

McGill University – Strategic Research Plan

A. Constructing the Future

McGill is Canada's premiere international research academic institution. Situated in a community both rich in the arts and culturally diverse, McGill fosters unparalleled richness of learning, social and research experiences, and a truly global experience and outlook. Our students and alumni are a community of scholars that creates opportunities for Canadians to participate in distinguished intellectual, research, business, artistic, government and cultural collaborations worldwide. McGill's unique reputation brings prominence to Quebec and Canada. It is the top research-intensive institution in the country as ranked by the *Times Higher Education supplement*. The THES/QS declared McGill the number one Canadian university by global standards and number 12 among the top 200 universities ranked. Since the launch of these annual rankings in 2004, McGill has consistently improved from 24th in 2005 to 21st in 2006, to 12th in this year's rankings. This year, Harvard was again ranked number one in the world, with Oxford, Cambridge and Yale tied for second. Among the top 20, McGill ranked ahead of Duke, Johns Hopkins, Stanford and Cornell. Among other Canadian universities in the top 50, the next nearest two ranked 33rd and 45th.

Our mission is to be ranked, by all indicators, among the top 10 public research-intensive, student-centred universities in the world. This goal can be achieved *via* focused objectives, enhanced investment in high quality research and sustainable excellence of our academic programs.

Two centuries of history and a long-standing record of excellence have made McGill Canada's best-known university in the world. With 25% of non-Quebec Canadian students and 20% of non-Canadians coming from 160 countries, McGill is both the most national and the most international among G-13 institutions. Graduate students make up 22% of McGill's 33,523 students, the highest proportion among Canada's top ten research universities. Our faculty attracts increasing number of prestigious national and international awards and prizes. Only in the last year, Charles Taylor became the first Canadian to win the coveted Kyoto Prize in the category of Arts and Philosophy. Nahum Sonenberg garnered a prestigious Gairdner International Award, often referred to as a "mini-Nobel," which is given to the world's best medical scientists. Margaret Lock, was awarded the 2007 Social Sciences and Humanities Research Council of Canada (SSHRC) Gold Medal. Professor Michael Meaney, of McGill's Douglas Mental Health University Institute won the inaugural Alberta Heritage Foundation for Medical Research (AHFMR) Lougheed Prize, and Graham Bell was named one of three finalists for Canada's most prestigious science award, the \$1-million Gerhard Herzberg Canada Gold Medal for Science and Engineering. These very recent accomplishments are clear indicators of the talent and creativity of our professoriate.

Research Chairs (CRC) and Canada Foundation for Innovation (CFI) programs have played a major role in defining the status of Canadian research institutions on the world scene. Our country has shown the entire world how to invest successfully in discovery, innovation, and excellence for the new millennium. These programs have had invaluable impact on our activities. McGill University has just completed in-depth analysis of our strengths and aspirations, and developed a coherent and comprehensive plan to face the challenges of the next generation. We are in the middle of an ambitious process of academic renewal, hiring 100 new faculty every year since 2000 (by 2010 two-thirds of McGill faculty members will have been hired in the preceding twelve years). Of the 834 new professors joining McGill since 2000, nearly 60 per cent have been recruited from distinguished universities and research institutes outside Canada. Equipping these new faculty members with best available tools for highly productive research careers constitutes a primary concern. Therefore, the timing is crucial for McGill.

Our *Strategic Research Plan* builds on our tradition of excellence and forms an integrated part of our roadmap to the future. There is an extraordinarily rich variety of research done at McGill with areas of strength such as, nanoscience and nanotechnology, public health and policy, genomics and proteomics, neurosciences, astrophysics, molecular biology and cancer, health and environment, music and brain, pain, photonics, renaissance studies, and medical imaging, where we lead or compare with the very best in the world.

Major objectives of the McGill *Strategic Research Plan* are to:

- Enhance key research themes and create new research opportunities with high impact on the national and international scene;
- Stimulate novel multidisciplinary research interactions across disciplines and institutions thus contributing to development of innovative research and academic programs;
- Strengthen internationally competitive research and scholarship in highly promising emerging areas;
- Augment investment in areas of strategic importance enhancing our ability to attract, retain, and develop outstanding faculty, students, and research staff;
- Capitalize on the most effective use of research and scholarship resources maximizing the benefits of the full value of intellectual property and research commercialization;
- Encourage balanced diversity of our faculty by actively seeking best-qualified candidates from different social groups and genders.

Reaching these objectives will maximize our opportunities for discovery and innovation.

McGill does not exist in isolation, and indeed continually pursues collaborative initiatives with its university partners in Montreal - where the close proximity of the four universities is a unique advantage, with universities throughout Quebec, Canada, and abroad. We are committed to pursue the internationalization of our activities, a traditional trademark of our institution, but in parallel we are developing closer ties with local universities and every year sees an increase in our collaboration throughout Canada. As part of its social mission, McGill is strongly committed to enrich society with the results of our research through application and commercialization contributing to clear economic benefits and influencing best public policies.

Strengthening Foundations

Universities are grounded in a long tradition of reflection and enquiry going back centuries, indeed millennia, in areas such as philosophy and mathematics. McGill has been an active participant in this tradition for close to two centuries, and fully intends to continue to do so, in a way that engages its scholars in the deepest aspects of the world that surrounds us. Our faculty has been recognised in Canada and throughout the world, by prizes, awards and nominations to learned societies. This happens for a reason- an emphasis on quality.

The principle of reflection and enquiry is of course at the forefront in our development of the general area of the humanities and the social sciences. Subjects such as anthropology,

communications, economics, interfaith studies, languages and area studies, linguistics, literature (both English and French), music, political science, religious studies and sociology are basic to our mission and indeed are undergoing vigorous development, with new hiring reflecting the evolution of the disciplines themselves. The two areas of literature and music have the particular feature of combining study and scholarship with artistic creation and performance. The confluence of research with musical or theatrical performance ties in to the University's broader social mission. This is an aspect which the University will continue to encourage.

McGill has a long-standing tradition of legal scholarship; moving forward this will develop around the foundational priorities of legal traditions and comparative law and legal pluralism, with an emphasis on trans-systemic legal education and comparative legal theory, and a strengthening of ties to scholarship on ethical, social and economic issues.

In Faculty of Science, the core development is centered around the four themes of mathematical and computational sciences (mathematics, computer science, modelling, statistics, algorithms and optimisation), physical sciences (physics, earth sciences, chemistry), biological sciences (molecular and cell biology, developmental biology, neurobiology and behaviour, evolutionary biology, ecological biology) and social sciences (social and cognitive psychology, human geography).

Strengthening the foundations is a notion that is equally relevant to applied or professional faculties, such as Agricultural and Environmental Science, Education, Engineering, Management or Medicine, and each will continue to evolve and develop their respective strengths in this way. Throughout the University, free, fundamental enquiry has some of the most direct and transformative impact on the evolution of knowledge - seeing this through is vital to our mission.

Bridging Disciplines

We are living in exciting times: research themes reach across disciplinary boundaries, meld with each other, indeed often become new disciplines in themselves. The University has a strong interdisciplinary culture, and is developing various mechanisms for facilitating the development of these themes; the main method has been the fostering of research centres, which have a nucleating effect and allow interdisciplinary interactions to occur. The themes selected for particular development include:

C.1. Area, Period, or Group Studies

C.2. Social Impacts - Public and Social Policy

C.3. Health and Society

C.4. Risk and Finance

C.5. Media, Mind and Technology

C.1. Area, Period, or Group Studies

This traditional approach to multi-disciplinary scholarship retains much of its pertinence, as it encourages breadth of approach and scope. Several of these have been singled out for development: Canadian and Quebec studies, Jewish studies, Islamic studies, European

studies, and Renaissance studies, where the Making Publics (MaPs) initiative has attracted important support. McGill University leads this seminal interdisciplinary research inquiry – with an international team of over 30 scholars - into the creation of “metaphorical” maps of early modern society that aim to explain the development of a “massive, progressive, democratizing push into modernity.”

C.2. Social Impacts - Public and Social Policy Here, a wide array of deeply interconnected topics touch on philosophy, law, history, economics, political science, anthropology, sociology, and reach into education, medicine, and management. Subthemes include:

- **Diversity, development, ethics and human rights**- Two major initiatives going forward are the McGill Institute for Nations, Development and States, dealing with ethnic conflict, human rights, empires and their legacies, economics and development, and the McGill Centre for Human Rights and Legal Pluralism. In Education, areas of emphasis will be student diversity and inclusiveness in education, youth and gender identity, disability studies, and indigenous studies in education.
- **Religion and society**- This is the examination of the full spectrum of human activity from the viewpoint of religion, including social, ethical, legal, educational and medical issues.
- **Family, gender and sexuality**- In the Faculty of Arts, family and gender studies are an important priority. In parallel, the Faculty of Education has major initiatives underway on youth with physical and mental health risks, including research on HIV/AIDS education, as well as addiction behaviours related to substance abuse and gambling.
- **technology and society**- Technology has a profound impact on society, and the University is developing several initiatives in these areas. The Faculty of Law has launched the Centre for Intellectual Property, and management and information systems are a major theme in the Faculty of Management.
- **Public policy and the public domain**- This theme examines the foundation, the formulation, the tools as well as the impacts of public policy on questions such as wealth and corporate governance. This is one of the foci for research in Canadian and Quebec Studies. Another theme is trade, mobility and enterprise touching on economics, management and law; this notably examines issues of markets, responsibility and dispute resolution in the context of globalization.
- **Social statistics**- This theme, currently an area of strength at McGill, provides the factual basis for work in all of the preceding areas that touch on the social impacts of public and social policy.

C.3. Health and Society

A recent University-wide thrust has developed at McGill a “schola” of professors studying medicine and culture in the broadest sense, with input from economics, anthropology, sociology, public policy, philosophy, psychology, medicine, dentistry, biomedical ethics, trans-cultural medicine and language. Drawing on the expertise of four McGill-based Canada Research Chairs – Global Health and Social Policy, Social Statistics and Family Change, Psychosocial Epidemiology, and Population Health – in addition to the James McGill professor in Integrated Studies in Education and the Scientific Director of the Canadian Centre of Excellence Child Welfare, to name only a few key players, this initiative will lead to the creation of a University-wide Institute for Health and Social Policy, where the range of inquiry will include not only how individuals develop illnesses, but also how the cultural, economic, geographic and other environments contribute to and are determinants of health.

C.4. Risk and Finance

The University will build on a significant concentration of researchers in the Desmarais Centre, around the related fields of risk and finance, with a particular emphasis on the international dimension.

C.5. Media, Mind and Technology

The University is developing two major initiatives in this area, in quite distinct directions. In music, a major initiative is underway, the Centre for Interdisciplinary Research in Music, Media and Technology (CIRMMT), to examine the scientific and technological ramifications of the creation, production and perception of music, as well as its preservation, with input from psychology, neurology and engineering. CIRMMT is quickly establishing itself as one of the major centres of excellence in the science and technology of music, with a unique combination of scientists, technologists and musicians working in collaborative projects. In another direction, the general phenomenon of language is examined from a variety of viewpoints at our Centre for Research on Language, Mind and Brain. Topics covered include speech modelling and analysis, neural bases of language, visual language processing, and both first and second language acquisition. In Education, the development of a virtual in-context learning environment is an important priority.

From Basic Science to Application

A common feature of many multi-disciplinary research themes is that they span the full spectrum of basic science to applied research. This is a priority of our scholarly enterprise. Indeed, as the connectivity of this spectrum increases, basic scientists often are involved in the ultimate technological development of fundamental research. Shared infrastructure platforms that underlie many of these developments constitute an important feature of our plans.

D.1. Environment

D.2. Mathematical Sciences, Physical Sciences and Engineering in the Life Sciences

D.3. Biosciences and Biotechnology

D.4. Materials, Nano-Science and Nano-Technology

D.5. Infrastructure Planning and Engineering

D.6. Information Technology

D.7. Space Science, Astrophysics and Aerospace

D.1. Environment

This broad theme has interconnections and extensive resonance throughout the faculties of Agricultural and Environmental Sciences, Law, Science, and Engineering, and embodied in the McGill School of Environment. Priorities include i) earth system science: an integrated approach, touching on global cycles, climate variability and change, with a new Green Crop Network and a plan for a Montreal Earth Observatory; ii) water resource management, environmental technology in remediation of contamination of drinking water or of aquifers; iii) ecology: ecology and conservation biology, biodiversity, ecoinformatics, complex ecological systems, long-term change; iv) human-environment interaction: sustainable development, green crops, sustainable forest development, green chemistry and more generally production systems and the environment; v) soils, land use and land cover change vi) clean energy systems: alternate energy conversion and exchange devices; vii) healthy

buildings and environments; and architectural and urban design for sustainable development.

D.2. Mathematical Sciences, Physical Sciences and Engineering in the Life Sciences

There have been major developments in the past few years, as exemplified by the crucial role that bioinformatics played in the human genome project. Priorities include: i) bioinformatics, and more generally, mathematical modelling and inference in the life sciences, in particular large data sets, tying in to the Genome Centre; ii) bio-systems engineering, building on expertise in imaging, signal processing, analysis and artificial intelligence; iii) computational biomaterials: computational modelling, multi-scale tissue mechanics, simulation; iv) biomedical devices; v) tissue engineering.

D.3. Biosciences and Biotechnology

Again, the basic science in genomics, proteomics and metabolomics is being translated into major advances in areas such as food production, food safety, nutrition, parasitology, plant science, animal science, microbiology and bioresource engineering. This is a major theme of development in Agriculture and Environmental Sciences, indeed one of the two foci for the development of the Macdonald campus.

D.4. Materials, Nano-Science and Nano-Technology

Materials science is one of the major growth areas in science and technology, with extensive applications in engineering and in the biomedical sector. McGill has invested quite massively in the area, and will continue to push this development. Over twenty new faculty members, half of whom are Canada Research Chairs in nano-science and nano-technology related fields have recently been hired. The basic science includes both questions of synthesis and characterisation, and involves an extensive use of electron microscopy, scanning probe microscopy, MRI/NMR, micro-machining, advanced spectroscopic analyses, as well as intensive computing.

New materials and nanotechnology are a major area of growth in engineering, with an emphasis on next-generation materials, materials at interfaces, aqueous-based processing of materials, light alloys, micro-electronic and micro-electromechanical systems, new manufacturing and repair techniques for aerospace, new semi-conductor materials and devices, and advanced construction materials.

One of the most exciting areas for development is that of biological and biomedical applications of nanotechnology and material science, with an emphasis on biosensors and biomaterials, drug delivery, bone growth and bone repair, and neuro-engineering.

D.5. Infrastructure Planning and Engineering

The major (urban and other) infrastructure renewal looming on the horizon is prompting research on infrastructure planning and engineering. Areas include i) safety risk analysis, design and rehabilitation of critical infrastructure, ii) water resources infrastructure, through McGill's Brace Centre iii) transportation planning and smart infrastructure.

D.6. Information Technology

With a strong base in theoretical computer science (a group of world renowned strength, with a recent Killam prize winner), themes covered include artificial intelligence and systems,

robotics (Centre for Intelligent Machines), communications, bioinformatics; geographic information science; and software engineering. In addition, significant new efforts are underway via the recently formed Centre for Advanced Systems and Technologies in Communications. Themes include intelligent signal processing, broadband transmission (including all-agile photonics networks) advanced networks, and communications software

D.7. Space Science, Astrophysics and Aerospace

McGill has considerable strength in astrophysics, space science and aerospace engineering. The astrophysics group has launched an ambitious satellite initiative building links with NASA, which will reinforce its expertise in experimental space science. McGill is the university in Canada with the greatest concentration of high-energy physicists – supported by a core of newly-recruited world-class Canada Research Chairs and institutional Macdonald Chairs.

Health and Life Sciences

The health sciences at McGill exhibit in themselves the full range of scientific endeavour outlined above, from basic science through to implementation, and indeed more strongly due to the collaboration with the health professionals of our affiliated research hospitals, who oversee the development of treatments and their implementation at the clinical level.

The health sciences have always been one of McGill's great strengths, and a top priority is to build on these strengths and push the boundaries of discovery even further. Indeed, at McGill, the health sciences are not uniquely the purview of the Faculties of Medicine and Dentistry; as outlined in previous sections, there is a strong base in Science, Engineering and in Agriculture and Environmental Science, as well as important ties with some areas of inquiry in the Faculties of Arts, Education, Law, Management and Music.

The following section outlines broad scientific themes and clinical strategies, which are linked by transecting core facilities and which form the basis of the health and life sciences component of the strategic research plan.

E.1. Basic Life Science Themes

E.2. Integrative Themes

E.3. Clinical Research and Health Care Delivery

E.4. Integration into Hospital Research

E.1. Basic Life Science Themes

With roots in chemistry, biochemistry and biology, the basic life sciences have undergone over the past few years a “molecular and genetic” revolution, thanks to the vast expansion of genomics, proteomics and other attendant techniques. The new Life Sciences Complex has led to a redesign of the concept of research in the area, in particular with research being organised not along departmental lines but in accordance with certain themes. This \$80M investment, with an important CFI contribution, aims to tighten the complex web of interaction between campus-based researchers and hospital-based clinicians and to encourage trans-disciplinary approaches to the study of myriad aspects of the health and life sciences universe. The themes include:

E.1.1. Structural and chemical biology

E.1.2. Cell and development biology, and evolution

E.1.3. Integrative genomics; epigenetics

E.1.4. Cellular and organismal information systems

E.1.5. Molecular medicine and medical genomics-complex traits

E.1.1. Structural and chemical biology-This thematic area refers to work in protein structure and function, and includes proteomics, the cataloguing and functional characterization of the entire repertoire of organellar and cellular proteins, and the delineation of their three-dimensional structures. An appreciation of how proteins are arrayed in cells will enhance our appreciation of molecular function, including such aspects as protein-receptor interactions, and the opportunities these provide for drug design and therapeutics. In chemical biology, the emphasis is on the design and testing of small molecules with powerful biological effects. These are relevant as probes for biological systems and as starting points for rational drug design. McGill has recruited new faculty members in structural and chemical biology - with plans to recruit more – including Canada Research Chairs in physiology and structural biology.

E.1.2. Cell and development biology, and evolution- A new Centre for Developmental Biology has reorganised facilities in the area. An emphasis is placed on the biological functionality of genes and proteins identified in high-throughput projects. In evolution, links from micro evolution to macro-evolution are developed, combining fields as disparate as developmental genetics and paleontology.

E.1.3. Integrative genomics; epigenetics- This area is concerned with the full understanding of the link between genotype and phenotype, including the understanding of variation and environment-genome interaction. An recent important McGill success was its role in the International Haplotype (HapMap) Project, the first comprehensive catalogue of human genetic variation, that will offer crucial insights into the genetics behind such common diseases as asthma, cancer and diabetes. Particular attention will be paid to behavioural biology and genetics, that is, the study of gene expression and regulation in behaviour and cognition, and the burgeoning field of epigenetics, following on recent ground-breaking work at the Douglas Hospital.

E.1.4. Cellular and organismal information systems- Building on a long tradition of analytic work, the approach here is integrative, and synthetic, focussing on the information and networking systems that underlie intra-cellular physiology. The application is not only to eukaryotic cells, but to the various microbes and parasites that infect them.

E.1.5. Molecular medicine and medical genomics-complex traits- The focus at the molecular level of endeavour is to apply genetic, structural and even environmental research to disease, host resistance and host-parasite interaction, drug design and drug receptor interactions. This approach is simultaneously being pursued at McGill in oncology and cancer genetics (see below), the biological base of chronic disease, major psychiatric syndromes, inflammatory bowel syndrome, metabolic bone and connective tissue biology, asthma, diabetes, host-pathogen interaction and infectious disease pathogenesis, and inflammatory and auto-immune diseases.

E.2. Integrative Themes

Several of McGill's greatest strengths in the health sciences extend out from the basic sciences out into important clinical research. Strengthening this translational chain is an important priority.

E.2.1. Cognitive, biological and behavioural neurosciences

E.2.2. Pain and palliative care

E.2.3. Host-pathogen interactions and infectious disease pathogenesis

E.2.4. Cancer

E.2.5. Rehabilitation medicine

E.2.6. Bone and periodontal research

E.2.7. Cardiovascular research

E.2.8. Inflammation and the immune system

E.2.9. Nutrition

E.2.1. Cognitive, biological and behavioural neurosciences-The field of neurosciences, from molecular to clinical studies is one of McGill's primary, indeed one of its world-leading, strengths, with two major institutes (Montreal Neurological Institute and the Douglas Hospital Research Centre) and significant presence at the McGill University Health Centre (MUHC), and in the departments of physiology and psychology. The research themes moving forward include neuroengineering, neuropsychology, neuronal regeneration and stem cells, muscle cell biology and its pathologic expressions, neuroimmunology, in particular multiple sclerosis, neurological tumours and the use of advanced imaging techniques to understand brain function.

The development of research on behaviour takes root in the neurosciences and extends its reach outward in a rich, transdisciplinary fashion. A primary example is the initiative in language, mind and brain, referred to above. Further, in the Faculty of Medicine, one approach will be to group a series of developments under the rubric of behavioural medicine, itself a construct of the interaction between genomics and cognitive neuroscience. Extending into all aspects of neurosciences, thematic groups in psychopharmacology, bi-polar illness, schizophrenia, suicide research, sleep and eating disorders have been developed to explore the major psychiatric illnesses of modern society. In the Faculty of Education, on a parallel track, an emphasis is being developed on childhood development disorders.

E.2.2. Pain and palliative care- With leaders in the field at McGill, this traditional strength is being expanded, in particular via the McGill Pain Centre, and collaboratively through aFonds de la recherche en santé du Québec (FRSQ) Pain Network, to focus on both the fundamental neural pathways of pain and on the clinical applications in palliative care.

E.2.3. Host-pathogen interactions and infectious disease pathogenesis-The traditional study of microorganisms as distinct from their hosts has been supplanted by research aimed at deciphering the delicate balance between the pathogen and the infected organism. McGill has world-leading strength in the area, in particular through its Institute of Parasitology, and will build on it.

E.2.4. Cancer-This is a major research priority at McGill, with some of its leading researchers; it is an area in which it leads in the Canadian scene, and in which it intends to remain so in a

full range of aspects of the field: animal models, signalling and chemical biology, novel therapeutics, and prevention and genetics. The Oncology sector regroups the fundamental molecular and animal model approaches of the Molecular Oncology Group of the MUHC and the Cancer Centre, and the more clinical and translational research approaches at the Jewish General Hospital, the MUHC and other McGill affiliated hospitals.

E.2.5. Rehabilitation medicine- This research area has a timely focus on an area with ever growing needs, in particular due to an aging population, and includes additional emphasis on chronic illness.

E.2.6. Bone and periodontal research- This is an area with substantial strength at McGill, in both Medicine and Dentistry, with important ramifications in materials research. It has been expanded considerably in recent years through the development of the Bone Centre, funded by Valorisation-Recherche-Québec (VRQ).

E.2.7. Cardiovascular research- This is an area of rapidly growing strength at McGill, with an integrated effort on the part of the University and the Jewish General Hospital.

E.2.8. Inflammation and the immune system- This is a central area, with world-leading strengths located at the MUHC (immune mediated inflammatory disorders), at the Meakins-Christie laboratories (respiratory inflammatory diseases) and the Jewish General Hospital (AIDS).

E.2.9. Nutrition- Through original initiatives covering both Medicine and Agricultural and Environmental Sciences, research across this spectrum will witness an integration of knowledge from traditional biochemical and endocrinological aspects of nutrition with the study of behaviour.

E.3. Clinical Research and Health Care Delivery

In the context of the evolution of our population and the increased costs of health care delivery, the study of the effectiveness of health care interventions is particularly relevant. This research typically takes the form of therapeutic clinical trials, but also includes an important methodological basis.

E.3.1. Clinical trials and epidemiology

E.3.2. Psychological epidemiology

E.3.3. Multimodal imaging, minimally invasive surgery and interventional radiology

E.3.4. Reproductive medicine

- **E.3.1. Clinical trials and epidemiology-** Building on the considerable expertise at McGill in this area, a program in clinical trials design and analysis is being developed with particular attention to the question of public health in the face of emerging infectious diseases. The new area of medical informatics and health care delivery, interfacing with management, is also being developed. The aim is to determine the most effective use of clinical and epidemiological data in both population and individual interventions, and to examine the delivery of health care to the population.

- **E.3.2. Psychological epidemiology-** This trans-disciplinary approach is aimed at understanding the impact and mechanism of the social and psychological state on human well-being. This forward-thinking endeavour will necessitate a broadening of the traditional methodologies common to biomedical research and will entail cross-campus collaborations.
- **E.3.3. Multimodal imaging, minimally invasive surgery and interventional radiology-** McGill has a strong group in the art and science of imaging, in particular in brain imaging, and more generally is active in the application of technology to medicine. The application of multimodal imaging, in real time, has great potential for the development of minimally invasive surgery.
- **E.3.4. Reproductive medicine-** This is a field in which McGill has made pioneering contributions and where its researchers are well-positioned at the crossroads of the biology of reproductive cells, rapid technological innovation and “high-impact” clinical medicine.

E.4. Integration into Hospital Research

McGill’s research hospitals reflect these research priorities in their own research plans, often in a more disease-specific way. The MUHC Research Institute focuses on cancer, cardiovascular disease, disability and improvement of the quality of life, endocrinology, metabolism and nutrition, infection, inflammation and immunity, neuroscience and mental health, respiratory and critical care, women’s health, reproduction and child development. The Lady Davis Institute for Medical Research at the Jewish General Hospital will be concentrating its strengths in aging, cancer, AIDS, and hemo-vascular medicine. The Douglas Hospital will be developing its specialty in the areas of mental health and neuroscience.

Canada Research Chairs

Alone among Canada’s major research universities McGill has allocated all of its Canada Research Chairs externally, using them as a tool in recruitment, with a separate chairs program created for retention purposes. The allocation of chairs has been made in support of the research plan, and this will continue to be the case. Our foremost priority is to recruit candidates of the highest calibre, and as the latter are not simply available on command (in particular in international recruitments) some flexibility will be necessary in the allocation process, with chairs being allocated only once a particularly talented recruit has appeared on the horizon.

Research Space

Even with new buildings (Shulich Music, Bellini Life Sciences, Cancer pavillon) coming on stream, McGill is still dramatically short of research space, and developing the necessary space either through renovation or construction is a major issue. This is all the more evident with the recruitment of new faculty.. In the medium term, there are two facilities being planned on the main campus -Arts and Allied Health - and, eventually, another at Macdonald, which will have significant, though not exclusive, research components; indeed, a feature of our development is that research and teaching are intimately linked.

The MUHC redevelopment project is underway at the Montreal Glen Yards site, and the construction of the concomitant new MUHC research institute (the Centre for Innovative Medicine) is the highest priority. The CIM will provide a solution to one of the key problems - fragmented infrastructure - responsible for the two major stumbling blocks in the biomedical

research continuum, namely (i) the translation from basic science to human studies and (ii) the translation of new knowledge into action in clinical practice and health policy-making.

These questions are also being addressed in McGill's other main research hospitals, by the translational population based research facility of the Lady Davis Centre for Medical Research at the Jewish General Hospital, and by a new proposed facility at the Douglas Hospital Research Centre.

Equipment and Research Infrastructure

New faculty- With significant recruitment underway, the equipping of new faculty is a major priority and we aim to ensure that highly qualified people can be working in fully operational laboratories upon their entry to McGill.

Major infrastructure platforms- Much of modern research requires expensive infrastructure, which, from an institutional perspective, should be shared for optimal use. Coordination plans are in place or in development for several major infrastructure platforms. It should be emphasized that this does not necessarily imply that all the equipment of a given type will be located in one place, but rather that the fleet of current resources and any plans for the acquisition of new equipment will be tightly coordinated. These platforms are, of course, often interrelated. They include:

H.1. Imaging, at all Scales

H.2. Biotechnology

H.3. Genomics-Proteomics

H.4. Phenotyping

H.5. Animal Models

H.6. Materials and Nanotechnology

H.7. Intensive Computation, Simulation and Visualisation

H.8. Environmental Facilities

H.1. Imaging, at all Scales

The use of imaging techniques permeates science and medicine, and the tools required are complex and expensive, so that sharing is now a necessity. One such example, at the very small scale, is the McGill Facility for Electron Microscopy Research, which combines a good number of the campus' devices in selected locations. We are planning to add to it a cryo-microscopy facility, which will greatly expand the range of microscopic imaging available to our faculty. On the human and animal scale, imaging, and in particular brain imaging, will need improvements and upgrades as the McConnell Brain Imaging Research facility comes on-line.

H.2. Biotechnology

The provision of generic services in this area, whether on a large scale adapted to the needs of the Agriculture and Environmental Science, or on a smaller scale required in the Medical and Science faculties, is an ongoing concern. For the latter, the Sheldon Biotechnology Centre has been and will continue to be a mainstay.

H.3. Genomics-Proteomics

Improvements in technology have enabled standard sequencing equipment to be located in many laboratories; next to this, there is a strong and growing need for high throughput or specialized genomic or proteomic services, as provided by the McGill Genome Quebec Innovation Centre, a Quebec-wide facility, which has had a central role in our development.

H.4. Phenotyping

There is a clear need both on campus and at the research hospitals for the creation of phenotyping facilities, in order to understand the way the genome is expressed and to make the best possible use of genetic information. This research platform, although distributed throughout McGill, will be coordinated for optimal use between research groups.

H.5. Animal Models

The use of animal models in human diseases is reaching all fields of biomedical research and it is a key priority for the university. In particular, the mouse, through its genetic malleability, is an essential tool to study the normal process of biological system organization and development, to comprehend the ontogeny, progression and treatments of a broad number of genetic diseases, and to assess the clinical potential of small molecules discovered through chemical biology activities. This is recognized in particular by the University's role as the lead institution in the *Réseau de recherche en transgénése du Québec*.

H.6. Materials and Nanotechnology

A major inter-institutional platform in fabrication is based at McGill (Nanotools), and it will need upgrades. The McGill Institute for Advanced Materials (MIAM), which coordinates efforts in the area, also wants to develop its characterization facility. Another important installation is the Regional High Field NMR facility.

H.7. Intensive Computation, Simulation and Visualisation

The advent of large scale simulation and modelling, in science, engineering, and the life sciences has made the availability of well-adapted, up-to-date computing resources a constant preoccupation. Advanced tools for simulation are a necessity; associated with these tools is a host of needs particular to this level of computation, as well as a requirement for visualisation tools. Our central High Performance Computing facility (part of CLUMEQ) is to be developed and expanded.

H.8. Environmental Facilities

McGill has a number of quite priceless research assets in the form of field stations, including the Gault reserve at Mont Saint-Hilaire, the Morgan arboretum on the western tip of the island of Montreal, the McGill Doppler radar in Dorval and others at remote locations such as the Subarctic Research Facility in northern Quebec. Much remains to be done for their optimal exploitation, in particular ensuring they are outfitted with modern sensing equipment. In a similar vein, the Redpath museum should be attached to a modern research facility for the study of evolution, with linkages to science, medicine, and education.