Pharmaceutical Sciences
Graduate School of Pharmaceutical Sciences
Jun Miyanohara

(1) What I learned this year

Training Program of Leaders for Integrated Medical System for Fruitful Healthy-Longevity Society (LIMS) has started since September, 2013, to cope with global-scale problems of an unprecedented aging society. It's my great pleasure to have become a member of the training program. One and half a year have passed and even now it seems difficult for me to study both in our laboratory and in LIMS. However, I have realized what I gained in such a busy curriculum was very helpful for me to consider not only medical problem around the world but also what I should be as a medical leader. In that sense, it was very fruitful period in my master's program. Here, I would like to introduce some of classes and a LIMS research I have been doing.

One of the most impressive classes for me was human anatomy. In the class, I have acquired extensive knowledge on human body by taking the lecture with students

majoring medicine. In addition, I could observe remains as a practice and for the first time realize the beauty of the human body. I have been studying on pathophysiology using rodents in graduate school of pharmaceutical sciences, and it seems very important for me to know the differences between animals and human, which is sure to be useful for my fundamental research.

We took the debate class following the previous year. The aim of the course is to improve communicating one's own ideas convincingly. Last year, English articles were provided and discuss the matter and then presented in parliamentary debate style. I could learn how to debate and improve our ability to form and express opinions in English. In contrast, this year, we practiced mainly the presentation on scientific proposals, such as how to get a research grant.

I had been in trouble with what kind of research I had to do, however, finally I have started a LIMS research since this year. I am looking forward to doing this study from next year.

(2) From next year

From next year I have to conduct researches both in pharmaceutical sciences and in LIMS and it would be required to do plenty of work during the doctoral program.

Thanks to teaching staff, office workers, and my colleagues, I had a fruitful time during my master's program. I am looking forward to your ongoing support, thank you.

Annual report 2014

Department of Polymer Chemistry
Graduate School of Engineering
Rei Kuwabara

In this year, I developed subcutaneous islets of Langerhans (islet) transplantation by implantation of cyclic peptide SEK-1005 (SEK) without immunosuppressive drug for insulin-dependent diabetes treatment, and I researched the mechanism of immune tolerance. Briefly, I prepared immune tolerance sites by implantation of agarose rods supplying SEK under the skin. By transplantation of allo-islet into the site, long-term allograft islet survival were accomplished without immunosuppressive drug, and almost of the recipient rats demonstrated stable normglycemia over 100 days after allo-transplantation. In histological examination (Fig.1), I demonstrated that insulin producing cells (allo--islet graft) were alive in subcutaneous tissue and islet grafts had functional vessels. Few immune cells infiltrated in and

around islet-grafts. Today's clinical islet transplantation have three problems; 1) shortage of islet donor, 2) immunosuppressive therapy, and 3) optimization of transplant site. This method can resolve problem 2) and 3), and become successful method of diabetes treatment. I had a patent application on the induction of immune tolerance by SEK in this October. Because I will apply for a patent of the mechanism of immune tolerance by SEK, I cannot show the mechanism in this report. I will put together a paper about the results of transplantation and this mechanism, and I want to carry out a clinical application with my research collaborators in the future.

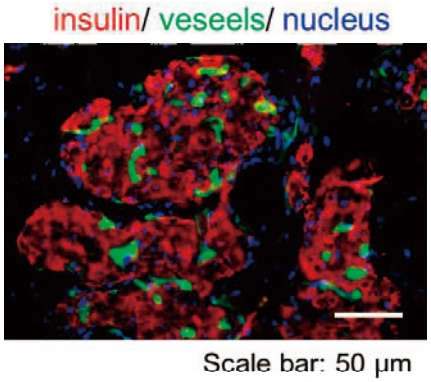

Fig.1 Immunofluorescent staining for insulin (red) and nucleus (blue). Functional vessels stained by the perfusion of FITC lectin

In LIMS anatomy practice, I could touch real human organs and tissues and modestly dissipate the dissociation between body parts of animals and human beings. This was difficult for me only by reading anatomical chart. This practice was an amazing experience to give the hint to achieve clinical application of my research.

To extend my knowledge and report my research, I joined three conferences, the 36th annual meeting of the Japanese society for biomaterials, the 6th Japan-Taiwan Nanomedicine symposium, and the 14th congress of the Japanese society for regenerative medicine by using Research Expense Allowance in LIMS. I would like to express my gratitude to this allowance.

Basic Studies and Applied Medicine

Department of Synthetic Chemistry and Biological Chemistry
Graduate School of Engineering
Takuto Suito

(1) LIMS subjects

Two of the most impressive LIMS subjects in this year are "Geriatrics" and "Human anatomy". In Geriatrics, I learned a concept of the geriatrics and the therapeutics of age-related disease. Aged-people have problems on both physically (e.g. sarcopenia) and mentally (e.g. dementia or depression). In addition, elderly people tend to have two or more diseases simultaneously. Thus, there are particular problems in medical care of elderly. So, they are needed comprehensive medical care, but there are not many

knowledge about them. I learned these situations about medical care of aged-people and I can found the problems of medicines for fruitful healthy-longevity society.

The class of “Human anatomy” is the most impressive one. In this class, we learned roles and function of human organs and motor functions through lectures and examination of cadaver. Even though we had shorter time to learn anatomy compared with medical students, but I thought I could learn the two main purposes of this class, one is the understanding of the 3D body structure and the other is acquiring the sense of responsibility.

In this class, we observe the complex body structures and their individual differences, and I also understood the medical risks derived from these differences. When I was undergraduate student, I majored in chemistry. In the graduate school I began to learn biology but did not have a chance to learn anatomy. t I felt I spend a precious time to learn practical knowledge of human body although I am not a medical student.

Through this class, I acquired not only a knowledge but also a responsibility as a researcher of developing medicine. The cadavers that we had used in this class are donated bodies and these donations are based on the expectations for the development of medicine. In order to answer these expectations, I want to keep in mind the thing which learn from this class.

(2) LIMS research theme

My research theme of LIMS program is “Study on gut commensal bacteria and age-related disease”. Recently, relationships of gut commensal bacteria and health of host organisms have been revealed including detail molecular mechanisms of them. Metabolites of commensal bacteria and medicines which regulate the balance of commensal bacteria have attracted a great deal of attention of researchers as a novel medication for some diseases. But the molecular mechanism of host-microbe interaction is too complex to be solved. So, I use simple model systems to elucidate the host-microbes interaction and their potentiality for medical applications. In this year, I achieved to establish the model system of studying host-microbes interaction using *Drosophila*. Next year, I want to research more details about age-related disease and commensal bacteria using this model system.

Finally, in this year, I have tried to keep in mind the importance of fundamental studies. All of medicines and other applied technologies are based on the fundamental studies. Through the lectures and research of basic studies in LIMS, I will make effort to be a medical developer who can find the seeds of research for the achievement of fruitful healthy-longevity society.

Progress Report

Department of Synthetic Chemistry and Biological Chemistry
Graduate School of Engineering
Kazuma Yamaguchi

2015.03.26

Object

Neurodegenerative disorder is a common name of progressive and incurable diseases that are caused by neuronal death. In our aged societies, neurodegenerative disorder has become one of the most serious problems. Because the disease onset is late, and as a result of increasing elderly people, there are many patients. Specific neurons die and patients lose the corresponding abilities; for example, Alzheimer's disease patients lose their ability to memorize because of hippocampus degeneration. Spinocerebellar Degeneration (SCD) is one of the neurodegenerative diseases and SCD is a generic name of diseases expressing the cerebellar ataxia as a main symptom. There are over 30,000 SCD patients in Japan, and 10,000 are hereditary. Comparing to Europe or America, the proportion of autosomal dominant SCD patients is high.

Autosomal dominant SCD is called Spinocerebellar Ataxia (SCA), and same as other neurodegenerative disorders, SCAs are progressive and the genetic anticipation, increasing severity and decreasing age of onset with successive generations of pedigree, is observed in some of SCAs. Cerebellar, brain stem and spinal cord slowly degrade in SCA patients. By the genomic analysis, SCAs are classified and named from type 1 (SCA1) and in 2013 the new type of SCA was reported (SCA37).

But the numbering of SCAs is not complete: It is said that some are vacant, and some of their causative genes are overlapped on genome and the more detailed researches are needed. Not only the incomplete naming, the molecular mechanisms of onset of SCAs are not also revealed.

Because there is no way to cure and these are late onset and progressive disease in highly aged society, we have many problems with SCAs. But there are some reports suggesting that the rehabilitation is effective to delay the progress of ataxia.

To make the information clear and study the effects of the rehabilitation, I set two themes in training program of Leaders for Integrated Medical System (LIMS program).

Themes of research in LIMS program

1) Molecular pathological study of spinocerebellar ataxia.

2) Nursing care and rehabilitation for patients with spinocerebellar ataxia.

Previous study (in my first year of master course)

At first, I studied about foundation of SCAs in Japan. The sum of patients with SCDs is about 30,000. A third of total SCDs patients (10,000 people) are hereditary. In hereditary SCD, firstly SCA3 patients are the most, the second is SCA6, SCA31, DRPLA, SCA1, SCA2 and other SCAs (7, 8, 17, 36). But the cause of residual hereditary SCDs (one third) remains unknown. Second, with Dr. Yamashita's cooperation, I could get an appointment to see two patients, one suffers SCA6 another suffers SCA36. There are many reports which suggest the effect of rehabilitation. And two patients (including father and aunt of SCA6 patient) showed the possibility that rehabilitation is effective to the SCAs. Some of SCAs show slow progress and the death of neurons may be also slow. If neurons die because the neuronal activity become low, we can help the dying neurons by making neuronal activity high. The rehabilitation or the drugs may be helpful for activation of neurons.

Results and Discussion (in my second year of master course)

I summarized the information of SCD causative genes, main phenotypes, distributions and the age of onset of SCAs from ORPHANET database. (Table 1)

Many types of diseases are reported, from 1 to 37. But SCA9, 24 and 33 were regarded as vacant. Some reports said SCA 15 and 16, SCA5 and 24 and SCA19 and 22 were respectively same disease because the loci of these causative mutation on the genome are overlapped. Actually, 32 SCAs are founded now.

But I found some interesting points when I was summarizing the reports. The causative genes of SCA23, 35 and 36 are not same but on the same loci 20p13. Similar thing was observed in SCA6 and 26, SCA13 and 14 and SCA15/16 and 29, they are on 19p13, 19q13 and 3p26.1 respectively. (SCA15/16 and 29 are caused by the mutation in the same gene.) Because the kinds of mutation are different, the mechanisms of onset may be different and the treatments for these diseases have to be distinguishable. (But there is a possibility that these mechanisms of onset are same, particularly SCA15/16 and 29.) However, the number of these patients is very small and therefore it is difficult to confirm the kinds of mutation. Of course there are many problems, but I think, only for the detection of the SCD type, we have to use next-generation sequencer. By reading the sequences of patient genomes, we can classify more precisely.

Table 1. Summary of SCDs

SCA type	mutation locus on the genome	Gene	protein	Locus of mutation (intron/exon)	Mutation	symptom
SCA1	6p23	ATXN1	Ataxin-1		CAG repeats	proprioceptive loss, hypoactive reflexes, ophthalmoparesis, and mild optic neuropathy
SCA2	12q23-q24.1	ATXN2	Ataxin-2		CAG repeats, the normal CAG repeat length is 15-24 and the SCA2 patients have 35 and longer repeats.	very similar to SCA1 but some patients show Parkinsonism
SCA3(MJD)	14q21	ATXN3	Ataxin-3		CAG repeats, The normal repeat length is 13-41 whereas repeat lengths causing SCA3 are greater than 56.	SCA3 is divided into 3 forms(MJD1, MJD2, MJD3). SCA3 type 1 (MJD Type 1, see this term) is associated with ataxia, ophthalmoparesis, pyramidal signs such as spasticity and hyperreflexia, and extrapyramidal signs including dystonia and other movement disorders presenting in adolescence. SCA3 type 2 (MJD Type 2, see this term) presents in middle adulthood with ataxia, spasticity, and dystonia. SCA3 type 3 (MJD Type 3, see this term) occurs after the age of 40 and includes ophthalmoparesis and anterior horn cell disease, i.e. fasciculations, atrophy, and weakness. Parkinsonism can also be a feature of SCA3. A likely overlooked but common feature is impairment of temperature sensation involving the entire body.
SCA4	16q22.1	PLEKHG4	Puratrophin 1		unknown	cerebellar ataxia, pyramidal signs, and peripheral sensory loss
SCA5	11q13.2	SPTBN2	Beta-III Spectrin		missense	cerebellar signs (ataxia, dysarthria, and intention tremor) with eye movement abnormalities such as gaze-evoked nystagmus, down beat nystagmus, and impaired smooth pursuit
SCA6	19p13	CACNA1A	alpha1A subunit of voltage-dependent calcium channel	exon 47	CAG repeats, SCA6 patients are usually of 21-29 CAG repeats	cerebellar signs of ataxia and dysarthria as well as dysphagia
SCA7	3p21.1-p12	ATXN7	Ataxin-7		CAG repeats, usually 36 or more CAG repeats	cerebellar ataxia and pigmentary macular dystrophy. muscle weakness, wasting, hypotonia, poor feeding, failure to thrive and loss of motor milestones.
SCA8	13q21	ATXN8/ATXN8OS	Ataxin-8		CTA/CTG repeats, CAG repeat	muscle weakness, wasting, hypotonia, poor feeding, failure to thrive and loss of motor milestones.
SCA9						
SCA10	22q13	ATXN10	Ataxin-10	intron 9	ATTCT repeats	cerebellar syndrome and epilepsy, sometimes mild pyramidal signs, peripheral neuropathy and neuropsychological disturbances
SCA11	15q15.2	TTBK2	Tau tubulin kinase 2		frame shift	dysarthria and progressive ataxia, jerky pursuit, horizontal and vertical nystagmus and ophthalmoplegia
SCA12	5q31-5q32	PPP2R2B	Serin/Threonine protein phosphatase 2A		CAG repeats at the 5' end of the PPP2R2B gene	It is characterized by the presence of action tremor associated with relatively mild cerebellar ataxia.
SCA13	19q13.3-q13.4	KCNC3	Potassium channel		missense	SCA13 is primarily a cerebellar syndrome, but dysphagia, urinary urgency, and bradykinesia have been described in affected patients older than 50.
SCA14	19q13.4	PKCG	Protein kinase C ganma		missense	cerebellar signs, hyperreflexia and decreased vibration sense
SCA15/16	3p26.1	ITPR1	Inositol triphosphate receptor type-1		missense	
SCA16		ITPR2	Inositol triphosphate receptor type-2		deletion	

SCA17	6q27	TBP	TATA-box binding protein		CAG repeats	It is characterized by a variable clinical picture which can include dementia, psychiatric disorders, parkinsonism, dystonia, chorea, spasticity, and epilepsy.
SCA18	7q22-q23	no responsible gene detected	-			axonal sensory neuropathy, while cerebellar ataxia and motor neuron dysfunction develop later
SCA19/22	1p21-q21	KCND3	Kv4.3 voltage-gated potassium channel		missense	
SCA20	11q12.2-11q12.3, overlapping with the locus for SCA5				duplication	
SCA21	7p21.3-p15.1	unknown	-			
SCA22		KCND3	Kv4.3 voltage-gated potassium channel		in frame deletion	
SCA23	20p12.3-p13	PDYN	Prodynorphin		missense	
SCA24						
SCA25	2p15-p21	KCNC3	Kv3.3 voltage-gated potassium channel			The clinical features vary widely from sensory neuropathy with little cerebellar ataxia to cerebellar ataxia with little sensory neuropathy.
SCA26	19p13.3	eEF2	Eukaryotic translation elomgation factor 2		missense	Slowly progressive gait ataxia, dysarthria, nystagmus, impaired pursuit, and dysmetric saccades were reported in all patients.
SCA27	13q34	FGF14	Fibroblast growth factor 14		missense/frame shift	early-onset tremor, dyskinesia, and slowly progressive cerebellar ataxia.
SCA28	18p11.21	AFG3L2	ATPase family gene 3 like protein 2		missense	juvenile onset, slowly progressive cerebellar ataxia
SCA29	3p26.1	ITPR1	Inositol triphosphate receptor type-1			Mild developmental delay, learning difficulties, and language dysfunction are frequently reported.
SCA30	4q34.3-q35.1	not identified	-			oculomotor dysfunction, moderate dysarthria and ataxia that progresses slowly and eventually leads to mobility impairment
SCA31	16q21	BEAN	Brain expressed protein associated with NEDD-4		TGGAA repeats	Ataxia, dysarthria, and horizontal gaze nystagmus
SCA32	7q32-q33	has not yet been identified				Manifestations include cerebellar ataxia, cognitive impairment and, in males, azoospermia. Cerebellar atrophy
SCA33						
SCA34	6q14	ELOVL4	Elongation of very long chain fatty acids protein 4			Progressive ataxia, dysarthria, decreased reflexes, and nystagmus
SCA35	20p13	TGM6	Transglutaminase 6		missense	progressive gait and limb ataxia, dysarthria, ocular dysmetria, intention tremor, pseudobulbar palsy, spasmodic torticollis, extensor plantar responses (Babinski sign), reduced proprioception, and hyperreflexia
SCA36	20p13	NOP56	Nucleolar protein 56		GGCCTG repeats	ataxic dysarthria, truncal ataxia, limb ataxia, general hyperreflexia and variably occurring lower limb spasticity
SCA37	1p32 and named the SCA37 locus	unknown	-			slowly progressive cerebellar ataxia (starting with falls, dysarthria and clumsiness followed by other cerebellar signs) along with altered vertical eye movements.

SCA type	Prevalence and Distribution	Age of onset
SCA1	SCA1 affects 1 to 2 per 100,000 people worldwide.	onset ranges from 4 to 74 years.
SCA2	SCA2 is very common in Cuba, particularly in the Holguín province, where approximately 40 per 100,000 individuals are affected.	Average is 30 years but can range from 2-65 years.
SCA3(MJD)	The highest prevalence has been found in the Azores (Flores Island (1/239)), intermediate prevalence rates in Portugal, Germany, the Netherlands, China and Japan, and lower prevalence in North America, Australia and India.	
SCA4	The causative gene was detected in kindreds from Utah (USA) and Germany.	
SCA5	Only three families (American, French and German) with SCA5 have been reported to date.	Average is 33 years but can range from 10-68 years.
SCA6	It is most commonly seen in Japan, Korea, the Netherlands and Germany. In Japan, there are about 3,000 SCA6 patients.	Average is 45 years but can range from 16-72 years.
SCA7	The estimated worldwide prevalence of SCA7 is less than 1/100,000 and it is thought to account for 2-4% of all forms of SCA (up to 7% in Asian populations). Higher prevalence is described in some populations such as in Scandinavia or South Africa.	
SCA8		
SCA9		
SCA10	Many kindreds have been found in Mexican and Brazilian populations. SCA10 is the second most common inherited ataxia in these two countries.	Average is 32.2 years but can range from 18-45 years.
SCA11	Fifty-one clinically affected members from four families (of British, Pakistani, German and French descent) have been reported to date.	Average is 25 years but can range from 11-70 years.
SCA12	Approximately 40 families have been reported.	onset ranges from 8 to 55 years.
SCA13	Fewer than 20 cases have been reported to date.	
SCA14	The disease has been reported in more than twenty families from Europe, the United States, and Australia.	Average is 33.9 years but can range from 10-70 years.
SCA15/16	Fewer than 80 patients affected by the disease have been identified to date.	Average is 39.6 years but can range from 20-66 years.
SCA16		
SCA17	ocal prevalence is 0.47 per 1,000,000 in the Japanese population and 0.16 per 100,000 in North-East England. Fewer than 100 families have been reported to date.	
SCA18	Only 26 cases in a 5-generation American family of Irish ancestry have been reported to date.	onset ranges from 13 to 27 years.
SCA19/22	Only 12 cases in a 5-generation Dutch family have been reported to date.	onset ranges from 10 to 46 years.
SCA20	Fewer than 20 cases in a 4-generation Australian family of Anglo-Celtic descent have been reported to date.	Average is 46.5 years but can range from 19-64 years.
SCA21	Fewer than 20 cases in a 4-generation French family have been reported to date.	The mean age of symptom onset was 17.4 years.
SCA22		
SCA23	This subtype has only been described in 4 Dutch families.	onset ranges from 43 to 56 years.
SCA24		
SCA25	Fewer than 10 cases in a 4-generation French family have been reported to date.	onset ranges from 1 to 39 years.
SCA26	To date, only 23 affected patients have been described from one American family of Norwegian descent	Average is 42 years but can range from 26-60 years.
SCA27	Fewer than 30 cases have been reported to date.	
SCA28	Prevalence is unknown. SCA28 accounts for approximately 1.5% of all European cases of ADCA.	The mean age of symptom onset was 19.5 years.
SCA29	The prevalence is unknown. More than 50 cases have been reported in the literature.	
SCA30	SCA30 has only been described in 6 patients from one Australian family to date.	Average is 52 years but can range from 45-76 years.
SCA31	SCA31 is the third most common form of ADCA (see this term) in Japan, where more than 20 families have been reported to date. It is rarely found in other Asian countries and is extremely rare in Western countries.	Average is 58 years but can range from 8-83 years.
SCA32	SCA32 has been reported in one Chinese family to date.	
SCA33		
SCA34	SCA34 has been reported in 25 members of one French-Canadian family to date.	Disease onset occurs shortly after birth with the appearance of papulosquamous, ichthyosiform plaques on the limbs, which are often only present in the winter. After the age of 25 they tend to disappear completely.
SCA35	SCA35 has been reported in less than 20 cases from 3 Chinese families to date.	onset ranges from 40 to 48 years.
SCA36	The prevalence is unknown. SCA36 has been described in at least 14 Japanese and Spanish families in approximately 90 individuals.	
SCA37	SCA37 has been reported in nine members of a Spanish kindred to date.	

Future plan

1. Continue studing the effect of rehabilitation and suggest the easy exsercise effective for SCD.
2. Elucidate the mRNA splicing mechanisms of *CACNA1A* gene, causative gene of SCA6.

Cooperation

1. Yasuo Mori, Graduate school of Engineering, Kyoto University.
2. Ryosuke Takahashi, Graduate School of Medicine, Kyoto University
3. Hirofumi Yamashita, Graduate School of Medicine, Kyoto University
4. Naoko Inaba, Center for the Promotion of Interdisciplinary Education and Research, Kyoto University
5. Christian Altmann, Graduate School of Medicine, Kyoto University

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Conference Reports

Report attending 6th Bordeaux RNA Club Workshop

Maki Sakuma (M2)

Place: Bordeaux, France.

Date: 26th and 27th of June, 2014.

Meeting description:

6th Bordeaux RNA Club Workshop is an annual event that gathers researchers all over the world to present their progress on their research on RNA. Especially Bordeaux University has excellent facilities and research groups in RNA structural biology and invited some of the most prestigious RNA researchers, including the Nobel laureate Thomas Steitz, in order to promote open discussion of the most recent research results of the participants. The workshop consisted of five 50-minute presentations by the invited speakers, eleven 20-minute presentations by selected participants, and two sponsor presentations, with three breaks and poster session.

My presentation:

My presentation was on the effect of compound TG003 on splicing and its therapeutic application. Since the LIMS objectives are to contribute to the problems of super aged society through research, two broader objectives of my presentation were to (1) promote the idea that small chemical compounds have potential in treating diseases arising from mutated genome targeting RNA, especially targeting pre-mRNA splicing, and to (2) show that the global transcriptome-wide approach (RNA-seq analysis) can identify features of sequences that respond to chemical treatment. Although the presentation centered on the disease Duchenne muscular disease, the message that our research pays the effort to bridge basic research and translational medicine and its possible application to other diseases was clearly stated. My presentation was related to my LIMS research in that I presented results that used the techniques to analyze the response of cells to chemical treatment and I plan to identify and show that the compound of interest is safe and effective looking at the transcriptome.

Response: My presentation, especially the aspect of the application to therapy, was well received and appreciated. The questions were mainly on the discovery process of the compound TG003 and its effect to splicing in other experimental setup and mouse models. The fact that TG003, as being an inhibitor of just one family of the kinases of the SR proteins, can alter the splicing was a surprise to some, and its possibility of becoming an RNA drug seemed to be inspiring.

Other presentations and useful information for future research:

Two out of five of the invited speakers (Ann-Bin Shyu and Raùl Méndez) mentioned on the importance of intrinsically disordered regions in the RNA binding proteins. Intrinsically disordered proteins have many interacting partners for their binding flexibility and are major upstream regulators of many cellular processes. For example, there is alpha-synuclein, which is involved in many neurodegenerative diseases. Possibly looking at the intrinsically disordered protein region in RNA binding proteins can lead to a discovery of RNA binding protein that is related to neurodegenerative diseases or other important diseases that is especially problematic to our super aged society.

Nick Proudfoot talked about G-quadruplex structure and its relevance in DNA damage and cancer. This structure was not familiar to me before, but this has attracted attention as a novel target anti-cancer therapy. So this is another keyword that I would like to explore in order to think of directions of future research for tackling the problem of super aged society.

Rheinhard Lührmann mentioned that he is developing small chemical compounds that target the spliceosome. His main objective was to study the transition stages of the spliceosome, but possibly some of the compounds he discovered may have anti-tumor activity, so his research findings will be very interesting to follow.

Useful information for program coordinators:

After I gave the presentation a few researchers came to talk to me about my presentations and in the course I mentioned that I have the three-months period of foreign internship. I asked for opportunities for aging research in Europe and most of them mentioned that they heard of a research institute in Cologne Germany, and I think that they were talking about the Max Planck Institute for Biology of Ageing. So it seems the Max Planck Institute for Biology of Ageing is gaining recognition as a representative in the research field, so perhaps LIMS and the institute can have some kind of communication.

In the RNA field, most research that is related to ageing is cancer, and the structural aspect of DNA and RNA has more influence to the pathology that I expected, and so courses on structural studies of biological molecules would benefit the students understanding and possible inspiration in inventing new technologies.

Conference Report of SPIE Photonics West 2015

Mikako Gomyo (M2)

(San Francisco, U.S., 7th to 10th of February, 2015)

1. Brief overview of the conference

I could have the opportunity to attend the international optics conference, "SPIE Photonics West", held in U.S. It is said to be the largest conference involved in optics including photoacoustics; there were 4,728 presentations and over 1,250 companies last year. I was really impressed with many latest and innovative reports, and there were enormous contents for providing me with my LIMS research ideas, "Quantitative assessment of photoacoustic properties of biological tissues by photoacoustic microscopy".

2. Presentations of the latest studies

I have learned particularly about the photoacoustic technology at the sessions of "Multimodal Biomedical Imaging" and "Optical Elastography and Tissue Biomechanics" among many courses I visited. Some impressive studies are introduced below.

The measured objects by photoacoustic technology appear to be expanding these years, and I got interested in the applied technique for dermis as a clinical subject. The section of "Multimodal Biomedical Imaging" contained the combined technology of optics and acoustics, called photoacoustics. Many kinds of photoacoustic applications were demonstrated on dermis, cerebral status, and so on. I consider the field of dermatology as especially in demand because no device which can express quantitatively distribution of substances beneath skin has ever been invented. My research should be involved in dermis or related diseases responding to the expectation for this field.

The fusion technology of optics and ultrasound elastography emerged in the immediate past and was given in "Multimodal Biomedical Imaging", and it is under investigation from many viewpoints. "Noninvasive 3D elasticity mapping using phase-stabilized optical coherence elastography" showed the feasibility of application for cornea, which really surprised me; although I research ultrasound elastography in order to elucidate stiffness of human soft tissue, I have never come up with the concept of measuring stiffness of eye. Further realistic perspectives of the fusion technique stated in

“Amplitude-modulated ultrasound radiation force combined with phase-sensitive optical coherence tomography (OCT) for shear wave elastography (SWE)”. While both OCT and SWE have already yielded practical applications, the proposed pulse compression by amplitude modulation suggested that in the fusion field of optics and acoustics the proposed method could satisfy the safety criteria of eye imaging (e.g. Mechanical Index < 0.23).

At present any photoacoustic methods have not been in clinical use, however, I am sure that the investigation of photoacoustics for further applications progresses gradually and steadily as my finding from the conference.

3. Experiences

I could have a talk with the prominent professor, J. C. Bamber, I met before in an international ultrasound conference, and I got to know he was involved in the fusion technique of optics and ultrasound. Since in this conference most people specialize optics basically, I felt a great potential in the fusion technique, photoacoustics, judging from talks by the professional of ultrasound.

I attended optional whole-day workshops of academic skills in the last day of my attendance. Various workshops are held by SPIE every year, and participants of the course I attended were age 24-52 bracket. The lecturer who published several books about academic presentation and writing provided interactive discussions for us. I could learn the essence of presentation and writing with incepting other members, especially postdoctoral researcher of OCT from Ireland whom I keep in touch even today. In addition, I could make fellows who lead to SPIE student club, and we promised each other that Kyoto University would join the student club next time. I could obtain the opportunity to improve my academic skills and to be acquainted with researchers involved in this field.

4. Conclusion

All things I experienced in this conference highly motivated me for research and study in LIMS program. I have a keen desire to go back to the conference again with my publication related to photoacoustics. The opportunity to attend the conference provided me with much more perspectives than I had expected.

Congress Report

Atsuko Ishida (M2)

[Outline]

Congress Name: 16th International Congress of the World Federation of Occupational Therapists in collaboration with the 48th Japanese Occupational Therapy Congress and Expo

Dates of Exhibition: June 18-21, 2014

Place: Pacifico Yokohama, Yokohama, Japan

Theme: Sharing Traditions, Creating Futures

[About Our Research]

We presented a research about falling risk of patients who were right brain damaged (RBD) due to stroke. In previous study, researchers reported that patients with RBD fell more than left brain damaged patients and they considered this was by left hemiplegia or unilateral spatial neglect (USN). However, the assessment on hemiplegia or USN cannot find falling risk, especially patients with mild disorder.

In this research, we investigated the relationships between falling risk of RBD patients and other assessments related frontal lobe.

In the result, falling risk of RBD patients had correlation with Mini Mental State Examination (MMSE), Line Bisection test, situation judge test, and Awareness test. And according to each result of those assessments, patients who showed good result in assessments of hemiplegia or USN got low score on situation judge test or awareness and they had moderate falling risk. This suggested that falling risk related not only hemiplegia and USN but also ability of situation judge and awareness.

Some occupational therapists (OT) in hospital asked us about this research. Many questions were about new assessment which added in this research and they told that they tried to assess frontal lobe ability by using this assessment. Other OT pointed out that we didn't control duration of feeding period after stroke, and further explanation was required about the different case with conclusion. We planned to conduct further research based on those advises.

[Findings]

This congress was world federation for OT and there were many clinical research about actual daily care. All sessions included techniques and methods of each country and I could compare Japan and other countries.

For example, in Ireland, inmates in nursing home work as café staff there. This is one

of assessments on social skills. OT can evaluate inmates' social function in nursing home. Or in Malaysia, nursing home has 'shelter room' for inmates who had falling risk, and in the room, staff pay attention with falling. These introduction gave me new view about the place OT working. I thought these large scale program should be added and be carried out in Japan, too.

There were some researches on falls in elderly effected by aging society. One research revealed where falling accidents happened or who had falling risk and other group researched effects of fall times by intervention like physical exercises and mental supports. As far as I could see, there were no presentation on 'risk of domestic accident' which we work on. However, I considered that we can use the idea of falling risk to our research by changing the index of risk.

Conference Report

Kouki Shinoda (M1)

Title: The Seventh Annual Meeting of the Japanese Society for Cell Synthesis Research
Date: November 13-14, 2014
Place: The University of Tokyo, Tokyo, Japan

Summary of Meeting

This meeting is an annual event for open study and discussion of Cell Synthesis Research. This meeting consisted of three plenary lectures, four sessions, and poster presentations. Presentations were conducted by many researchers in various research fields including Synthetic Biology and System Biology.

Presentation and useful information for future research

Dr. Bayley gave a presentation on minimal artificial tissues assembled by droplets. Aqueous droplets joined by lipid bilayer can form 3D network and can interact with each other through protein pores incorporated into the lipid bilayers. Taking advantage of this technology, they have developed neuron mimic circuit. As aqueous droplets are biocompatible, this technology can be applied for new medicinal materials or devices. In a poster presentation, it was reported that the droplets were applied to a detection device for influenza virus. This method can be applied as a

diagnostic tool for many kinds of infection. In drug delivery applications, this technology may be useful for hormone replacement therapies that are synchronized with circadian variations.

Dr. Morizane gave a presentation on iPS cell-mediated therapy for the treatment of Parkinson's disease. Parkinson's disease is a progressive disorder of the central nervous system, resulting from the death of dopamine-producing cells in the substantia nigra of midbrain. In animal experimental model, dopaminergic neuronal cells were generated from iPS cells derived from patient's own cells were transplanted into the brain of cynomolgus monkey. Autologous transplantation elicited only a minimal immune response in the brain in contrast to the allografts, and increased a survival rate of dopaminergic neurons. Their research is currently underway to facilitate the clinical applications of iPS cells for regenerative therapy in neurodegenerative diseases.

Dr. Moriya gave a presentation on the factors which determine the expression limit of all protein-coding genes of budding yeast. They developed a genetic method called genetic tug-of-war (gTOW) to measure the copy number limit of overexpression of a target gene. Yeast cells are transformed by the plasmid encoding a target gene with its native regulatory sequences, and the gene becomes proportionally overexpressed according to the increased copy number. By using this method, his group showed that yeast cellular system was robust against an increase in the copy number by up to 100 copies in over 80% of the genes. They also showed that the limitations of copy numbers were affected by some factors such as the load of turnover and imbalance of components of constituting protein complex. Circadian rhythm is generated by negative feedback loop of clock genes. To understand the limit and threshold of expression levels of clock genes might enable us to control circadian rhythm by achieving the maximum expression of genes transiently.

Conference report

Hiroki Enno (M1)

The 36th Annual Meeting of the Japanese Society for Biomaterials
(2014/11/17~2014/11/18, Tower Hall Funabori)

This conference gives variety of lectures about biomaterials from the views of basic material, basic technology, basic clinic and basic industry.

Impressive lectures

1A-SL1 細胞シート再生医療の創生　岡野光夫

The speaker gave us a lecture about the preparation of cell sheets for regenerative medicine. I was impressed because this technology was derived from a simple polymer which shrinks depending on the temperature, and he applied that to the removal of the cells from cell dishes. It would have been difficult for me to come up with such innovative idea, using polymers for this kind of biological application.

2A-S2-1 機能性ポリマーや化合物によるヒト多能性肝細胞の増殖分化制御への応用
中辻憲夫

The lecture was about the practical procedure to produce iPS cells in bulk. The technology seemed simple but very powerful. This lecture made me realize how important it is to apply such technologies to biological fields.

1F-14　ナノ流体スマート制御へ向けたチオール化温度応答性ポリマーの分子設計と合成、評価　四宮未郷

The speaker talked about the application of thiol polymer, which can be controlled by temperature, for micro fluid devices. From this lecture, I understood the importance of micro fluid devices for the medical field and the demand of such kind of materials that control small amount of substances. I believe that my current research filed, porous coordination polymers, has the potential to play important rolls in the fields of micro fluid devices in the future because they can also control small molecules.

2E-21 腫瘍でくすりを作る“酵素封入型 PICsome”の機能評価　安楽泰孝

The lecture gave me the new insights about drug delivery system (DDS). Compared to the conventional DDS, his approach was unique because instead of drugs, enzymes that can generate drugs at specific sites of tissues were delivered. Using this system, we can deliver stable precursors of drugs or some kind of generator of drugs such as proteins instead of unstable drugs.

Useful information for my research

1. In the past few decades, micro fluid devices have become one of the most important technologies in the medical fields because they enable us to make diagnosis instantly with just a drop of blood. However, handling small amounts of substances at nano levels is still a problem. Porous coordination polymers (PCPs), on which I base my research, can easily handle small amounts of molecules, even if they are gas molecules. So PCP should be an excellent candidate for this field.
2. There are three factors controlling cell function, namely biochemistry, physical chemistry and structural mechanics. In this conference, there were many reports showing that some stimuli also controlled cell growth. From this point of views, I can also control the cell by stimulating some chemical compounds from PCPs.

3. As a biomaterial, there are many different ways to apply iPS cells in the medical field, such as cell sheets. So, when we consider how it can be applied in this field, it is better to focus not only on clinical medicine but also on regenerative medicine. This is because there is much room to be developed for the field of regenerative medicine, and it will have a high impact for society.

Useful information for other LIMS members

2D-07 細胞の形を操る形状記憶培養皿の開発　荏原充宏（for Aila, Shinoda and Dojo）
The speaker talked about the cell culture dishes, whose surface structure can change by temperature. So by using these cell dishes, the morphology of cells can be controlled. It may be important for nerve cells (for Aila) to control the preferable direction of cell growth. Additionally, for the clock gene expression, the morphology change will affect its function. I thought that this information would be interesting for cell research.
1E-08 配向制御型細胞シートを用いた異方性を有する筋組織の構造制御（for Nishitani）
To realize complicated structure like our body tissue in cell dishes, the key is to control the direction of cell growth. For example, skeletal muscles are grown as a bundle for one direction. So the speaker tried to control the direction of cell growth by using cell dishes, whose surface was covered with polymer and modified in a one-direction-pattern at micro levels. Nobuhiko Nishitani, a LIMS student, studies about the self-assembly of small molecules and the surface of it. If he can regulate the surface of the cell dishes by using self-assembly of small molecules, he may be able to control cell growth directions at the molecular level.

Report of attending 37th Annual Meeting of the molecular biology society of Japan

Kumiko Dojo (M1)

Place: Pacifico Yokohama
Date: 25th-27th of November, 2014

Meeting description

The annual meeting of the Molecular Biology Society of Japan is the largest molecular biology meeting in Japan. Many researchers from various field gathered in this 37th annual meeting and gave talks and put up posters of leading edge study.

Impressive lecture

1W6-2 岩本和也

「脳ゲノム解析と精神疾患」

Schizophrenia is a serious mental disease, and its socioeconomical loss is huge. According to the results of the human genome project, it turned out that half of the human genome is composed of repeated sequence which seems meaningless. One third of the repeated sequences are called LINE-1. LINE-1 are retrotransposons, which amplify themselves in a genome, and induce disorders of proper recognition of DNA sequence. The presenter and his colleagues measured the amount of LINE-1 sequence in the schizophrenia patients and found that the patients significantly have more LINE-1 sequence compared to the healthy subjects. They also found that development of these diseases have both genetic and environmental backgrounds. The presentation was very impressive because it reminded me of the LIMS course where I went to the care center for schizophrenia patients. I hope these findings will compensate for the development of diagnosis, prophylaxis, and cure of schizophrenia.

Useful information for my research

1P-0706 Jun Nakano

“Regulation of mouse affective behaviors by the circadian clock in the forebrain.”

In the era of relentless work, our body clock is perturbed. Due to rotating shift-work and work at midnight, phase relationships between internal circadian rhythms and the external day/night cycle are unfitted. Continuing these types of lifestyle can end up with serious mood disorders including major depressive disorder and bipolar disorder. The presenter and his colleagues showed that mouse anxiety-/ depression-like behavior is significantly perturbed in mice which lack circadian rhythmicity of clock genes in the forebrain. This finding astonished me because regional impairment of clock genes in brain affected the whole-body. Age-related loss of function in a specific part of the brain may cause disorder of clock genes, leading to whole-body level of disorders.

2P-0487 Kiyomichi Imamura

「高浸透圧刺激による時計リセットシグナリングおよび遺伝子応答の解析」

Almost all organisms have a circadian clock, which keeps the approximate 24 hour rhythm in our body. The clock is composed of clock genes including BMAL1 along with their important post-translation regulations that maintain rhythmicity. The members in his laboratory found c-Jun N-terminal kinase (JNK) as a novel clock gene kinase. The presenter and his colleagues found that the phase of clock is re-set by activated JNK through hyperosmolar stimulation. They next profiled genes which responded to the stimulation, and found Dec1, Dec2, and E4bp4 were specifically transcribed as targets.

They suggested this novel finding would be important for development of a novel field of diseases related to jet-lag, sleep disorder, and lifestyle diseases which result from shift-working. This presentation gave me important information for my own LIMS theme to think and find a solution for patients with shift-work diseases.

Useful information for other LIMS members

1P-0766 Mayumi Takahashi

「clk-1 トランスジェニックマウスにおける寿命延長とミトコンドリア機能低下」

The clk-1 gene encodes an enzyme necessary for bisynthesis of coenzyme Q (CoQ). It is already reported that loss of function of clk-1 in *C. elegans* elongates life expectancy. The research was not applied to mammals because they cannot survive without the gene. So the presenter and her colleagues rescued the clk-1 knock-out by dose-dependent clk-1 transgene. This mouse express less CoQ. As a result, the life expectancy of both male and female transgenic mice elongated. They insisted that less CoQ in the clk-1 transgenic mice caused decreased function of mitochondrial metabolism in the muscle, which caused whole-body level of decreased metabolism and miniaturization, leading to concomitant elongation of life expectancy. This discovery suggests that clk-1 is a novel mammalian longevity factor.

Conference report

Masatoshi Uno (M1)

The 37th Annual Meeting of the Molecular Biology Society of Japan (2014/11/25~27 / at Pacifico Yokohama in Japan)

1. Summary of Meeting

This Meeting is an annual event of Molecular Biology Society of Japan, it is an academic conference of general molecular biological research. Main topics of this conference treated not only molecular biology that included cell biology, structural biology, genetics etc., but also educational activities for research fraud and career support for young researchers.

2. Useful presentation for my research in the conference

(1) RDF を用いたパスウェイ・マップの統合[2P-0969]

The presenter of this poster said, in nowadays research data of biological signal pathway map were uploaded with various formats in many sites. This situation was not useful and opposed discovery. So he proposed that all signal data file would convert a single format and integrate their data. In summary, he would standardize and integrate biological pathway map data. This proposal was so useful because I had proposed a similar theme of LIMS research in this semester.

(2) リウマチ様関節炎発症における F759 マウスと野生型マウスの違いのコンピュータモデルによる解析[3P-0705]

The presenter of this poster researched Jak-STAT signaling system of IL-6R downstream, and this signaling system was forecasted to concern Rheumatoid arthritis. He simulated and compared natural system and system of mutant induced Rheumatoid arthritis. This proposal would be helpful my LIMS research because I will research signal system of Rheumatoid arthritis in LIMS research.

3. Useful information for other LIMS students in the conference

(1) Let's think about career paths for young life scientists [1F7]

This forum introduced some career support activity for students in doctoral program and postdoctoral at some Universities and some talking by office workers. Especially, career support program of Nagoya University had more achievements of internship. It will be helpful for internship program of LIMS. For details, please refer to the following web site.

{http://www.aip.nagoya-u.ac.jp/index.html }

5.

広　報

Public Relations

6.

産公学連携

Industry-Public-Academia Cooperation

文部科学省博士課程教育リーディングプログラム

Leaders for Integrated Medical System

for Fruitful Healthy-Longevity Society

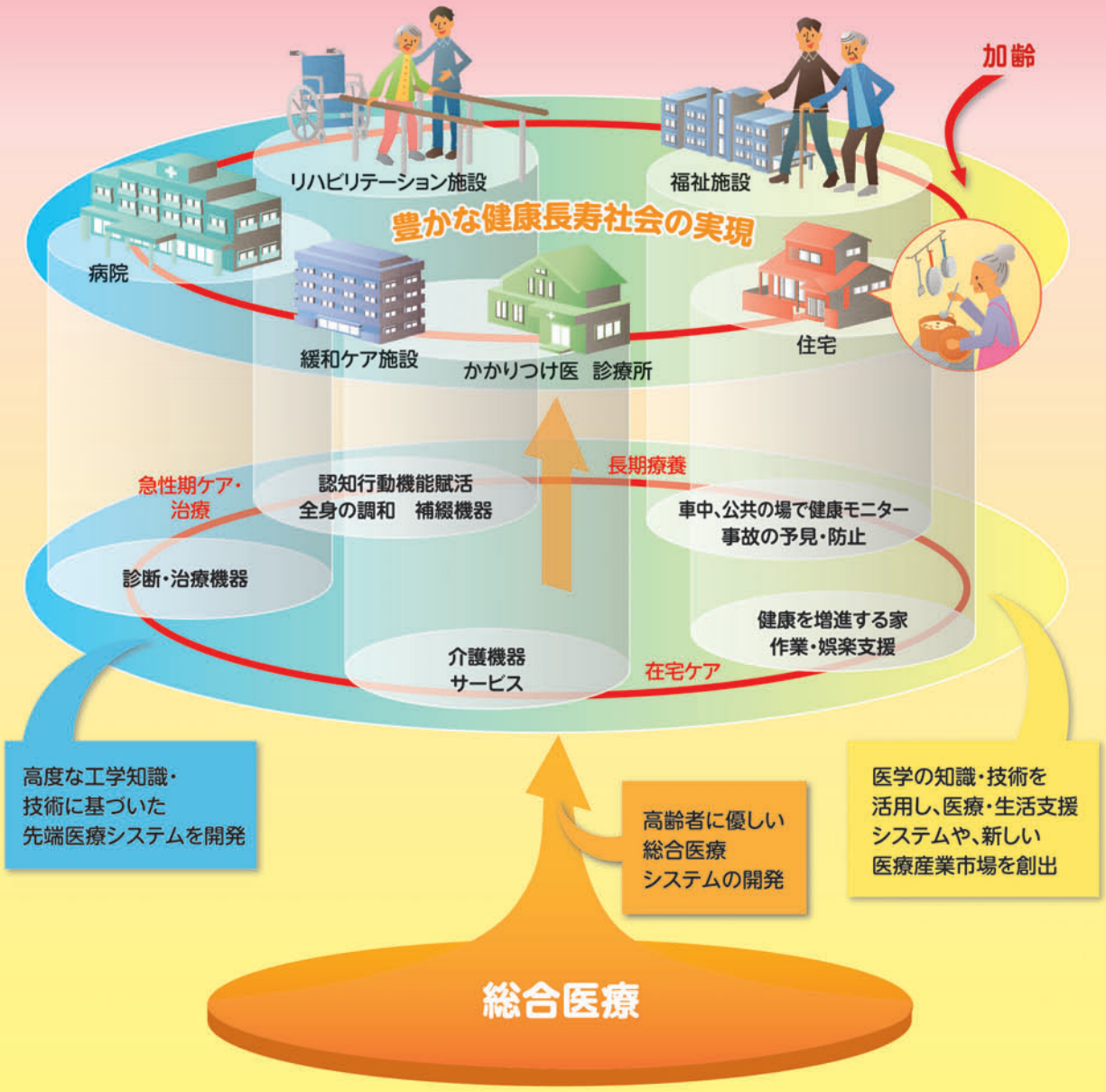
充実した健康長寿社会を築く　総合医療開発リーダー育成プログラム

京都大学
KYOTO UNIVERSITY

Medical Innovationから Medical Revolutionへ

医療・健康という切り口から、新たな概念を創出し、個人の一生や、地域社会、
広域世界の全体適合性を向上させる動きをMedical Revolutionと命名しました

総合医療と新たな医療産業

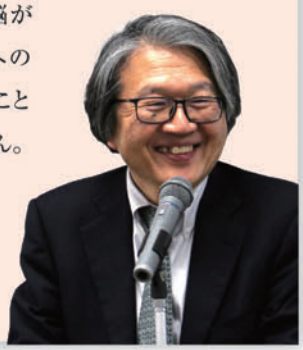


プログラム・コーディネーターから皆さまへ

医工連携ということが重要であると言われて久しいですが、本プログラムは、「充実した医学研究環境に触れつつ工学や薬学を学ぶ」という発想で、工学や薬学の基礎・応用研究に加えて医学の基礎から臨床、介護までを学び、医学、工学、薬学の垣根を越えた新しい研究領域を開拓していくことができるリーダー育成を目的としております。

高齢者医療・介護は、特に高齢化が顕著に進んでいる日本で、長い健康長寿を達成するための必須の条件の一つです。単に病院で行う医療だけではなく、一般家庭にもっとも近い、かかりつけ医への支援、長期療養施設のあり方など、高齢化した社会を支えるためのさまざまな工夫を積極的に発信できる人材を育成することも、もう一つの大きな目的です。

多くの若い頭脳がこのような分野への参画を希望することを願ってやみません。



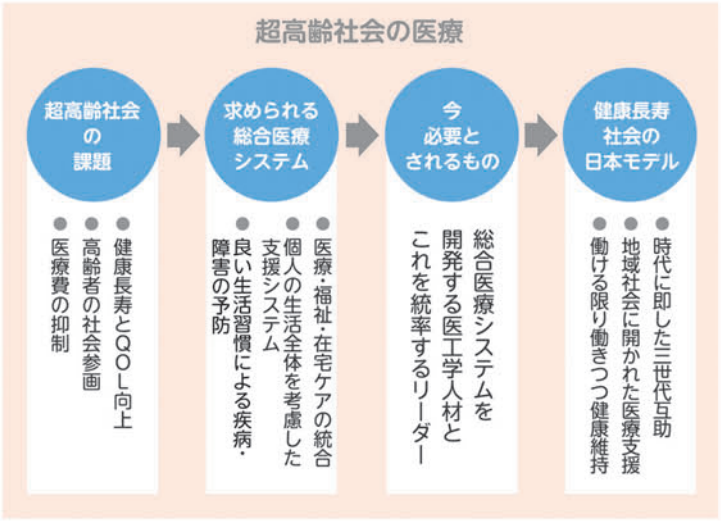
医学研究科
教授　福山 秀直

総合医療の構築

世界で人口構成の変化に伴う疾病や障害の変化、社会構造の変化への対応が迫られています。各国に先駆けて超高齢社会を向えた我が国では、高齢者の生活の質（QOL）を向上しつつ健康寿命を延伸すること、高齢者が社会参画しやすい環境を構築すること、医療費の増大を抑制することなどが、喫緊の課題としてあげられます。これら課題を克服し健康長寿社会を達成するため、全く新しい"総合医療"の構築が求められます。

先ず、医療・介護・福祉の統合、個人の生活全体を考慮した支援システム、健康に良い生活習慣による疾病や障害の予防などを、具体的な仕組みとして実現することが求められます。医学と工学の高度な技術革新に基づき、病院医療や在宅ケアの向上、新たな医療産業や雇用の創出、地域の活性化など、'医療イノベーション'の重要性が提唱されています。

更に、これら全体が調和し、個人の一生の推移に応じて活用できる"総合医療"を構築する必要があります。健康長寿社会の日本モデルを創出し、これを持って世界に貢献するため、新たな概念を創案し、多分野の人々を統率して、総合医療を推進するリーダー人材が求められます。



総合医療開発リーダーの育成

真に医学と医療が分かる医工学人材を育成し、
医学の中に蓄えられた知識を他分野に発展させるリーダーを輩出します。

LIMS履修者への指導風景

**本プログラムでは、各履修者の所属研究科の指導教授に加えて、
LIMS指導教授、メンター(LIMS特定教員) 2名の4人体制でサポートをしています。**

英語debate

生理学実習

学際応用科目実習

人体解剖学実習

医療・生活支援システム学実習

プログラムへの期待

本人は一人前に基礎医学や医工学の研究をしているつもりでも、今考えてみると、あの時私に解剖や生理の知識が充分にあったら、と思うことが何回もある。もちろん実際にあったところで私の研究成果は何も変わらなかったかもしれないのだが、少なくとも結論に至るまでの時間は短縮できたのではないかと思う。また、工学系と医学・薬学系の先生方が協力して研究を展開しようとしても、なかなか意図がつたわらないもどかしさを双方が持ってるように感じる。このLIMSプログラムにより、医学・薬学生に工学の知識、工学研究科院生に基礎医学・薬学を学ばせることは、間違いなくお互いのコミュニケーションを改善しこれからの長寿社会を牽引するリーダーの育成を加速させると確信している。

工学研究科
教授　森 泰生

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健康長寿社会の総合医療開発ユニット
info@lims.kyoto-u.ac.jp
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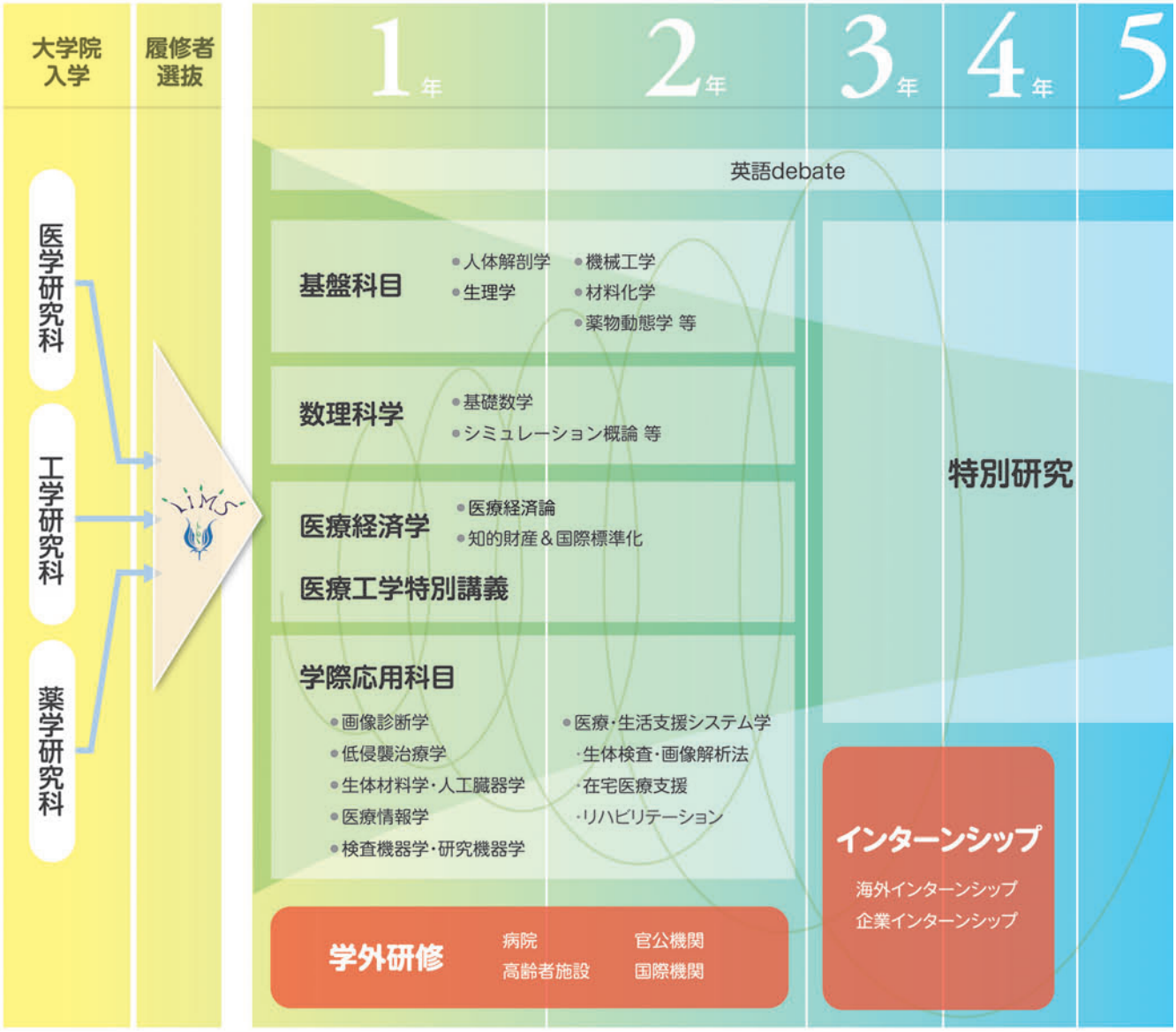
京都大学 KYOTO UNIVERSITY



医工薬学の基盤に基づく人材育成

京都大学が培った専門性の高い医工学の知識と技術を体得し、社会ニーズに基づいて研究開発を進める能力を獲得します。

人体を知る

理・工・薬・看護・リハビリテーション・検査学系等出身のLIMS履修者が、医学部卒業生に匹敵する基礎医学と生体知識を習得できるように効率的なカリキュラムを用意しています。

- 人体解剖学：医学部学生と同等の環境で人体解剖学のエッセンスを実習します。
- 生理学：多様な組織・臓器や全身の、機能連関に着目する視点を獲得します。

現場を知る

京都大学医学部附属病院・関連医療機関、高齢者施設、企業、公的機関、国際機関などでの研修を通じて医療・介護支援などの現場ニーズを理解します。

社会規範を知る

医療政策、医療経済、医療倫理、知的財産、国際標準化など、社会における医療ルールを学修します。

年

学位取得 ※1

博士

医学 ※2
医科学
人間健康科学
工学
薬科学

＋

リーディングプログラム修了の付記

※1 取得できる学位種別は在籍する研究科・専攻による

※2 4年制博士課程の場合は4年間で実施

キャリアパス・将来像

このプログラムで養成される総合医療開発リーダーの人物像として、以下の例が挙げられます。

- 先進医療分野の革新的人物として、医学・医療の広範な知識、高度な工学技術を駆使し、高齢者に優しい医療支援機器システムの立案ができる。
- 高齢者特有のニーズを理解し、自立した生活や社会参加の向上方法を創案できる。
- 高齢化社会の医療経済問題を深く理解し、プロアクティブに対応できる。
- 世界標準を目指す医療産業を創出できる。

これまでに無かったような専門職や専門分野を、学生自ら作り出し、開拓していくことも期待されています。

- 産業界において、新しいサービスやビジネスモデルを創出し、高齢者の生活全般を考慮して支援するシステムの整備を牽引する。
- 大学・研究機関では、医・理工学界に埋もれている斬新な知恵を、日常生活に活用する土壌を開拓する。
- ベンチャー起業
- 政府・行政機関において、活力をもって生活できる社会に向けた施策を立案し、産学における研究開発の成果を迅速に社会実装する体制の整備に尽力する。
- 国際社会で、先端的な医療・介護支援システムの普及促進を行い、質の高い日本モデルをもって健康長寿社会の拡充に貢献する。

総合医療開発リーダー

豊かな健康長寿社会の実現

社会需要に基づいた産学公連携による人材育成

単に技術の高度化を追い求めるのではなく、社会需要の側から発して技術創出をめざし、必要に応じて未知技術を探索したり、既存や新技術を柔軟に統合するセンスを養います。

研究室内で達成できる技術水準に安住せず、社会実証研究・社会実装の中での技術の成熟を、初期から展望する企画力を養います。

社会コストや医療経済学的根拠を考慮し、社会実証研究を通じて、新規技術・システムの評価基準、規制のあり方、倫理規制について提言したり、政策決定のための根拠を提供したりできるような、俯瞰力やコミュニケーション能力を養います。

学外ワークショップへの参加

老健施設の見学

Program for Leading Graduate Schools, Ministry of Education, Culture, Sports, Science and Techonology

Leaders for Integrated Medical System

for Fruitful Healthy-Longevity Society

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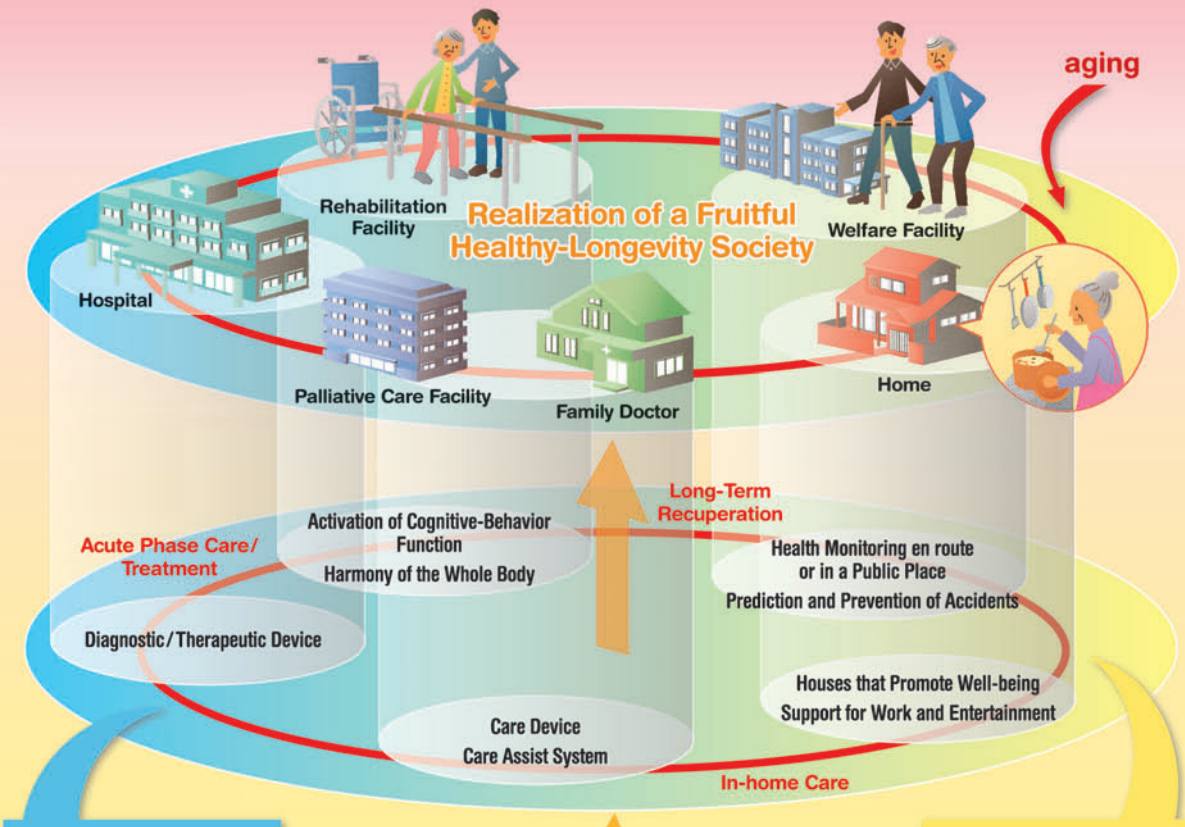
from Medical Innovation to Medical Revolution

"Medical Revolution" is a movement to create a new concept from the perspective of health care and well-being, and to improve compatibility as a whole between individual-life, community and worldwide issues.

Integrated Medical System and New Health Care Industries



Develop a state-of-the-art medical care system based on sophisticated engineering knowledge and technology

Development of an Elderly-Friendly Integrated Health Care System

Create a health/lifestyle support system and a new market in Health Care Industry by taking advantage of medical knowledge/technologies

Integrated Medical System

Message from the Program Coordinator

The importance of coordinating medical sciences with engineering has long been emphasized, and this program is based on the concept of "studying engineering and pharmacology in a rich medical research environment". It includes basic and applied research in engineering and pharmacology as well as in basic medicine, clinical medicine and nursing care so as to train leaders who are motivated to exploit new areas of research across the medicine / engineering / pharmacology boundary.

In a "super-aging" society such as Japan, medical / nursing care for the elderly is an absolute necessity for attaining healthy-longevity. Another major purpose of this program is to support human resources development, training individuals so that they can actively transmit various ideas to support the aging society; ideas not just for medical care at hospitals, but also to support family doctors and to manage long-term recuperation facilities. I earnestly hope that talented young people will join this field.

Hidenao Fukuyama,
Professor,
Graduate School of Medicine

Implementation of Integrated Medical System

Measures to keep up with the shift in diseases and disorders due to the changes in population structure as well as with the changes in social structure are in urgent need worldwide. Japan as one of the leading super-aging societies in the world must resolve pressing issues such as to extend healthy life expectancies while improving the quality of life (QOL), to create an elderly-friendly environment and to contain health care costs. To overcome these challenges and build a healthy-longevity society, it is necessary to implement a totally innovative "integrated medical system".

First of all, there is a need to embody specific systems to integrate home care/medical care/welfare, to create support systems to fit the lifestyle of individuals, and to prevent diseases and disorders through introduction of a healthier lifestyle. Based on sophisticated progress of medical science and engineering, the importance of 'medical innovation' has been proposed. This includes the upgrading of hospital medical care and in-home care, creation of new health care industries and employment, and revitalization of local communities.

Further, it is necessary to finely coordinate all these factors to implement an "integrated medical system", which can be customized according to the changes in the lives of individuals. There is a need for talented leaders who can invent new concepts, be a leading figure for people from various fields and promote integrated medical system, in order to create a Japanese model of a healthy-longevity society and for the model to contribute globally.

Health Care in Super-Aging Societies

Challenges
- Healthy-longevity and improving QOL
- Social participation of elderly people
- Containment of health care costs

Needs
- Integration of home care, medical care and welfare
- Support system to fit the lifestyle of individuals
- Prevention of diseases and disorders through introduction of a healthier lifestyle

Expectations
- Leaders to create an integrated medical system based on social needs and by applying their knowledge and experience in medical engineering

Japanese Model
- Mutual aid among three generations
- Health support open to the community
- Maintain health by staying at work

Training Leaders for Integrated Medical System

We will train graduate students in the field of medico-engineering who truly understand medical science and health care, and foster leaders who can apply medical knowledge to other fields.

京都大学 KYOTO UNIVERSITY

Graduate Schools
- Graduate School of Medicine
- Graduate School of Engineering
- Graduate School of Pharmaceutical Sciences
- Graduate School of Economics

Research institutes, etc.
- Research Institute for Mathematical Sciences

Kyoto University Hospital

Research and Educational Unit of Leaders for Integrated Medical System

Center for the Promotion of Interdisciplinary Education and Research

Other units

Internship / Dispatch lecturers / Training

Cooperative Companies
Medical device industry, automobile industry, housing industry, ITC industry, etc.

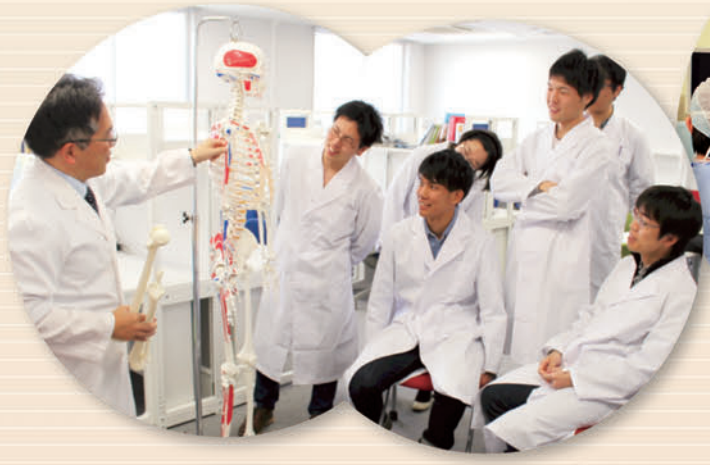
Public Organizations
Kyoto City, Kyoto Prefecture, Keihanna Science City, etc.

Scenes of Guidance to LIMS Students

**Each student of the LIMS Program is supported by four senior persons:
one Professor of their own graduate school, one Professor and two Mentors of the LIMS Program.**

Debate

Physiology Practice



Human Anatomy Practice

Interdisciplinary
Application Practice

Medical and Life Support Systems Practice

Expectations for the program

During those training days as a junior scientist, I believe that I managed to become a qualified researcher of basic medical science, or medico-engineering after I entered the field from outside. But looking back, I also sometimes think that I could have performed better if I had full training and knowledge of anatomy and physiology at that time. While such knowledge may have had little effect on the results of my research, it could at least have helped me to be more tactical and time-efficient. Collaborations between researchers from different fields such as engineering, medicine and pharmacology are sometimes hindered by communication difficulties between them. I am confident that, mentoring the students of graduate school of medical science / pharmacology the knowledge of engineering, and the students of graduate school of engineering the basic knowledge of medical science and pharmacology in this LIMS program will surely improve their mutual communications and accelerate nurturing of individuals to lead the future longevity society.

Yasuo Mori, Professor,
Graduate School of Engineering

Research and Educational Unit of Leaders
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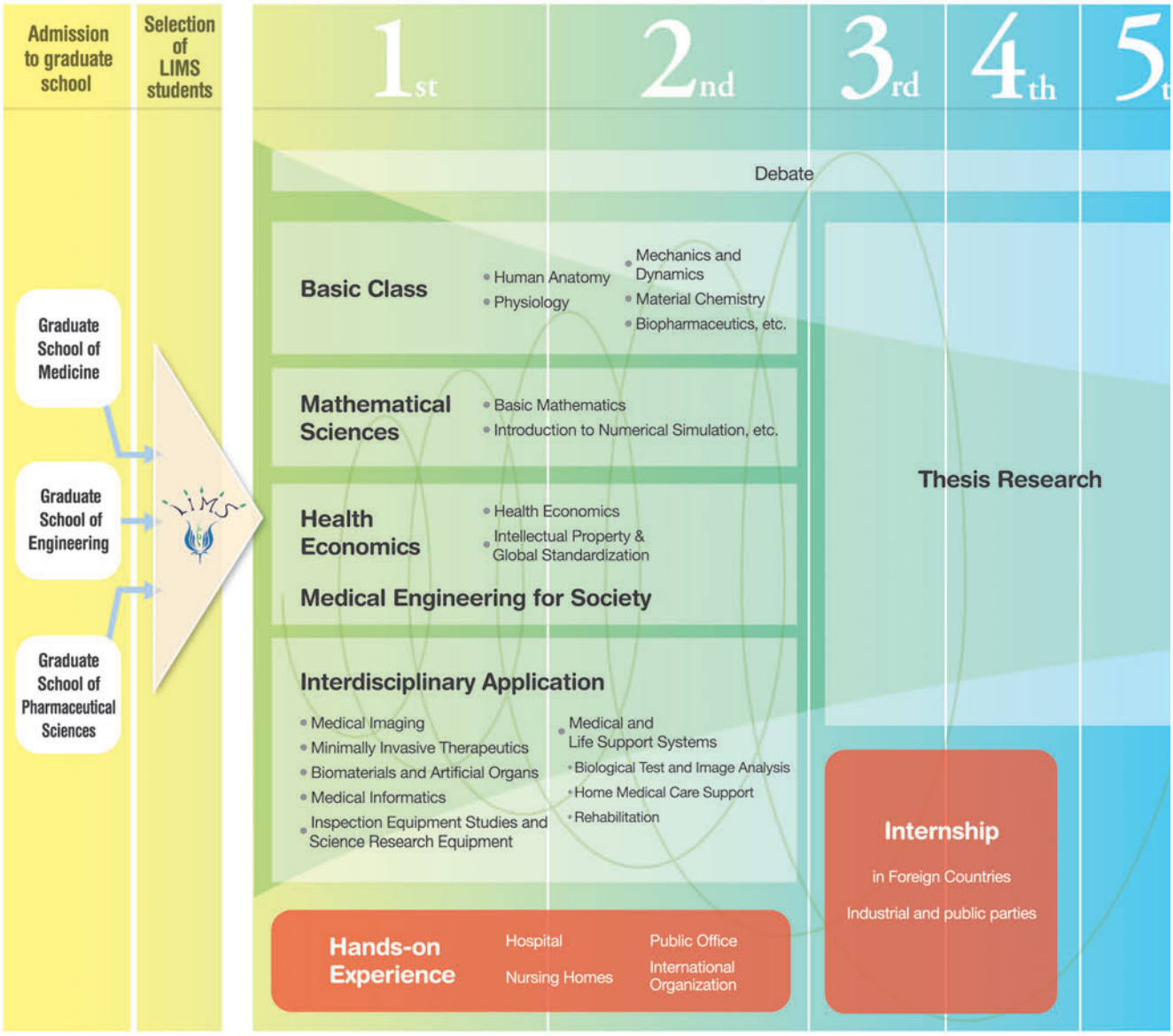

Training Based on Medical Science, Engineering and Pharmacology

Acquire highly specialized knowledge and skills of medico-engineering cultivated by Kyoto University and acquire the ability to perform R & D based on social needs.

Know the Human Body

The program provides an efficient curriculum so that LIMS students from the Graduate Schools of Science, Engineering, Pharmaceutical Sciences, Nursing, Rehabilitation, Medical Technology, etc will learn the basics of medicine and knowledge of the living body comparable to graduates from medical schools.

- Human Anatomy: Practice the essence of human anatomy in a similar environment as medical students.
- Physiology: Acquire a sense to focus on functional coordination of the diversity of tissues, organs and the whole body.

Understanding the Needs

Through training at Kyoto University Hospital, related medical institutes, nursing homes, companies, public and international organizations, the students will understand the social needs especially in medical and health care practice.

Know the Norm

Master the social norm related to health care such as healthcare policy, healthcare economics, healthcare ethics, intellectual property and global standardization.

Acquisition of Doctorate ※1

Doctor of ※2

- Medicine
- Medical Science
- Human Health Science
- Engineering
- Pharmaceutical Sciences

+

Certificate of the "Leading Program"
(additional remark)

※1 Category of degree that can be acquired depends on the student's graduate school or major.

※2 Complete in 4 years for a 4-year doctor course.

Career paths/Future goals

Students are expected to play leading roles in divers scenes including but not limited to the following:

- Can integrate wide knowledge of medical science and health care and sophisticated engineering technology to invent an elderly-friendly support system that may lead to medical innovation.
- Can understand the needs specific to the elderly and propose new ideas to improve autonomous life and motivation for social participation.
- Can deeply understand the health economics in the aging society and behave proactively.
- Can create a health care industry aiming to meet global standards.

It is expected that students will create and cultivate professions or special fields not seen before.

- Can create new services and business models in the industrial world to guide preparation of a support system for the elderly by carefully considering every aspect of their lives.
- In universities and research institutes, can lay the groundwork on which unconventional wisdom buried in medicine, science, or engineering may be developed to be put into use for everyday life.
- Start a venture business.
- In governmental and public organizations, contribute to policy making for a vibrant society, and swift social implementation of the fruits from R&D through industry-academia cooperation.
- In the global community, propagate advanced medical and health care system, and expand the healthy-longevity society by effectively using the high-quality Japanese model.

Leader for Integrated Medical System

Realization of a Fruitful Healthy-Longevity Society

Training through industry - academia - government cooperation based on social needs

Aim to foster a sense to create techniques based on social needs rather than seeking sophistication of techniques alone, or, if necessary, to search for novel technologies and flexibly integrate them with existing techniques.

Cultivate the ability to put in perspective, from the early stages, future technological maturation such as during operational experiments or after social implementation, without being satisfied with the level of technology attained in laboratories.

Foster their abilities in situational assessments and in communication i) to contemplate social cost, evidence in health economics and to develop and conduct operational experiments, ii) to propose methods of evaluation, regulation or ethical consideration of new technologies and systems, ii) to prepare supportive evidence for political decision making.

Participation in extramural workshop

Field trip to geriatric health services facility

ホームページ改定への取り組み

文責： 山本浩司（LIMS特定准教授）

本年度はLIMSウェブサイトに対する要望への対応、およびより効果的且つ魅力的な情報発信を目指してデザイン変更やコンテンツの整理・拡充に取り組んだ。

・ アクセス解析からわかる傾向

サイト改変を進めるに際し、各ページへのこれまでのアクセス回数を分析して以下の傾向が認められた。

- 日本語ページで最もアクセス数が多かったのは「指導スタッフ」のページである
- 次いで日本語ページでは「募集概要」、プログラムの「概要と目的」と続く
- 英語ページで最もアクセスが多かったのは「募集概要」のページである
- 次いで英語ページでは「プログラムの内容」、「カリキュラムの概要」と続く
  （ただし、学内限定ページに関する情報は除く）

日本語ページで「指導スタッフ」のページにアクセスが集中していたのは意外であった。LIMS プログラムのイメージを掴むうえで、参画分野や教官が重要な情報源になっているようである。一方、英語ページへのアクセスでは概要的要素が重視される傾向にあったが、それ以外のコンテンツへのアクセス数は低かった。従って、各コンテンツの概要を充実させること、あるいは概要と他ページのコンテキストを明確にすることが重要であると考えられた。

・ 優先的に改変を試みている項目

上記傾向と直接寄せられた意見を元に、以下の3点に注力してウェブサイトの改変に取り組んだ。

1. トップページの構成を変更し、見易さや activity の伝わるデザインにする
2. コンテンツ間で重複した内容をまとめ、リンク構成をわかり易くする
3. 外内部から要望の強かった Q&A を設置する

トップページの改変は企業と連携し最終的なデザインの調整を行っている段階である（Fig.1 トンプページ草案）。また、その他の項目も最終的な文言の調整や編集を行っている（Fig.2 Q&A の一例）。来年度上旬には新たなサイトに更新予定である。

Fig. 1 トップページの草案

Fig. 2 Q&A の一例

Renewal of the LIMS website

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In this year, we addressed redesign and improvement of the current LIMS website in order to put out more effective and more attractive information on the Internet.

- Historical trend analysis for the current website

The results found by analyzing the access frequency of each page in the current LIMS website were as follows:

+ The most visited page in the Japanese sites was the "Staff" page.
+ The next popular page was the "Application Overview", and then the "Outline and Objectives" of the overview on this program.
+ The most visited page in the English sites was the "Application Overview" page.
+ The next popular page was the "Program contents" of the overview, and then the "Curriculum overview". (Exception of counting the number on the page limited to the domestic students (campus only))

The fact that the most frequent page in the Japanese sites was the "Staff page" was unexpected for us. Information on the LIMS supervisors and their expertise appeared to be significantly important to grasp an image concerning LIMS program. The traffic analysis for the current English pages had a trend focusing on the abstract of each category. Considering these tendencies, it was thought to be important to enhance the abstract of each content and their contexts in a new website.

- Preferentially-improved contents

On the basis of those results and the requests from visitors, we preferentially focused on the following three points.

1. To redesign the front page so that our activities come through.
2. To minimize the inclusion of duplicate information and comprehensively display relation among each content.
3. To locate a Q&A site requested from both domestic and foreign visitors.

As to redesign of the front page, we are now working in collaboration with a design company and in the final stage (Fig. 1 Draft version of the LIMS front page). In addition, final adjustments and revisions of the terms in the other items are being processed (Fig. 2 an example of Q&A site). We plan to launch a new LIMS website in the early of the next academic year.

Fig. 1 Draft version of the new front page.

Fig. 2 Example of Q&A site.

産公学連携

LIMS プログラムでは、企画段階から多分野の企業や公的組織に聞き取り調査を行い、プログラム実施に際し、そのうち 20 余組織が協力組織として参加している。協力組織の講師により、座学・議論・課題解決・企業訪問などの形で講義を実施している。

講義：

I. 医療工学特別講義Ⅰ： ８企業８名（16 コマ）

講義題名：

1. 標準化活動
2. 知的財産戦略と国際標準化
3. 生体計測・イメージング機器の研究開発
4. 医療機器関連材料の研究開発
5. 在宅医療・健康産業の研究開発
6. 光技術の研究開発と医用応用
7. 整形外科分野における新規製品の研究開発について
8. 治療機器の基礎研究開発

II. 医療工学特別講義Ⅱ： ７企業８名（14 コマ）

1. 総合医療上オフの効率的な可視化
2. 大規模脳情報クラウドを活用した健康長寿社会の基盤構築
3. 自動車運転の安全性と人的緒因子
4. フィールド実証の課題
5. ヘルスケアビジネスにおける技術開発とマーケティング戦略
6. 医療・健康に関するビッグデータの活用事例と社会システムの創出
7. 健康な生活を促す住環境

III. 知的財産＆国際標準化： 企業・公的機関 9 組織 9 名、（15 コマ）

1. 医療産業に必要な技術＆知財経営学
2. 技術経営・知財経営学と研究開発
3. 創薬のプロセス１・探索段階
4. 創薬のプロセス２・臨床段階
5. 創薬と医療行政（PMDA）
6. 医療機器における国際標準化
7. 医療機器の重要な国際規格
8. 医療機器の薬事規制／国際開発
9. 医工連携の実例と展望
10. 医療情報産業の創出
11. ベンチャー企業のビジネスモデルと事業開発
12. 知財の国際ハーモナイゼーション

Industry-Public-Academia Cooperation

We have been referring to opinions and comments of companies and local governments since during planning LIMS Program. Twenty some of them are now supporting LIMS program as Cooperators. In collaboration with lecturers from the cooperating organizations,

we prepared tree subjects in which students can receive interactive lecture, discussion, problem solving practices on practical issues in the real world..

Subjects:

I. Medical Engineering for Society I:

Eight lecturers from 8 companies (16periods)

Theme of class:

1. Introduction to the Standardization
2. Strategies for Intellectual Property and Global Standardization
3. R&D for Biometric Imaging Analysis
4. R&D in Biomaterials and Bio-devices
5. R&D for State of Art Biomedical Optics Techniques
6. R&D in Orthopedic and Dental Fields
7. Basic R&D toward Therapeutic Apparatus
8. R&D Based Home Medical Care

II. Medical Engineering for Society II:

Eight lecturers from 7 companies (14periods)

Theme of class:

1. Effective Visualization of Information for Integrated Medical System
2. Building social infrastructure for healthy, ageless society utilizing the brain information cloud
3. Safety and Human Factors of Car Driving
4. Collaboration for Social Experiments
5. Global Technological Development and Marketing Strategy on Healthcare Business
6. Big Data Applications for Healthcare, and Creation of New Societal Systems
7. Strategies to Improve Health through Daily Life Environment

III. Intellectual Property & Global Standardization

Nine lecturers from an independent administrative agency, public organizations, and a company + Kyoto University Staff

Theme of class:

1. Management of Technology and IP for Health Care Industry
2. R&D and Management of Technology and IP
3. Innovative Drug Development 1, Exploring Stage
4. Innovative drug development 2, Clinical Stage
5. Medial administration for drug development
6. Global standardization of Medical devices
7. Major International Standards
8. Regulation of Medical Devices
9. Regulation of Medical Devices/ International Development of Medical Devices
10. An Aspect of Medical Engineering
11. New Industries of Biomedical Informatics
12. Models of Start-up Business
13. Development of Start-up Business
14. International harmonization of IP

編集後記

初めての年報作りは慣れないことばかりで、気がつくと祇園祭がとうの昔に過ぎ、大文字まで終わってしまいました。来年は、桜の頃は無理としても（温暖化で関西でも３月から咲きますし)、紫陽花の頃にはお届けできるようにしたいと思います。(M. N.)

LIMS に携わって 2 年が過ぎました。一期生の報告書内容はそれぞれ深みが増し、また LIMS 内の学生さんの連携が受賞に繋がるなど、成長には目を見張るものがあります。学生さんに負けないよう自分自身を磨くと共に、一緒に面白いことができたらいいなぁと思っています。(Y. H.)

Postscript

We first apologize for this late publication. Not only Gion-matsuri but also Daimonji has already passed. Next year we will finish this work and deliver our annual report to you before the hydrangea season. (M. N.)

Two years have passed since I started working in LIMS. LIMS students have shown remarkable progress as reflected in their annual reports, which has also led to the students receiving an award for their work based on their LIMS project. As well as brushing up teaching and research skill, I hope together with the students we can make interesting research. (Y. H.)

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