University of Manitoba | Faculty of Science

STRATEGIC RESEARCH PLAN

2024 - 2029

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Contents

01 Traditional Territory Acknowledgement 3

02 A message from the Dean 4

03 Our research strengths and future directions 5

04 Our current strengths 6

- Sustainable environments and preserving biodiversity 6
- Data science, modeling, computing and analytics 6
- Green technologies, advanced materials and sensors 7
- Health, disease and therapeutics 7
- Interactive networks, complex interactions and autonomous agents 8
- Energy, matter and the universe 8

05 Our future directions 9

- Fundamental science 9
- Environmental sustainability 10
- Information and data technologies for a changing world 10
- Enabling responsible northern development 11
- Enabling technologies for improved human and animal health 12
- Food and water sustainability 12

01 Traditional Territory Acknowledgement

The University of Manitoba campuses are located on original lands of Anishinaabeg, Ininiwak, Anisininewuk, Dakota Oyate and Dene, and on the National Homeland of the Red River Métis.

We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of Reconciliation and collaboration.

During the historical Indigenous science tour at The Forks where the Treaty Relations Commission of Manitoba was also discsussed.

02 A message from the Dean

The University of Manitoba Faculty of Science has a proud history of curiosity-driven research that has advanced our understanding of the natural world, driven innovation, and contributed to addressing complex societal challenges. For centuries, history has demonstrated the profound value of curiosity-driven university research to societal advancement. Accordingly, an overarching objective of our 2024 – 2029 Strategic Plan will be to empower faculty and students to continue seeking answers to questions that are bounded only by their imaginations, to make new discoveries and to open new directions for social, cultural, or technological advancement. Importantly, supporting fundamental, curiosity-driven research across the breadth of scientific disciplines in the Faculty of Science also fuels the opportunity for entrepreneurship and to translate fundamental discoveries into practical, real-world solutions that benefit society.

The creativity, curiosity and expertise of members of the Faculty of Science is broad and fascinating. Whether it is advancing our understanding of subatomic physics, developing new ways to address antibiotic drug resistance, or discovering how environmental pressures such as climate change affect biological systems, the Faculty of Science offers something for everyone interested scientific discovery.

As a member of the Manitoba community and being situated on Treaty 1 Territory, the Faculty of Science will continue its commitment to Reconciliation by building pathways for sustained Indigenous student achievement in the sciences. We are committed to creating a diverse, inclusive, and welcoming environment where everyone and their research passions can thrive. We are proud of the vibrant and impactful research conducted by our faculty and students. Together, we will continue to *'discover the unknown + invent the future'.*

Sincerely,
Brian Mark

Brian Mark, Dean of the Faculty of Science and Professor in the Department of Microbiology

03 Our research strengths and future directions

The Faculty of Science is one of the largest academic units at the University of Manitoba with approximately 200 full-time academic staff, 90 support staff, 6500 undergraduate and 400 graduate students. We are a research-intensive Faculty that strives to answer fundamental questions to better understand our world and to advance technological solutions to address current and future challenges. With an annual operating budget of approximately $50M, and annual research revenue averaging $20M, we position ourselves at the forefront of discovery and development across a broad range of areas that impact society.

Moving forward, based on the principles described in our overarching 2024 Faculty of Science Strategic Plan, we will promote and support fundamental research in all disciplines and recognize that generating new knowledge and perspectives is foundational to the advancement of science and the mission of the University. We will strive to cultivate interdisciplinary research, and this is reflected in our strategic research areas that target fundamental discovery, as well as applied research with expertise from departments across the Faculty. We recognize that strengths in individual disciplines provide the basis for interdisciplinary thinking and collaboration that enables broader and more complex scientific questions to be answered.

The Faculty of Science is home to a diverse array of research strengths, many of which are included in six strategic areas: Sustainable environments and preserving biodiversity; Data science, modeling, computing and analytics; Green technologies, advanced materials and sensors; Health, disease and therapeutics; Interactive networks, complex interactions and autonomous agents; Energy, matter and the universe.

Each of our strategic areas align with one or more of the University of Manitoba's signature or priority research areas (Foundations; Social justice and human rights; Research by, for and with Indigenous peoples; Water and food security; Health and well-being; Climate action and sustainability; Manitoba, Hudson Bay, Arctic and the world).

04 Our current strengths

The Buller Building, built between 1931 and 1932, is home to the Department of Microbiology.

Sustainable environments and preserving biodiversity

Across the entire spectrum of life from bacteria to large mammals, ourFaculty will continue to conduct research on population dynamics and health, climate change impacts across the full spectrum life, from the cellular to the ecosystem, development of sustainable crops, water quality and more. Emphasis will focus on systems impacting Manitoba, including our aquatic and terrestrial ecosystems and agriculture, and to understand and mitigate the adverse effects of human activity on Arctic environments.

Data science, modeling, computing and analytics

To harness the vast amount of data generated by modern society, we aim to develop tools and methods including novel mathematics and computational algorithms, information theory, large-scale data management, mathematical and statistical modeling, data mining, and machine learning, visual analytics, and video and image analyses for innumerable applications, including bioinformatics and drug design, digital agriculture, environmental monitoring, economic forecasting, and disease modeling. The theoretical foundation of many of these tools and models will be investigated by mathematicians.

Green technologies, advanced materials and sensors

We will continue building and developing strengths in eco-friendly technologies including new solar capture and nuclear energy strategies, efficient energy storage, nanomaterials, thin films, sensors, biomaterials, polymers and composites with applications spanning quantum computing, medical imaging, device coatings and bioremediation.

Health, disease and therapeutics

Across the Faculty, we will build on our research strengths in human, animal and plant health, including an improved understanding of the molecular basis of disease, drug discovery and resistance, as well as the development of new diagnostics, biomanufacturing approaches, biostatistics and mathematical models of disease. Building on these strengths, we will aim to incorporate a One Health approach, which recognizes that human wellbeing and health of all organisms and that of our environment are closely linked and dependent on each other.

Image from left to right: The Thermo Scientific Talos scanning/transmission electron microscope (S/TEM); Exterior shot of the Manitoba Institute for Materials; The X-ray photoelectron spectrometer; The Thermo Scientific electron microscope.

Image from left to right: A science student beside equipment developed at the Maker Space for breast research; A science student working with coupled pendulums; A science student seeking assistance at the Statistics Help Centre.

Interactive networks, complex interactions and autonomous agents

Large, complex systems of devices and organisms solve problems through coordination and cooperation. We aim to understand the theoretical structure, organization and dynamics of these networks, exploring the construction, implementation, and application of distributed, parallel, and asynchronous algorithms and processes within these systems. Considering issues of security, privacy, and trust, we will explore applications including economic forecasting, disease modelling, migration, information distribution, and traffic optimization, within structures such as communication networks, neural networks, cities, swarms and herds.

Energy, matter and the universe

The Faculty will continue to advance theoretical and experimental research in sub-atomic and particle physics, magnetism, biomedical physics, condensed matter and materials physics, quantum physics and quantum information technologies, and astronomy to enhance our understanding of the universe and to drive the development of advanced technologies including sensors, telescopes, future energy sources, computing, imaging and diagnostics.

05 Our future directions

Drawing from our expertise described above, the Faculty of Science has identified six strategic research areas for which many of our researchers are either already strongly committed or are increasing their investment.

These strategic research areas will help ensure that Canada's research capacity continues to contribute strongly to scientific discoveries and innovations that will improve the quality of life of all people in an environmentally sustainable and respectful manner for future generations and all ecosystems on our planet.

Fundamental science

Fundamental science will remain the cornerstone of our research activities. It drives discovery of new phenomena in biology, chemistry, physics, mathematics, statistics and computational sciences. From these discoveries emerge new theories and technologies that can transform our lives. From our scientists at the leading edge of Canadian subatomic particle physics and astronomy research, to those exploring new discoveries in the life sciences, we will continue to advance our understanding of the natural world and the forces that govern its structure. In this technological age, our scientists in mathematics, statistics, and computing science will likewise play critical roles in developing analytical methods and algorithms to advance our understanding of our world and the information we generate.

Faculty of Science chemists and physicists will continue to lead research in the design and control of new forms of matter and materials with a great diversity of novel properties, while our life scientists will explore the remarkable diversity of organisms on this planet to help us understand the organization of life, from the molecular building blocks to entire ecosystems. By supporting fundamental science, we aim to ensure that humanity has a solid foundation of knowledge to draw upon when making critical decisions that impact society, the economy,
and the environment.

Image from left to right: A student watches a chemical reaction; An anechoic chamber in a physics lab.

Environmental sustainability

Increases in greenhouse gases are considered the primary driver of climate change, which poses serious threats to both our planet's ecosystems and humanity's prosperity. To reduce the levels of fossil-fuel derived greenhouse gases, the Faculty of Science is dedicated to enhancing our exploration and development of alternative energy production and storage technologies. Changes to Canada's and the world's climate are anticipated to have significant impacts on ecological communities, organisms' abundances and distributions, and frequencies of invasive species. Research on identifying and protecting vulnerable habitats will be a priority, to ensure the resiliency of our national and global environment.

Information and data technologies for a changing world

Mathematics, statistics, and computer science are inextricably linked to many aspects of daily life, playing integral parts in transport and navigation systems, communications, finance, power supplies, health systems, research, and education. The amount of data stored in computing networks is growing exponentially, and new methods of managing, transferring, and analyzing big data sets will drive many of our research activities in the future. Innovations in augmented reality technologies, artificial intelligence and human-computer interactions will be a focus for our computing scientists, and research on quantum computing, which relies on quantum physics principles to solve computational problems too complex for classical computing, will help drive new health care, manufacturing, and cyber security applications of the future.

Enabling responsible northern development

Canada's North has vast resources of fish, forests, minerals, and wildlife that will attract many future investments and job creation opportunities. To ensure that exploration and development occurs with a strong focus on protecting human and environmental health, the Faculty of Science has prioritized research on identifying and minimizing impacts on critical ecosystems while providing essential services to remote communities.

Our researchers will increase engagement with Indigenous communities to ensure that technologies deployed and developed in the North are done in consultation and collaboration with the local peoples. The Faculty of Science's Wawatay program, which offers Indigenous students unique and customized research opportunities, will expand, providing our researchers with more opportunities to engage with Indigenous peoples in collaborative technological developments that respect the unique aspects of the northern ecosystems.

During the Wawatay program orientation, students and facilitators prepare a mist net for bird banding.

Enabling technologies for improved human and animal health

The Faculty of Science has historically supported a strong contingent of researchers with interests in developing new technologies to improve human and animal health.

With expertise in drug design, drug target identification, pathogen detection and antimicrobial development, host-pathogen interactions, synthetic biology, and biotechnology platform development, our researchers will help discover and develop the next generation of therapeutics and vaccines to ensure that our populations and livestock animals are well prepared for future epidemics and pandemics.

Food and water sustainability

With changes in climate predicted to have significant impacts on our crops' productivity, it is critical that we develop new technologies to ensure a sustainable food supply. The Faculty of Science will promote research in developing crops that can adapt to increasing frequencies of abiotic and biotic threats and limited availability of fertilizers.

The success of these technologies will be further augmented by more accurate remote sensing technologies, large-scale data analytical tools, artificial intelligence-guided crop health monitoring, and biotechnological crop remediation responses. Protecting our freshwater supply and water quality are equally essential for both the health of our ecosystems and to ensure a sustainable supply of safe water for human use.

The Faculty of Science is committed to maintaining a strong research focus on evaluating all aspects of our waters, including monitoring changes in chemical composition, the biodiversity of organisms in aquatic and riparian habitats, and the risks posed from microbial contaminants of our drinking water. Protecting this valued resource, particularly in the face of more frequent extreme weather events, will remains a key strategic priority of our science.

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