The 21st Century Center of Excellence Program (COE Program)

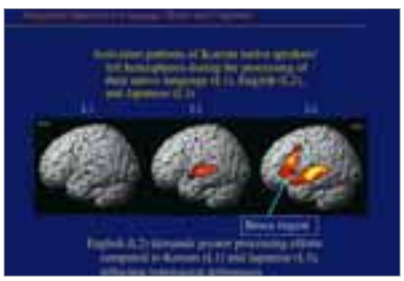
The COE Program is a new project introduced in 2002 by Japan's Ministry of Education, Culture, Sports, Science and Technology. It's aimed to promote establishment of the world's top-class universities renowned for their vitality and level of international competitiveness in Japan. At this end, in order to enhance educational and research standards in this country and to foster creative leadership for the international academic community, the COE Program facilitates the development of a competitive academic environment, and supports the establishment of international research and educational centers in all fields of study.

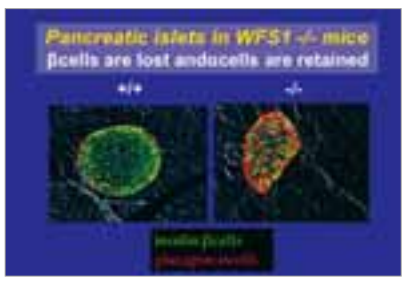
FY 2002

Program Leader	Research Fields	Program Title	Contents
Life Sciences Masaaki Sato	Human Biomedical Engineering	Future Medical Engineering based on Bio-nanotechnology	When we visit hospitals for treatment or medication, we find ourselves surrounded by various testing and therapeutic equipment. These devices and equipment are achievements in the field of human biomedical engineering based on the latest engineering technologies and contribute to the health of our community. By applying high-precision and sophisticated biological nanotechnology, this COE Program aims to develop technologies for the increasingly growing elderly population enabling senior citizens to lead healthy lives, as well as technologies that can contribute to medical care and treatment. We are also involved in such research and technological development aimed to foster the young researchers.
URL: http://www.fmbe.coe.tohoku.ac.jp/			
Chemistry and Material Sciences Yoshinori Yamamoto	Multidisciplinary Chemistry	Unexplored Chemistry: Giant Molecules and Complex Systems	We have entered an age where research is focused upon unexplored giant molecules and analysis of unexamined complex systems; we advance from the age in which synthesis, analysis, expression of functions, and theory establishment of normal molecules (below that of 1 nm size) is carried out. The aim of this program is to conduct research including the analysis, construction, and expression of functions of complex systems such as in giant molecules and complicated molecular associates, and to also systemize the area of unexplored giant-molecule chemistry for practical application. We have, for the first time in the world, succeeded in completely synthesizing ciguatoxin, and further accomplished total synthesis of gambrierol and brevetoxin B, both of which are natural giant marine molecules (3 nm) and toxins produced by fish. Every year, more than ten thousand people in the tropical and sub-tropical regions receive injury from these marine toxins. It is our hope that the success in the total synthesis of the molecules will facilitate in the treatment of people who are affected by the poisonous fish and the development of those medical kits.
URL: http://www.chem.tohoku.ac.jp/COE/			
Chemistry and Material Sciences Akihisa Inoue	Materials Science	International Center of Research & Education for Materials	Our aim is to develop new advanced functional and high-performance materials while clarifying mechanisms by which properties appear. These newly developed materials with artificially designed structures are created by highly sophisticated technology in nanostructure control, material processing under extreme conditions, nanohybridization, nanofabrication, ultra-thin film processing, etc. This center is determined to recruit young vigorous researchers who are willing to take on the challenge of studying unexplored fields of materials science and also actively promote and facilitate exploratory research based on unique and innovative ideas of young researchers in collaboration with promotion members.
URL: http://21coe.jp/index-e.html			
Information Sciences, Electrical and Electronic Engineering Tatsuo Uchida	Electrical and Electronic Engineering	System Construction of Global-Network Oriented Information Electronics	Through fusion of Nanotechnology (NT) and Information communication technology (IT), we can apply fundamental research of materials, processes, and evaluation, etc. to applied research of cutting-edge devices and systems to create original scientific technologies leading to the direct support and reinforcement of international competitive power, establishing a prominent research and education center in the world. Through such activities, we aim to take the initiative in the fields of the next-generation network information home electronics and mobile communications which are expected to be the main global "battlefield" for the next ten years, establishing the basis for the next-generation information electronics systems for the start of an era beginning 10 years from now and beyond.
URL: http://www.ecei.tohoku.ac.jp/21coe/e/index.html			
Humanities Kaoru Horie	Language Sciences	Strategic and Education Center for an Integrated Approach to Language and Cognition	What is going on in a human brain when one is speaking or trying to comprehend what is being uttered? This fundamental question remained unanswered for many years. An "Integrated Approach to Language, Brain and Cognition" uncovers the inner working mechanism of our brain by employing functional Magnetic Resonance Imaging (fMRI) and visualizing which part of our brain is working when we produce and comprehend utterances. This study will contribute to improvements in rehabilitation therapies for speech disorders and help prevent age-related speech disorders by training and keeping our brain in good shape. It will also facilitate the development of efficient foreign language learning methods and may even lead to the development of a robot that can understand language. A collaborative team of researchers in linguistic sciences from various subdisciplines including linguistics, brain sciences, psychology, and engineering, closely work together to reveal "language in the brain".
URL: http://www.lbc21.jp/index_e.html			
Total: 5 programs			

FY 2003

Program Leader	Research Fields	Program Title	Contents
Medical Sciences Kazuo Sugamura	General Medical Sciences	Center for Innovative Therapeutic Development for Common Diseases	Our aim is to cure "signal transduction diseases" caused by abnormalities in the signal transduction system, including immunologic diseases, cancer, metabolic diseases such as diabetes, and neurodegenerative diseases. Combining fundamental medical science and clinical science, an organically integrated series of research was carried out to investigate the molecular mechanisms responsible for the onset of signal transduction deseases, in order to develop new treatments. Through these studies, we hope to foster world-class researchers in the area of medicine and life sciences, as well as form an advanced treatment center for signal transduction diseases.
URL: http://www.med.tohoku.ac.jp/sugamuracoe/			
Mathematics, Physics, and Earth Sciences Osamu Hashimoto	Physics	Exploring New Science by Bridging Particle-Matter Hierarchy	The program intends to establish an international center of excellence for education and research by exploring particle-, nuclear-, condensed matter- and astro-physics as well as interdisciplinary fields including mathematics. Thereby we aim at unified understanding of space evolution process and hierarchical structure of the universe. We explore new research fields of science by taking elementary particles, nuclei, atoms, molecules, stars, and galaxies formed with evolution of space since BIG BANG as the particle-matter hierarchy. Based upon research belonging to each hierarchy, we conduct bilateral educational programs in collaboration with overseas institutions in addition to domestic educational programs. By bridging particle-matter hierarchy in this way, we promote understanding the physical world, and contribute to the intellectual assets for mankind.
URL: http://www.phys.tohoku.ac.jp/coe/index-e.html			
Mathematics, Physics, and Earth Sciences Eiji Ohtani	Earth and Planetary Science	Advanced Science and Technology Center for the Dynamic Earth	We aim to clarify the evolution of the earth, recognizing that changes occurring in vast space and wide time scale phenomena of the earth's fluctuations as a sequence of precursory events, catastrophic change, relaxation, and recovery. In particular, we develop unique, state-of-the-art earth science technologies to investigate dynamics of the earth, including the core and mantle dynamics, seismic and volcanic activities, climate changes, the solar and terrestrial system, as well as the assessment of effects of impacts on small celestial bodies during the earth evolution. At the same time, we aim to foster young creative research leaders who can play an active role in the international science community, have a flexible capability to respond to the current needs of science and technology, and possess outstanding skills of technical development and various field works.
URL: http://www.21coe.geophys.tohoku.ac.jp/index-e.htm			
Mechanical, Civil, Construction and Other Engineering Tetsuo Shoji	Mechanical Engineering	The Exploration of the Frontiers of Mechanical Science Based on Nanotechnology	We establish a new academic field, "Mechanical Science based on Nanotechnology," to satisfy the social demands for the functional and structural designs for next-generation machines through the scientific rationale of nano-scale. We also establish a world-leading research and education center of mechanical science by "Double-spiral research and education programs," that enables doctoral students and young researchers to go through both the interdisciplinary and international research activities and to foster their serendipity and leadership.
URL: http://pm.mech.tohoku.ac.jp/21COE/index.htm			
Mechanical, Civil, Construction and Other Engineering Shigenao Maruyama	General Engineering	International COE of Flow Dynamics	Our studies involve a variety of spatiotemporal flow dynamics from the nano scale, which identifies the movements of atoms and molecules, to the mega scale, which targets on the earth and space. We aim to clarify the flow mechanism and create the functions which lead to an effective use of force and energy, which contributes to resolving the 21st century problems related to the environment, energy, and life. As well as fostering human resources in leadership it plays an active role in global scenes through mutual internship overseas, educational programs focused upon individual talent, and in the international liaison offices.
URL: http://www.ifs.tohoku.ac.jp./21coe/index_E.html			
Social Sciences Yoshimichi Sato	Sociology	Center for the Study of Social Stratification and Inequality	When society was poor, it was believed that once society became affluent, inequality would disappear. However, even in affluent modern society, various inequalities such as educational, career, and gender disparities still exist. Why do they exist? We are exploring this puzzle from the viewpoint of social science at our center. Furthermore, we are extending our research to the investigation of desirable "fair society."
URL: http://www.sal.tohoku.ac.jp/coe/index-en.html			
Social Sciences Miyoko Tsujimura	Law and Politics	Gender Law and Policy in the Gender Equal Society	We focus upon the legal and political scientific research of theoretical problems on the gender-equal societies promoted by Japan and the world in the 21st century. We promote the global dissemination of research study and educational accomplishments of related gender laws and policies and also encourage the applied research of policy implementations in collaboration with numerous academic institutions, local governments and bar associations in Japan and around the world.
URL: http://www.law.tohoku.ac.jp/COE/			
Total: 7 programs			





FY 2004

Program Leader	Research Fields	Program Title	Contents
Innovative Academic Field Yutaka Imai	Clinical Pharmacology and Therapeutics	Comprehensive Research and Education Center for Planning of Drug Development and Clinical Evaluation	For a certain drug to become useful in the health and welfare of mankind, it must pass through various processes, starting from the fundamental science of drug development to clinical application in humans. In particular, a drug in the clinical application requires the accumulations and integration of knowledge and experience covering the ethics and economics in addition to its medical and pharmaceutical values. This center fosters professionals with knowledge and experience, and the aims for establishing an academic research organization capable of proposing ideas for clinical development of drug and management for drug development and evaluation.
URL: http://www.crescendo.pharm.tohoku.ac.jp/index_e.html			

Total: 1 program

Tohoku University Biomedical Engineering Research Organization (TUBERO)

URL: http://www.tubero.tohoku.ac.jp/

In 2003 a research grant, the Special Coordination Funds for Promoting Science and Technology of the Ministry of Education, Culture, Sports, Science and Technology was awarded to Tohoku University for establishment of center for research in advanced biomedical engineering which was inaugurated as the Tohoku University Biomedical Engineering Research Organization (TUBERO).

TUBERO aims to develop new biomedical engineering treatments which contribute to enhance the QOL in patients, developing interdisciplinary research systems integrating life science with the engineering areas. As a main player in revolutionizing systems and awareness, TUBERO will become a global center in biomedical engineering.

Biomaterials Science

The area of research is in the development of highly functional and safe biomaterials which are made of metals, ceramics and/or polymers for use in surgical and dental field. The applications of new materials such as in therapeutic instruments, bio-tissue regeneration, less-invasive measuring instruments are being investigated.

Nanomedicine

This division aims at (1) the compactification of medical devices and sensors for implantation, (2) clarification of the precise function from cell to whole body, and (3) development of a functional measurement system, therapeutic method, and functional regenerative technique. The tasks in the development of bio-mesuring sensors, therapeutic method of diabetes, application of shock waves to treatments, development of artificial organs such as artificial anus, artificial heart, and that of a compact heart-lung machine, are the selected targets in this division.

Biofunctional Science

Based on a thorough consideration of the dynamic in-vivo environment, we would elucidate on the structures and functions of protein molecules and cells which are the basic components of living tissues and organs using advanced technologies such as in gene analysis and nano-micro machining technology. In addition, the medical engineering technology to regenerate tissues and organs by transduction of protein molecules and cells into the body and the translational techniques for clinical application are being developed.

Telecommunications and Information Technology

This division covers research topics in (1) the application of telecommunications technology in medical treatment, (2) the visualization of live body information under medical treatment and diagnosis and (3) the medical application of management technology.