

## **Research for a Brighter World**

### **McMaster University's Strategic Plan for Research 2018-2023**

At McMaster, research is a living, breathing entity. It elevates the student experience, energizes our faculty, and stimulates the kind of original thinking that has made McMaster a national leader in research excellence and earned us a place as one of the top 100 universities in the world. From becoming the first university in the Commonwealth to house a nuclear reactor to our radical notion of problem-based learning and evidence-based medicine that revolutionized the way health professionals learn and practice, McMaster's outstanding researchers have had extraordinary success in achieving outcomes that have deep- and far-reaching impact on health, prosperity, and the future of our planet.

#### **Key Objectives**

In the spring of 2011, McMaster University released a document that would serve as a calling card for the next chapter of our illustrious history. Titled *Forward with Integrity*, it reaffirmed McMaster's commitment to strengthening the excellence of our research while, at the same time, seeking opportunities to integrate research more purposefully into our academic mission.

Since then, we have been engaged in an institution-wide process that has brought faculty, staff, and students together to review our research mission in detail. The goal was not merely to preserve McMaster's enviable position as a Canadian research powerhouse, but to ensure that we continue to make a difference—in the competitiveness of our researchers, in the quality of our teaching, and in the impact we have on the world around us.

*Research for a Brighter World – Strategic Plan for Research 2018-2023* lays out a vision and plan to bolster McMaster's research mission and to take our institution's research excellence to an even higher level by:

- Recruiting and retaining researchers and trainees of the highest calibre;
- Building on our strengths and capitalizing on our interdisciplinary capacity;
- Promoting a deeper understanding of the importance of equity, diversity and inclusion to strengthen our research programs and teams;
- Ensuring that Indigenous ways of knowing are recognized as valid forms of research;
- Encouraging a broad range of research approaches and methodologies;
- Promoting knowledge mobilization and translation, technology transfer, and commercialization to maximize the benefit of research to society;
- Fostering collaboration with national and international academic, hospital, government, community and industry partners; and
- Providing trainees and early-career researchers with innovative research, mentoring and training opportunities.

#### **Core Values**

McMaster's commitment to research excellence is informed by a set of core values from which we will not waver:

- We insist on ethics, equity, and excellence in scholarship in all research programs;
- We regard the work of educating students, and of extending the boundaries of knowledge through research, as inseparable and mutually reinforcing activities;
- We recognize that fundamental research is essential to scientific discovery and advancement;
- We conduct research that advances society, using the best practices and cutting-edge technologies available to us;
- We support collaborative work and thinking across Faculties and disciplines as an essential driver of innovation;
- We partner with hospitals, governments, institutions, community organizations and businesses locally, nationally, and globally to share resources and expertise, solve complex problems, spur economic growth, and create a more skilled workforce;
- We share our knowledge widely to help shape policies and practices that will strengthen communities and improve lives in Canada and around the world.

## **Strategic Initiatives to Meet Complex Challenges**

Adhering to our core values and objectives, we have identified the following eight cross-disciplinary and interrelated themes, which will galvanize our research and training efforts in the years ahead.

**Addressing the Growing Burden of Chronic Disease:** Chronic diseases are a growing burden on our health care system. A leader in advancing bench-to bedside-to-community research, McMaster has amassed an enviable corps of outstanding scientists—in genomics, immunology, microbiology, medicine, population health, health policy, and biostatistics—who are characterizing the relationship between disease development and our fundamental biology, genetic make-up, environmental exposures, and social conditions. Their efforts are enabled by world-class research facilities, including the McMaster Institute for Molecular Biology and Biotechnology, the Farncombe Family Axenic-Gnotobiotic Facility, the Biointerfaces Institute, and the Fraunhofer Project Centre for Biomedical Engineering and Advanced Manufacturing.

Fundamental scientists in our Centre for Metabolism, Obesity and Diabetes Research and Stem Cell and Cancer Research Institute are making great strides in understanding the genesis of diseases like diabetes and leukemia. Our translational scientists, such as those in the Farncombe Institute, have deep experience with first-in-human studies, enabling the evolution of promising new discoveries. Hospital-based institutes, like the Firestone Institute for Respiratory Health and the Thrombosis and Atherosclerosis Research Institute, bridge the divide between basic discovery and clinical implementation.

The Cochrane Canada Centre and the Health Information Research Unit are internationally recognized for their cutting-edge approaches to the development of evidence-based resources and tools that define best clinical practice. Health policy and community-based researchers in the Escarpment Cancer Research Institute and the McMaster Health Forum work with governments and communities to optimize timely access to and delivery of health care. As well, the Michael G. DeGroot Institute for Pain Research and Care is developing new strategies for the treatment and prevention of chronic pain.

Among our greatest strengths in the battle against chronic disease is our ability to conduct population-level studies through, for example, the Population Health Research Institute and the Population Genomics program, that provide crucial evidence of health outcomes. Our world-leading cohort studies are central to our understanding of the onset, progression and outcome of chronic diseases. McMaster-led cohorts such as the Canadian Longitudinal Study on Aging, Prospective Urban and Rural Epidemiological Study, and the Canadian Healthy Infant Longitudinal Development birth cohort, provide critical data to maximize prevention, treatment and management of the most challenging chronic diseases.

**Advanced Materials and Manufacturing:** Success in today's fast-paced, consumer-driven, global environment requires innovative approaches to manufacturing and the development of new materials. It depends on rapid technology transfer through every link of the supply chain, from materials selection to product performance.

McMaster has exceptional expertise in materials and manufacturing research, and is leading the way in fields such as nanotechnology, ecohydrology and biomaterials. Indeed, McMaster was the federal government's first choice when it decided to relocate Canada's premier materials laboratory, CANMET-MTL, to McMaster Innovation Park, a hub for transformational research and new start-up companies. We have established state-of-the-art research facilities to provide researchers, trainees, and their partners with the infrastructure that they require to achieve their research goals. This includes the McMaster Automotive Resource Centre, the McMaster Manufacturing Research Institute, the Centre for Advanced Nuclear Systems, and the Brockhouse Institute for Materials Research – home of the Canadian Centre for Electron Microscopy, one of the leading electron microscopy facilities in the world.

Our internationally recognized researchers and facilities have been instrumental in developing a regional supercluster on Advanced Manufacturing for Southwestern Ontario, and play an integral role in a tri-university Advanced Manufacturing Consortium that will increase Ontario's capacity to compete globally in emerging areas such as next-generation additive manufacturing and digital components and devices.

**Aging Across the Life Span:** In Canada, as in many other areas of the world, a dramatic demographic shift is underway. Canadians aged 85 and over are now the fastest-growing segment of the population, making the study of aging more important than ever before. At McMaster, more than 100 faculty members and post-graduate students from disciplines as diverse as gerontology, biology, psychology, rehabilitation science, business, and sociology are examining the phenomenon and science of aging from every angle.

McMaster is the headquarters of the Canadian Longitudinal Study on Aging – a Canada-wide, long-term study that will follow 50,000 Canadians aged 45 and above for at least 20 years with the goal of finding ways to help Canadians live long and well. We have also established several interdisciplinary research centres with a focus on aging, including the Labarge Optimal Aging Initiative, the Labarge Centre for Mobility in Aging, the Gilbrea Centre for Studies in Aging, the Aging, Community and Health Research Unit, and the McMaster Institute for Research on Aging. They are designing smart cars for older drivers and smart homes that can alert health professionals to the first signs of Alzheimer's or diabetes, and considering how information and communication technologies can best be designed to support the needs of older adults and improve their quality of life.

Critical to any study of aging is an understanding of how early childhood development influences health and well-being across the lifespan. To improve this understand, together with our hospital partners, researchers and trainees affiliated with McMaster's Offord Centre for Child Studies, the CanChild Centre for Childhood Disability Research, and the Metabolism and Childhood Obesity Research Program, among others, are working to advance prenatal and infant health development locally and around the world.

By blending scientific expertise and medical advances with social insights, engineering acumen, and exceptional facilities, including the McMaster Physical Activity Centre of Excellence, the McMaster Digital Transformation Research Centre, and the Large Interactive Virtual Environment (LIVE) Lab, McMaster researchers and trainees are leading the way with innovative solutions designed to foster active and healthy populations across the lifespan. In addition, researchers in finance and social sciences are devising new strategies to ensure that financial literacy and savings meet the challenges presented by the longevity revolution.

**Data, Artificial Intelligence and the Digital Society:** The benefits of 'big data' for our society are vast. We can measure and manage data more precisely than ever before, and use those data to make more informed decisions.

McMaster researchers and trainees within and across every discipline are working with enormous datasets in innovative ways to better understand how the digital revolution is impacting individuals and transforming organizations, economies, and society at large. They are scrutinizing individual genomes to revolutionize patient care with tailored treatments and novel therapeutic discoveries, assessing how to govern the acquisition and use of big data, improving vehicle reliability, safety, and fuel economy, redesigning rail safety processes, and studying the properties of stars.

Advances in data management and analysis are being made and used by researchers and trainees within several of McMaster's interdisciplinary research centres and facilities, including MacDATA, the Computing Infrastructure Research Centre, the McMaster Digital Transformation Research Centre, the Statistics Canada Research Data Centre, and the Public Economics Data Analysis Laboratory, to create smart energy meters for homes, assess energy consumption patterns, examine the functions of and map changes in our brains, and help banks, retailers, and other companies provide better customer service. They are engaging with researchers across the institution, as well as with industry, government, and the community, to address a broad range of issues and strengthen our position as an international leader on all matters related to data and digital transformation.

**Environment and Energy:** The devastating impact of climate change can be seen everywhere—on human health, ecosystems, economies, our natural resources, the ways we live and work, and, ultimately, the future of our planet. Since complex challenges require a multi-faceted approach, our researchers are active in collaborative networks locally, nationally, and globally that bring innovators and policymakers together to forge solutions with real impact.

From the Dofasco Centre for Engineering and Public Policy, FloodNet, and the McMaster Institute for Transportation and Logistics to the McMaster Centre for Climate Change, the United Nations University Institute for Water, Environment and Health, and the Global Water Futures program, McMaster researchers are engaged in both the technical and policy aspects of Great Lakes cleanup, flood forecasting and management, reducing emissions, and the global water crisis.

Interest in clean energy sources has also led to a resurgence of interest in nuclear power as a means to generate electricity, and as the Canadian university with the most powerful research reactor, our researchers are world-leaders in nuclear safety and radioactive waste management. The reactor also provides isotopes that allow researchers to detect key nutrients in crops—improving agricultural productivity and food security in an era of climate change.

Our strong collaborative networks and unique research facilities, including the McMaster Nuclear Reactor, and the Gerald Hatch Centre – a living energy systems laboratory, have opened up an exciting world of opportunities for our researchers and are enabling them to carve out a more optimistic vision for our planet.

**Equitable, Prosperous and Sustainable Societies:** The 21<sup>st</sup> century is witnessing a complex array of forces: fast-paced technological innovation, globalization, economic restructuring, social inequality, regional conflicts, and international migrations. This is creating enormous challenges for our political institutions, restructuring economic relationships, generating social upheaval, transforming the content, meaning, and role of work in our lives, and posing urgent questions of justice and equity.

Within our interdisciplinary institutes, centres, and facilities, including the Centre for Community-Engaged Narrative Arts, the Bertrand Russell Research Centre, the Institute on Globalization and the Human Condition, and the Centre for Peace Studies, researchers and trainees are engaging with local, national, and international partners to broaden our understanding of, and develop innovative approaches and methods to addressing, these profound issues.

**Indigenous Knowledge and Research:** Indigenous research approaches that take into account Indigenous Knowledge and methodologies that are grounded in Indigenous history, practices and ways of knowing are increasingly being recognized as valuable approaches to exploring and developing innovative solutions to local, national, and international concerns.

Established in 2016, the McMaster Indigenous Research Institute aims to support interdisciplinary research and serve as a gateway to partnership building with Indigenous research collaborators across the University, within the region, and around the world through the sharing of research expertise, helping advance understanding of working by and with Indigenous communities, and by bringing together faculty and researchers across multiple disciplines. This world-class facility facilitates and promotes increased visibility of Indigenous Knowledge and methodologies; creates space for dialogue between Western research approaches and Indigenous research collaborations; and supports Indigenous and non-Indigenous researchers and decision makers in the area of Indigenous research.

**Understanding and Responding to Infectious Disease:** Infectious diseases are the leading killer of children and adolescents worldwide, and one of the leading causes of death for adults. Globalization, increased drug resistance, and climate changes are compounding the problem. Over the past two decades, we have established an impressive group of world-class researchers from around the globe—experts in the social determination of infection, emerging infections, bacterial immunology and the study of bioactive small molecules—who are bridging the divide between basic research and the clinic and community to develop life-altering drugs, vaccines, and prevention strategies, and working to address ethical challenges associated with global health and development.

McMaster's Michael G. DeGroote Institute for Infectious Disease Research has become a magnet for the next generation of infectious disease specialists, fostering groundbreaking research in antibiotic resistance mechanisms, new drug discovery, and innovation in therapeutic alternatives to antibiotics. Researchers within the McMaster Immunology Research Centre are designing universal flu vaccines and running clinical trials on new TB vaccines.

Key to these successes are McMaster's world-class facilities, including the Centre for Microbial Chemical Biology, a Biosafety Level 3 lab, and the Robert E. Fitzhenry Vector Facility - a certified Good Manufacturing Practices facility for clinical drug production. Together, these facilities have positioned McMaster as an internationally recognized centre for excellence and allowed our researchers to develop better science and translate it into new products, changes in clinical practice, and innovative community supports and policies.

### **Planning for Success**

Informed by the strategic priority areas identified in *Research for a Brighter World – Strategic Plan for Research 2018-2023*, each Faculty has identified its own areas of focus. Together, institutional and Faculty strategic directions guide the University's pursuit of, and investment in, research and training opportunities, including those afforded by partnership and strategic programs, such as the Canada Research Chairs (CRC), Canada Foundation for Innovation (CFI), Ontario Research Fund, and tri-agency initiatives.

The research areas to which appointments are made through CRCs, as well as other Chair investments, reflect ongoing planning guided by institutional objectives and Faculty priorities. CRCs are allocated to Faculties proportional to the funding secured by each faculty from relevant tri-agency programs. Each Faculty develops a plan to allocate CRCs in accordance with identified research thrusts, with plans reviewed and endorsed at the institutional level. Flexibility is built into this CRC process to allow for emerging opportunities that arise throughout the life of the program. Nominations for faculty with clinical or cross-appointments with affiliated teaching hospitals are consistent with established mutual priorities. External recruitment for clinical faculty is performed in conjunction with clinical program leaders and in consultation with the relevant teaching hospital. In accordance with our core values, McMaster is committed to actively seeking qualified candidates from under-represented groups and, as outlined in our CRC Equity, Diversity and Inclusion Plan, is taking steps to address any imbalances that may occur throughout our CRC nomination and renewal processes.

Critical to recruiting, retaining and supporting excellent researchers is the establishment of world-class infrastructure, including research platforms with specialized equipment and technical expertise. From department-based laboratories to suites of equipment housed within centres and institutes to state-of-the-art national research facilities, we have supported research platforms which provide our researchers the cutting-edge methods and tools required to impact their fields of research, and enhance Canada's national research landscape. Support from the CFI and the Province of Ontario has facilitated the establishment of research infrastructure and spurred several multi-institutional initiatives. Institutional priority for CFI and provincial applications is given to research programs that most closely align with one or more of McMaster's strategic directions and take into account federal and provincial science and technology priorities.

We will maximize training and knowledge transfer opportunities provided by tri-agency initiatives, such as the NSERC Collaborative Research Education and Training Experience program, which will allow us to develop innovative, high-quality, and interdisciplinary research and training programs in institutional areas of strategic priority and thereby recruit the highest quality personnel from around the world. We will support applications to the NSERC Strategic Partnership Grants programs which enhance our knowledge and technology transfer and commercialization efforts by enabling and strengthening collaboration with our industry partners.

Planned pursuit of these and other opportunities, guided by our strategic priorities, will enable us to build on our areas of research strength, enhance our research training programs, and build strategic partnerships, and, ultimately, advance human and societal health and well-being.

### **Measuring for Success**

It is critically important that we monitor our progress as we work to build on our world-leading research enterprise. To that end, at the department, Faculty, and institutional level we will regularly evaluate our research and training programs through self-study, including reviews led by internal interdisciplinary councils and committees, as well as evaluation by external experts. These studies will allow us to measure the results of our efforts, monitor our progress, and compare ourselves to peer institutions.