



## **Strategic Research Plan 2018-2023**

*Excellence in Research through Diversity of Thought and Understanding*

*Research brings Queen's to the World and the World to Queen's*

**2018**

## Introduction

Queen's University has 175+ years of shaping Canada's future – through innovation and impact as a leader in higher education, research and knowledge mobilization. We are a leading research-focused academic institution with a profound sense of community and purpose. At the core of our success is a commitment to research excellence, and the inextricable link that binds teaching and research through a common fundamental thread of curiosity and understanding. Indeed, the [Academic Mission](#) highlights the academic heart of our institution as follows:

*We regard Queen's as a university that is both student-centred and research-intensive. Its mission is thus defined by two central activities: learning and discovery. To ensure that these two activities work together learning must proceed in the same way that research progresses: through the guided struggle with a question, a problem, a relationship, or a task.*

### Queen's Research Mission:

- Advance societal knowledge through discovery and discourse that is founded on equity and diversity,
- Enhance societal values, social mobility and inclusion through scholarship,
- Translate knowledge into practice and innovation, and
- Increase global engagement and presence.

The Queen's environment is a catalyst that challenges and supports, in equal measure, the balance of innovative research with excellence in teaching to provide a dynamic living and learning environment – an environment where exceptional people create an unrivalled community and an unmatched mix of opportunities for discovery, collaboration, and partnership.

The Strategic Research Plan (SRP) is a component of [broader integrated institutional planning](#) that includes the Academic Plan and the Strategic Framework, as well as a variety of strategic documents that emerge from individual faculties and elsewhere. The guiding principles that shape the research mission reflect our academic mandate as a research-intensive university with a transformative student experience. The SRP embraces and advances the recommendations provided by the Truth and Reconciliation Commission (TRC) Task Force report and the report of the Principal's Implementation Committee on Racism, Diversity and Inclusion (PICRDI). Equity, diversity and inclusion are foundational in achieving excellence of ideas, scholarship and innovation within the university research environment, and in the creation of opportunities for students and with our international research peers.

Queen's greatest strength in research has always been the *people* – a talented collective of faculty, students, trainees, staff, and diverse partners – and their contributions to innovation and scholarship. With a commitment to *helping people achieve excellence in research and scholarship*, Queen's staff deliver a vast array of services that support research and scholarship. Scholars may work in collaborative and interdisciplinary teams or individually as they engage in dialogue with other scholars and community partners around the globe. The university has embarked on an

ambitious five-year faculty renewal program that is designed to reinvigorate and increase research success and capacity. Our researchers achieve national and international acclaim and recognition for their work, which is reflected by Queen's presence within Canada's U15 group of research-focused universities.

## **Truth and Reconciliation**

The Truth and Reconciliation Commission (TRC) Task Force, coupled with faculty recruitment and support for Indigenous scholarship and cultures, has led to a positive growth in Indigenous research at Queen's. Documents that provided a backdrop to the TRC Task Force's "Extending the Rafters" report observed: "The Royal Commission on Aboriginal Peoples in its extensive program of research set a standard for community-engaged research; the Delgamuukw decision of the Supreme Court recognized the legitimacy of oral traditions of knowledge to be considered along with documentary evidence in establishing claims under law; the Tri-council Policy Statement on research ethics (TCPS 2010) set out an ethical requirement for community engagement in research affecting First Nation, Inuit and Métis communities; Indigenous communities and representative organizations have developed codes of conduct for research and have embraced the principle of Free, Prior and Informed Consent articulated in the *United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)* and popularly expressed in the phrase 'Nothing about us without us'" (Marlene Brant Castellano and Michael Green). These principles guide Indigenous research at Queen's and serve as a foundation for increased Indigenous research leadership and allied scholarship. Queen's SRP commits to support the diversity of perspectives across First Nations, Métis and Inuit communities, while working with the Indigenous research community to examine how Indigenous ways of knowing impact research across the university.

Support for the diversity of Indigenous research appears in a variety of ways. For example, the reciprocal relationships and interdisciplinary connections across faculties are present in community-based participatory research (CBPR) partnerships with Indigenous peoples to examine issues of mutual interest ranging from education to health. An increased presence of Indigenous scholars across disciplines is reflected through signature programs such as the Queen's National Scholar program, which has been highly successful in the recruitment of a diverse pool of talent, as has the Canada Research Chairs Program and the current renewal of Queen's faculty. Finally, collaboration with Indigenous communities, both internally and externally, reflects an opportunity to pursue comprehensive and inclusive knowledge growth.

Over the course of the next five years, Queen's will champion its commitment to research with Indigenous cultures in the broadest context, reflecting the excellence within this community of scholars, and to discover and expand research opportunities both within the university and in community settings.

## **Reaching beyond PICRDI**

The Principal's Implementation Committee on Racism, Diversity and Inclusion (PICRDI) highlighted a goal of sustainable institutional change that embraces the interconnected paths of

research and learning and the relationship to race and diversity. The Queen's community is actively pursuing a path designed to achieve tangible and lasting change with respect to anti-racism, diversity and inclusion. These goals emerge from a larger framework of institutional cultural norms at Queen's as foundational to the mission of the university. Queen's faculty and students, many with racialized social identities and international origins, are committed to scholarly and practice-based inquiry on critical race, histories of anti-Black violence, and institutional inequities that perpetuate systemic racial discrimination. Anti-racism, anti-oppression, and social justice are inextricably linked in PICRDI report. Scholarship that explores anti-oppression and social justice recognizes power imbalances; knowledge and skills are core to the elimination of racism. Queen's research growth embraces the principles and goals of the [PICRDI report](#) and is partnered with the broader interdisciplinary research community in dialogue and action.

### **Canada Research Chairs**

Canada Research Chairs (CRCs) represent an important investment by the federal government to attract and retain some of the world's most accomplished and promising minds. CRCs allow Queen's to advance established and emerging institutional research strengths, improve global engagement and reputation, and distinguish itself through excellence in research and scholarship. CRCs contribute to the world's most pressing issues. Their work leads to deep discovery and innovation for societal benefit – in disciplines ranging from health to philosophy to engineering. Moreover, they help train the next generation of skilled professionals who will improve Canada's competitiveness and reputation in research and scholarship.

Queen's recently posted [The Queen's CRC Equity Action Plan](#) – a plan for the recruitment, hiring and retention of CRCs. Importantly, issues of equity, diversity and inclusion were also addressed in the plan, with the goal of ensuring and sustaining the participation of members of the four designated equity-seeking groups (

. On November 28, 2017, Queen's University Senate pledged its commitment to these goals through explicit advocacy for inclusive excellence in the CRC Program:

*The research community at Queen's is committed to and recognizes that building a culture of diversity is a socially responsible approach that actively removes discrimination and barriers to inclusion to provide benefits that reach beyond Queen's University. At Queen's, we recognize that diversity advances research for the greater good by valuing alternate perspectives, thereby unlocking creative potential and stimulating novel collaborations. To that end, Queen's values its responsibility to promote equity in the employment of women, racialized/visible minorities, Indigenous/Aboriginal peoples, and persons with disabilities; Queen's is an advocate for equity within the Canada Research Chairs Program. Queen's commits to evaluating representation of the four Designated Groups listed above within its Canada Research Chair Program and commits further to striving proactively to meet and to maintain its equity targets among the exceptional researchers recruited to this program. (Approved by Queen's University Senate, November 28, 2017).*

Queen's has adopted various strategies to reach the equity targets in the Canada Research Chairs allocation, as required by the Tri-agency Institutional Programs Secretariat (TIPS). Strategies include hiring practices that facilitate the enhancement of equity to address the particular issue of gender representation, as well as other mechanisms to increase the opportunity to recruit a diverse cohort of excellent researchers in strategic areas.

## **Student Engagement and Trainees**

Graduate students and postdoctoral fellows are important research partners who thrive as a community of emerging interdisciplinary scholars; new interdisciplinary partnerships provide skills for the future that distinguish them as members of the Queen's community. Trainees engaged in research and innovation grow through experiential learning, embracing state-of-the-art-research opportunities, launching start-ups based on discoveries made at Queen's or engaging with community NGOs through the unique PhD-community Initiative program. The exceptional pool of students and postdoctoral fellows represents an unrivalled talent base that has broad impact. Queen's will enhance its commitment to simplify the movement of graduate students and postdoctoral fellows across borders to achieve dual-degree programs with academic exchange partners, to collaborate with international and multinational research networks, and to facilitate the recognition of education completed via international partners. The emergence of experiential learning through research or societal and business opportunities has become part of the undergraduate fabric of learning as capstone courses and internships continue to grow. Several formal programs support experiential learning including the Dunin-Deshpande Queen's Innovation Centre Summer Initiative, the Inquiry@Queen's Undergraduate Research Conference via the Library and the [Undergraduate Student Summer Research Fellowship program](#). Queen's is committed to enhancing the graduate and undergraduate student environment in partnership with the Alma Mater Society and Society of Graduate and Professional Students (SGPS), as they pursue the development of new student environments that provide dedicated space for interactions that support a range of purposes, including the interdisciplinary exchange of ideas, opinions and methodologies linked to research and scholarship.

## **Research Centres and Institutes**

At the foundation of our research practice is the curious, critical and creative scholar who both challenges and conserves the knowledge that came before them. They innovate disciplines through careful and persistent inquiry at their desks, labs and libraries. Outstanding [research centres and institutes](#) bring together scholars across disciplines to pursue fundamental and applied research that address grand challenges and societal issues of national and international scope. Queen's research strengths are also reflected in specialized, [state-of-the-art facilities](#) that provide the foundation for national and international research and scholarly investigation – including those related to studying aspects of the performing arts, digital humanities or the fundamental questions of solar particles. The open dissemination of peer-reviewed research and scholarship in all forms is supported by a wide array of services and platforms through the Queen's Library, including knowledge synthesis and open scholarly publishing. Research data management is a core support

at Queen's in anticipation of the emergence of a national policy for open access to data. Together, research platforms and faculty, coupled with innovative services and supports, provide unique opportunities for students, postdoctoral trainees and visiting scholars to pursue fundamental knowledge.

### **Innovation and Entrepreneurship/Partnerships and Innovation**

Knowledge mobilization – taking “ideas to impact” to address the pressing challenges of society – builds livelihoods and strengthens communities. The launch of unique industry and business partnerships that impact the local and national landscape and economies are a robust feature of the research and innovation landscape. These activities are facilitated by pan-university initiatives such as the Dunin-Deshpande Queen's Innovation Centre (DDQIC), the Office of Partnerships and Innovation (OPI), Innovation Park and the School of Graduate Studies, along with specific initiatives such as the Studies for National and International Development network, the Centre for Business Venturing and the Centre for Social Innovation. The Foundry program offered by the DDQIC and OPI supports students and recent graduates to build commercial ventures based on fundamental discovery or software designed to guide diversity assessment in the workplace. Linkages to regional, provincial and national innovation and entrepreneurship ecosystems promote effective mobilization of ideas and creation of commercial and social impact ventures. The Queen's Global Network provides expertise that links to ventures around the world, including locations in London, New York, San Francisco, Los Angeles, and Shanghai.

Translating research seeds the development of new products, technologies and services for public benefit. Bringing fundamental knowledge to the point of translation involves a diversity of supports, including those of research partnerships (including industry), technology licensing, and start-up formation. Successful knowledge mobilization provides the university with many benefits, including the opportunity for Queen's students to be full partners in technology transfer-related commercialization or alternate sources of funding via research partnerships/contracts. Entrepreneurial opportunities such as the TriColour Venture Fund bring together students, faculty and community members. The economic development that results from activity in the innovation and entrepreneurship space creates future employment and trains highly-qualified and gifted leaders, while generating important social impact.

The support of start-up companies has emerged as a key strategy for the commercialization of early stage research innovations at Queen's. Start-ups represent unique opportunities for students, postdoctoral fellows and faculty entrepreneurs to acquire new skills as they translate early research innovations into standalone businesses. Queen's incubator space and support for start-ups offers entrepreneurship programming, and develops and promotes research partnerships with industry, governments, and not-for-profits, including other academic institutions. The Office of Partnerships and Innovation provides expertise related to intellectual property and commercial opportunity that are needed to advance discoveries and technologies to the marketplace, coupled with extensive networks to cultivate engagement with business, government and not-for-profits.

## **Global Reach**

Strong and positive relations with global partners are key to this strategy as Queen's continues to build its international presence and importance in research and education. Scholars expand academic networks, make connections with other specialists, and gain access to unique communities, equipment or facilities. Many of our faculty have international engagement through formal, as well as informal, research collaborations and partnerships. Social justice and community-based research initiatives and networks address global health, food security and sustainable cities, which in turn mobilize research into communities in the global south and in northern communities. Several of our research centres and institutes are already world-renowned in the research they undertake nationally and internationally, and enjoy extensive collaborations with individuals and teams around the globe. Queen's faculty and graduates are part of an unrivalled network of international leaders who provide comprehensive knowledge from environmental humanities to economic analytics to the global resilience of Indigenous cultures.

## Queen's Research Excellence

The SRP identifies six primary research themes that highlight a spectrum of research and embrace both established and emerging strengths and priorities. Research themes link Queen's to complex problems that demand creative solutions, to national priorities and to international Grand Challenges. Fundamental understanding and knowledge mobilization create novel solutions for health and wellness, stimulate inclusive, vibrant and sustainable societies, invent novel technologies, energize economies and advance human rights.

From the breadth and depth of research at Queen's, strengths and priorities emerge that reflect a composite of factors including: research leadership, international reputation, critical mass reflected by established research centres and institutes, specialized and unique research facilities, acclaimed galleries and performing arts venues. These are enabled by significant investment by national and international research agencies through research grants, awards and infrastructure support of facilities. Areas of priority are also influenced by recommendations from other important Queen's planning exercises.

The themes and their sub-themes are outlined below.

### 1. Securing Successful and Just Societies through Scholarship, Governance and Policy

Institutes and departments reflect the commitment of Queen's scholars to address the history, theory, acquisition and practices that lead to vibrant and safe communities – practices which in turn are coupled with inclusive and successful societies. Queen's embraces the interface between research and policy to innovate across sectors including academic institutions, government, industry, civil society, social media, and international organizations.

#### ○ Sub-Theme: *Equity, Anti-Racism and Inclusion*

In order to create and support inclusive communities and societies, Queen's is committed to the study of racism, violence and other forms of social injustice coupled with the scholarship of change, anti-racism and equity. Faculty researchers collaborate across disciplines to inform local and global policies and practices, and to inspire inter-culturally responsible leadership. Studying racism, Islamophobia, antisemitism, and other forms of discrimination, researchers focus on historical and contemporary inequities as well as resistance practices, activism, anti-racism, and anti-oppression. The scholarship of inclusion investigates the mechanisms and solutions linked with the social climate and the acceptance of differences that come with diversity, i.e. different ways of living and working. Scholars at Queen's investigate how communities respond, the cross-cultural and transnational solidarities they develop, and their modes of organizing. Anti-racist scholarship at Queen's integrates perspectives from migration studies and Black studies, in order to engage questions of power, decolonization, post-colonialism, diaspora, advocacy, and activism.

Our scholars embrace equity as a substantive fairness for everyone to ensure that members of equity-seeking groups are able to achieve full participation in the university. Queen's will engage with faculty, trainees and the University Council on Anti-racism and Equity (UCARE)



in the formation of a research centre to promote the study of anti-racism, anti-oppression, and equity. Focusing on topics core to the research and academic mission, a virtual interdisciplinary centre will embrace current departmental strengths, while recognizing the need for participation of scholars from multiple faculties. As part of this initiative, the university will invest in the Queen's University Research Opportunities Fund (QROF) to provide awards to be used as a stimulus over the next five years to enhance the growth of anti-racism scholarship for established and new faculty members.

- Sub-Theme: *Democracy, Justice and Equality*

The philosophy of law, political philosophy, applied ethics, business and gender equality are a preface to democratic governance and policy and represent a strength at Queen's. Peaceful coexistence rests on legal and social commitment as foundations to building communities and strengthening relationships between people. This commitment is rooted in our understanding of diversity, inclusivity and community. Indeed, research on democratic governance, policy, business and law coalesce around their roles as sites of inclusion or exclusion in relation to indigeneity, gender, age, race, religion, sexual identity, or any other aspect of social diversity. Political participation and social justice outcomes are studied with regards to how government decisions to restructure healthcare systems affect access to services; territorial issues such as how to draw national boundaries; poverty, housing and homelessness; urban environments and planning; and minority rights. The [Centre for the Study of Democracy and Diversity](#) is a multi-disciplinary research centre that joins together international scholars focussed on nationalism, multiculturalism, ethnic conflict management, territorial conflict, and minority rights in diverse areas of the world. Financial and social-behavioural accounting topics are intimately linked to governance and are strengths in business research at Queen's.

- Sub-Theme: *Global Governance, Public Policy and Economic Analysis*

Queen's has a long history of excellence in international policy and global governance innovation. Queen's researchers are leaders in the practices and policies that maintain civil liberties, human rights, privacy and fairness.

Canada's security and defence engagements, including international peacekeeping, have provided a diverse collage of topics for Queen's scholars. The [Centre for International and Defence Policy](#) is a leader in research linked to international security, military cooperation, and issues of gender in the armed forces. The long-standing Studies for Nation and International Development network attracts a university-wide range of scholars together with graduate and undergraduate students.

The Surveillance Studies Centre collaborates with major international surveillance research networks and continues to propel Canadian social sciences scholarship onto the digital world stage. Economics at Queen's is synonymous with excellence and complements the analysis of other research groups. Competition, trade, financial, fiscal and social policies are influenced through the fields of industrial, international, macro-, labour, development, finance, public, urban, and environmental economics. The crucial links between theory, data and evidence-based policy making are provided through world-class theoretical and applied econometric

analysis. The [John Deutsch Institute for Economic Policy](#) has a long history of creating productive links between policy-makers and academia.

The history of extra- and non- governmental, community-based and cultural institutional citizenship practices emerge through established and emergent research interests such as the Muslim Societies, Global Perspectives initiative, The North American Cultural Diplomacy initiative, and the Social Ecology of Vulnerable Media initiative. The [Centre for Governance and Accountability](#) complemented by an array of other Queen's scholars address related issues of inclusivity and citizenship as reflected in governmental budgetary processes, new venture creation, social entrepreneurship, corporate social responsibility, governance and accounting. These issues are also intimately related to emerging areas of climate finance juxtaposed with business innovation, corporate finance, financial markets and institutions, and corporate taxes.

## **2. Fundamental Principles of Nature: from Discovery to Application and Innovation**

Queen's University has a rich and diverse record of excellence and leadership within the natural and physical sciences. The fundamental characteristics of systems ranging from subatomic particles to molecules and materials, to biomolecular structures exert a profound impact on our understanding of life and the existence of the planet. Research that addresses foundational principles and knowledge spans the university to provide the conceptual building blocks for innovative and applied research. Insight into the processes through which molecules define materials, into how chemical and biological structures participate in the emergence of life and into the ways in which we seek to understand human and non-human relations are critical for innovation. They have widespread application within business, psychology, education, energy, engineering, health and medicine.

Foundational research in physics is acknowledged for its international leadership as reflected through astroparticle physics, astronomy, and photonics. Similarly, the biology of life and the planet are interrelated on a grand scale that drives behaviour and evolution. Biodiversity and the environment are research strengths at Queen's where a rich interdisciplinary network of scholars addresses environmental challenges that span climate change to ecosystem rehabilitation of the acidification of lakes to conservation genetics and analytics. Enduring conversations and inquiries into the way we understand ourselves and our tools for understanding nature are highlighted by a diverse array of scholars. Indigenous ways of knowing are linked to biological research, conservation and biodiversity and their intersection with affected communities and policymaking, through academic and community engagement. A broad discourse embraces the social, cultural, economic and political practices embedded within scientific and technological development as well as broad philosophical inquiry related to the narrative of evolution and survival.

### ○ Sub-Theme: *Understanding the Universe, the Planet and our Place*

The Canadian Particle Astrophysics Research Centre (CPARC) was established in 2016 with a mission to coordinate, expand and strengthen Canada's efforts in experimental astroparticle physics, cosmology, detector development, and low-background techniques. The Canada First

Research Excellence Fund (CFREF) established CPARC with an award of \$63M. CPARC is led by Queen's whose faculty include many of the scientists that developed the Sudbury Neutrino Observatory (SNO). Measurements at SNO solved a long-standing puzzle in particle astrophysics known as the Solar Neutrino Problem, leading to a [2015 Nobel Prize for Queen's Professor Emeritus Arthur McDonald](#). Queen's faculty, students, postdoctoral fellows and research associates continue to play key roles in SNOLAB experiments, which aim to unravel the dark matter mystery and to reveal the fundamental properties of neutrinos. CPARC is integrated with the Astrophysics Group Queen's, where many of the same questions that drive research at CPARC, such as the nature of dark matter and the origin of structure in the Universe, are addressed through theoretical, computational, and observational astrophysics. Astroparticle physics at Queen's relies on the state-of-the-art, multi-institutionally managed and highly internationally-collaborative [SNOLAB facilities](#). A major goal of Queen's University is to develop new state-of-the-art facilities on the Queen's campus for discovery, education, outreach and knowledge translation in physics.

Understanding the fundamental underpinnings of life itself is very much an area of strength at Queen's. Scholars examine the general principles of cell and molecular biology, physiology, evolution and behaviour. These studies embrace the diversity of nature from ancient life forms such as archaeobacteria to plants to mammals, terrestrial and aquatic, on both the small scale and large scale. Our scholars use powerful molecular genetic methodology and tools, mathematical modeling, and sophisticated techniques in the lab and field to answer some of the most pressing fundamental questions about cellular function, climate change, human behavior and the evolution of the Earth; where significant expertise is devoted to understanding the complexity of geologic processes that have shaped the planet.

- Sub-Theme: *Ecology, Biodiversity and the Natural Environment*

Aquatic and terrestrial ecosystems are sentinels of environmental change that reflect the unprecedented influence of human activities on landscapes. The interaction between climate change, nutrient pollution/loading, and resource use represent a challenge to the levels of biodiversity in Canadian and international watersheds. These and other factors negatively impact ecosystem services that benefit global societies. Queen's is at the forefront of research investigating the impact of these and other emerging stressors on freshwater and other ecosystems at levels ranging from individual species to entire ecosystems in the past and present, using various tools such as mathematical modelling and pattern recognition.

Our researchers are also acknowledged internationally for their discoveries, innovative methodologies and creative monitoring protocols that guide public policy on issues related to climate change, water pollution and the protection of the Arctic environment. Major research infrastructure for the study of lake and land-based ecosystems includes the [Queen's University Biological Station](#) (QUBS), which encompasses 3400 hectares of land within the Frontenac Arch, a UNESCO World Biosphere Reserve. The recent launch of the interdisciplinary [Beaty Water Research Centre](#) is dedicated to water-related issues concerning economic growth, social well-being and a healthy population in Canada and around the world. Queen's also has a diverse array of scholars in the arts and media who thematically link significant research on the culture of nature, visualizing climate change, the media of and in the circumpolar Arctic, and policy development tied to northern Inuit and settler institutional development. These

scholars demonstrate that research about the natural world is mobilized across numerous publics and disciplinary boundaries.

### 3. Mobilizing Creativity and Enabling Cultures

Queen's scholars explore the relationships amongst cultures, economies and societies, and the reciprocal influence that leads to the creation and exhibition of art, the development of transnational media, experimental media and creative industries. Scholarship that embraces the global and cross-cultural exchange of ideas and forms of representation fundamentally counter hegemony and colonialism and are inclusive in nature. Many aspects of this research are unifying across diverse schools of thought and products, as they embrace historical context, history, archival material and research-creation. Research into audio-visual regimes, their histories and economies, contribute to our capacities to interact critically and productively with information of all kinds. Cultural industries, social media platforms and cultural activism provide robust research networks at Queen's. Understanding of art and its history also contributes to awareness of the fundamental concerns of human society. Understanding visual creativity (and learning how visual images communicate) impacts communication in the arts, as well as many areas of business and science. Language is inseparable from human cognition and Queen's is home to highly committed faculty and trainees pursuing scholarly and creative work that explores the linguistic expression of imagination and ideas in present and past cultures.

- Sub-Theme: *Creative Production and Expression*

Creativity reinforces and binds cultural ties and traditions, challenges current affairs, preserves, questions and interprets history, and effects social change via stories designed to reveal a deep understanding of self and society. Cultural production emerges out of research into material culture, language, social power and inequalities, and global markets of display and dissemination. Whether working with community-based initiatives, research in and through practice embraces information and science to bring perspective on important social issues via a national and global lens that explores the past and present. Strengths include Canadian drama through creative and productive theatre to award-winning composers who blend elements of modern and classical music or embrace vocal and instrumental elements inspired from the Canadian landscape. National and Indigenous cultural creation and analysis comprise an emerging focus than extends to artworks that engage the legacy of settlement and the local spaces of occupation and displacement. Art restoration and history are signature research strengths of national and international recognition at Queen's. They merge sophisticated inquiry and fundamental knowledge with an ability to preserve and restore the most foundational legacy of all peoples – Art. Queen's scholars build bridges in the midst of political conflict, between cultures and across historical periods by pursuing interactive and expanded media, innovating the interconnections between digital media, mapping, historical geography and documentary practices. These innovations in Research Creation and cultural practice at Queen's are supported by remarkable facilities such as the [Agnes Etherington Art Centre](#) and the [Isabel Bader Centre for the Performing Arts](#). Both facilities provide state-of-the-art environments that uniquely support scholarship, performance, and preservation of art that extend to advanced media research facilities.

- Sub-Theme: *Society, Culture and Human Behaviour*

Global cultures reflect a diverse and rich display of constructs and conventions that influence behaviour. Value systems and religions impact social order, which are in turn reflected in law, literature, social justice, leadership, politics or governance, as well as through trade, marketing, media and business. One of the primary objectives of historical research is to better understand changing social and cultural norms and to shed critical light on the distinct power relations, economic systems and forms of exchange, and modes of thinking that help produce these norms and that in turn are shaped by them. The tension between the understanding of global histories, including Canadian multiculturalism and its own emerging modern history, and the cultural “present” of social critique and cultural activism yields a robust context of inquiry. In a global environment, with international business, scholarly discourse and market economies are changing rapidly, and they routinely transcend national borders via media or material exchange of thought and economies. Queen’s scholars seek to understand the societal impacts of business, including their effects on human behaviour and adaptation to change. These interactions extend to how organizations respond to changing society demands, and how organizational actors construct meaningful relationships with their societal and institutional environments. The [Centre for Social Impact](#) and the [Centre for Governance and Accountability](#) contribute to a scholarly environment that welcomes a myriad of cultures, economies and methods within its research and learning environments to explore society, business and organizational or institutional environments. Queen’s scholars advance knowledge and understanding through the exploration of music, literatures, cultures and histories within the northern hemisphere, while embracing the stories and histories of Indigenous cultures and women of art and insight. Scholars and students are connected through global knowledge partners, Canadian networks and the Matariki Network.

○ Sub-Theme: *Resurgent Indigenous Research in Local and Global Contexts*

The recommendations of the “Extending the Rafters: Truth and Reconciliation Commission Task Force Final Report” have renewed the commitment to the growth of Indigenous Studies as an area of focus reflected by important interdisciplinary research groups and opportunities. Queen’s is committed to engage with faculty and the community to develop the academic framework for an interdisciplinary Centre for Indigenous Research that is oriented toward the emerging strengths within the research community. Among these emergent strengths are expertise in contemporary and historical Indigenous art history, languages and literatures, research-creation, ethnic conflict resolution, Canadian and global Indigenous education and Indigenous health. These are accompanied by cross-faculty expertise related to social impact and sustainability, accounting and governance in Indigenous communities and the relationship between leadership and socioeconomic circumstances.

Queen’s scholars are committed to nation-based resurgent research approaches and methods that embrace the opportunity to advance reconciliation and conciliation, improve education, and benefit research outcomes across disciplines and global partner networks. Scholars pursue Indigenous literary theory as well as sustaining Indigenous knowledge practices that embrace the social foundations of governance, sustainable life-systems, and Indigenous languages. Queen’s scholars display a profound commitment to community-based scholarship and display skills that include film and media, global Indigenous educational practices, language preservation through education, dispute resolution and assessment and health. State-of-the-art media facilities at the Isabel Bader Centre for the Performing Arts allow for the preservation

and remediation of diverse collections of audio-visual products created by First Nations and Inuit artists, women and collectives. Preservation of a media history, routinely marginalized, allows scholars to explore and facilitate discussion of cultural heritage. Faculty collaborate with the Agnes Etherington Arts Centre to realize innovative exhibitions and knowledge mobilization events such as the annual Conversations in Indigenous Arts Series. Community-based participatory approaches that embrace, explore and respect the needs of the community and Indigenous ways of knowing are also routinely employed in the research fields of Education, Health and Business, and at the Centre for Social Impact.

#### **4. Health, Wellness and the Determinants of Human Health**

The generation of foundational biomedical knowledge and its translation to novel therapies, health practice and policy is a cornerstone of Queen's health research strengths, encompassing fundamental chemistry, psychology, biomedical and translational medicine, clinical trials, patient-oriented research, data analytics and bioinformatics. The health and wellness theme unites faculties at Queen's, while embracing novel research partnerships with the Kingston Health Sciences Centre and Providence Care. This reflects a deep commitment to join with affiliated hospitals to advance health research, in Kingston and Southeastern Ontario through the novel model of a partnered research institute focused on patient-oriented outcomes that are relevant regionally, nationally and internationally. Mental health represents a significant focus for Queen's and its hospital partners and is one that relies on scholars from diverse backgrounds in order to understand the complex neurobiology and psychology that provide insight into behavior and the basis of cognition and emotion. Health and the human fabric emerge through scholars from the arts and humanities as they address questions of equity, inclusion, and diversity through interdisciplinary contributions ranging from aging and dying to the positive impact of the creative arts. These scholars explore the social issues of equity, power, social justice and the cultural politics of illness and medical humanities linked to health justice. They represent research facets that balance and intersect fundamental and applied medical sciences.

The extent of interdisciplinary research permeating this theme is reflected by the cross-cutting expertise threading through subthemes outlined below. For example, transformative work linking fundamental mechanisms of disease, patient-oriented research and clinical practice, and population health is occurring in the areas of cancer, cardiovascular and respiratory diseases, mental health, gastrointestinal disorders, and neuroscience.

- Sub-Theme: *Patient-Oriented Research, Transformative Health Care and Health Promotion*

Patient-oriented research, as defined by the Tri-Council Agencies, refers to “*a continuum of research that engages patients as partners, focusses on patient-identified priorities and improves patient outcomes.*” The related field of precision medicine identifies approaches that will be effective for patients based on genetic, environmental, and lifestyle factors. Both approaches embrace a recognition that health relies on multiple factors that may be influenced by lifestyle, culture, and Indigenous ways of knowing.

Cancer research has a rich history of discovery, accomplishment and leadership in these areas, and the [Queen's Cancer Research Institute](#) comprises a cohort of international leaders within cancer biology, epidemiology and clinical trials. The [Canadian Cancer Trials Group](#), a signature research strength at Queen's within the Faculty of Health Sciences, has global scope and impact, and is an international leader in the design and execution of national and international multi-centre clinical trials.

Health research at Queen's far exceeds its regional foundation, with a national and international impact and presence that ranges from the [Canadian Institute for Military and Veteran Health Research](#) and the [International Centre for the Advancement of Community Based Rehabilitation](#), to networked health analytics within the [Canadian Frailty Network](#), the [Canadian Primary Care Sentinel Surveillance Network](#) (see *Analytics* subtheme below) or the [Canadian Biomarker Integrated Network in Depression](#). Queen's researchers have partnered seamlessly with our academic hospital partners across several sites and facilities. A bold new facility, focused on patient-oriented research, provides new opportunities via the WJ Henderson Centre housed within the Kingston Health Sciences Centre.

Queen's houses several multi-disciplinary centres and institutes that address fundamental discovery, translational research and therapeutics. The [Centre for Neuroscience Studies](#) explores the mysteries of the brain, from cellular function to psychology to neurosurgery to guide new methods to understand, diagnose, restore health and to preserve quality of life for those facing the challenge of disease and neurological disorders. The [Human Mobility Research Centre](#) facilitates cross-faculty collaboration to develop innovative and effective treatment strategies for bone and joint disorders such as those caused by arthritis, osteoporosis or injury. Health promotion and evidence-based strategies cross faculty-based boundaries to elucidate the foundations of active living across generations and cultures. The [Queen's Cardiopulmonary Unit](#) integrates fundamental and clinical investigators with a common goal of developing novel therapies for the treatment of cardiorespiratory disorders. A similar cross-cutting approach characterizes the [Gastrointestinal Disease Research Unit](#) to explore fundamental discoveries associated with gut inflammation and the microbiome to clinical trials of intestinal bowel disease.

- Sub-Theme: *Analytics, Healthcare and Promotion across Populations and Cultures*

Interdisciplinary excellence at Queen's explores human mobility, public health and disease management in their broadest contexts. Novel computer-guided and analytic tools harness the power of informatics to transcend human limitations in surgery to develop innovative and effective treatment strategies for bone and joint disorders and activity-based interventions to promote healthy living. Mental health research crosses a broad sector of expertise, which extends from basic research into the causes and course of mental illness to the development of new therapeutic technologies. Interdisciplinary collaborations explore novel strategies to assist youth and adolescents in navigating a vulnerable period in social and mental health. A deep historical and policy-based approach to understanding how the health of a culture translates into the mental, spiritual and physical health of a people or age group fosters partnerships between leading researchers at Queen's across a network of scholars, government, not-for-profit organizations and industry to improve the quality of life for youth. Strong knowledge mobilization partnerships exist at Queen's that span health care in the North, disparate societal

communities, as well as several innovative programs in Africa. The latter embraces a novel research strength through Queen's University's Ethiopian partner, the University of Gondar, to pursue [community-based rehabilitation for those living with disabilities](#). Significant and long-standing health research programs are also well established in Tanzania and Rwanda.

Queen's and its academic hospital partners serve as a leading hub of networks directing population and patient-oriented research, as well as optimizing health care. A community of researchers, data experts and clinical experts apply epidemiological and big data approaches using multiple health and medical record databases to improve health sciences research, health policy and health promotion. The [Institute for Clinical Evaluative Sciences](#) (ICES) established its first satellite centre at Queen's, which provides access to data from the Ontario Ministry of Health and Long-Term Care. More recently, additional databases have emerged from the Queen's-based [Canadian Primary Care Sentinel Surveillance Network](#) (CPCSSN), the [Canadian Institute of Military Veteran Health Research](#) (CIMVHR) with a mandate to enhance the health and well-being military personnel and their families, and the [Canadian Frailty Network](#), which is pan-Canadian initiative focused on optimizing care of the frail elderly. Health analytics is a prominent focus that crosses multiple faculties and disciplines.

## 5. Sustainability, Environment and Resources

Interactions within the research domain of *Sustainability, Environment and Resources* represent an institutional strength at Queen's. Researchers focus on challenges related to the sustainability of our planet and human civilization, defined as *resource use and waste production within the carrying capacity of Earth*. A talented open network of investigators connects alternative energy solutions and public policy, cleantech, environmental protection, environmental rehabilitation, social innovation and environmental humanities. Indigenous ways of knowing are connected to sustainability through multiple pathways including community-based participatory research that relies on reciprocal and respectful relationships between community and scholar. Queen's faculty are international leaders in describing and predicting the impact of environmental change on biological systems, the impact on individual species within entire ecosystems, which range from Canada's North and the communities that reside there to sensitive provincial, national and international biospheres. Resource management and sustainability address the essential challenge of our global civilization to manage our climate impact below the [internationally adopted 2° C threshold](#) and embrace broad-based environmental thought and justice reflected in critical, philosophical reflection.

### ○ Sub-Theme: *Alternative Energy Solutions and Energy Policy*

Research into alternative energy encompasses solar, nuclear, hydro technologies and wind for on-grid and off-grid (remote) communities. Specialized lab-based and in-situ experimental facilities are employed to develop efficient and sustainable solutions for energy conversion and distribution, the novel use of materials to enhance energy storage, as well as the assessment and design of materials to increase longevity. For example, sophisticated testing and analyses of materials to increase the operational lifespan of nuclear reactors is an important sector that relies on the [Reactor Materials Testing Lab](#). This is one of a handful of international facilities



dedicated to preserving the physical materials that comprise a nuclear reactor, and provides important links between fundamental research, industry, policy, and government. Queen's solar energy, nuclear, hydro and other energy solutions parallel research on water management/preservation through multiple research groups, including the [Beaty Water Research Centre](#), and are coupled with [policy research](#) that guides the future of the Canadian Energy strategy.

- Sub-Theme: *Cleantech*

Scholars at Queen's are leaders in the development of cleantech and green chemistry solutions. For example, knowledge and practices to reduce and remediate agricultural and industrial water emerge from fundamental discovery and modelling. Provincial, national and industry-based programs provide new opportunities to expand further the expertise in the development of environmentally sustainable chemical processes to reduce pollutants and energy waste, while conserving materials. This opportunity also embraces the development of large-scale alternative water and waste management technologies and sustainable environmental approaches with a focus on integrated bioresource management. Queen's technologies continue to emerge as startups and lead to research collaborations with not-for-profits and industry to reduce environmental impact.

- Sub-Theme: *Protecting the Natural Environment*

Queen's researchers are addressing the impacts of natural-resource utilization (water, energy, and minerals) on the environment and our society by bringing scientific and engineering knowledge of natural resources to bear on issues of national and international social relevance. Scholars link the past and present roles of mining and waste in the destruction of healthy ecosystems and Indigenous communities. Queen's is home to international leaders in the development and testing of critical environmental infrastructure through a unique [GeoEngineering Centre](#). Their research explores the boundaries and solutions for geosynthetic barriers and buried infrastructure to protect the environment. An additional focus is on the social, cultural and political contexts of resource depletion and waste in an ever-increasing global consumer culture. Interdisciplinary research at Queen's embraces the stewardship, environmental justice and sustainable systems that led to the ethical commitment of our community toward preserving and protecting the lands and waterways of Turtle Island. The Centre for Social Impact also examines how companies drive negative environmental effects, as well as positive social change, for example within Indigenous communities. The resilience of communities is linked to the growth of the social enterprise sector and new business model research that examines the triple bottom line of social, environmental, and financial performance.

## **6. Interdisciplinary research in materials, computational analytics and human-machine interactions**

Queen's embraces the unique opportunity to combine outstanding students and excellence in discovery to create a bold vision that integrates materials, analytics, business and engineering.

Merging discovery and knowledge translation with the inherent talent of the Queen's human capital impacts across multiple sectors of society and embedded economies.

- Sub-Theme: *Materials Discovery and Molecular Design*

Fundamental understanding of the structure and behaviour of materials gives us the ability to control and manipulate their shape, size, function, and stability. Queen's researchers design and create novel materials such as new energy storage materials, photonic materials, machinery fluids, pharmaceuticals, artificial tissues, smart materials and stimuli-response materials. Queen's researchers are discovering methods to identify and predict the molecular composition of both biological and synthetic compounds leading to more effective and less expensive health care solutions. Future smart materials and coatings are destined to have economic impact in the automotive, petrochemical, and agricultural sectors.

Modern applications will increasingly require materials with advanced structural control on a very small scale. Nanoscience and technology has witnessed recent tremendous growth. [NanoFabrication Kingston](#) (NFK), a collaboration between Queen's University and CMC Microsystems, provides researchers with access to leading-edge equipment and expertise for designing and prototyping microsystems and nanotechnologies.

- Sub-Theme: *Analytics and Digital Technologies*

Digital technologies are pervasive and are rapidly transforming societies, cultures, business, financial markets and society. Analytics, in particular, is a transdisciplinary focus deeply rooted in computing and mathematics, which extends to the social fabric of society, business, education and learning. The Queen's Business Analytics focus is a research strength that relies on several components such as the Smith School of Business Scotiabank Centre for Customer Analytics, the Smith/IBM Cognitive Computing Centre and the Centre for Advanced Computing. Analytics at Queen's aims to positively influence societal change through art, media, economics, education, engineering, health, policy and planning, which is based on fundamental discovery and insight. Research in this area is highly interdisciplinary and disruptive with the development of new mathematical, statistical, computational, and digital methods.

Strategic analytics, cognitive computing and artificial intelligence (AI) technologies extend across the expertise of the School of Computing, mathematics and statistics, biology, chemistry, physics, business, engineering, environmental science, health and medicine and education. Queen's has significant strength that embraces multi-disciplinary research that leverages data analytics to security to protect networks, computers, programs and data from attack, damage and unauthorized access.

Emerging research within this subtheme has a wide range and includes scholarship that explores learning paradigms and delivery embedded within educational technologies to the development of novel computer-guided surgical approaches. Both areas are transformative and disruptive. Expansion of bioinformatics and health analytics is augmenting both the established and emerging research directions of this cluster.

- Sub-Theme: *Human Machine Interactions, Machine Learning, Software Analytics and Smart Infrastructure*

Understanding and design for the complex interactions that are emerging between humans, machines and systems, and their environments is a rapidly evolving science and art. Queen's University is positioned to pursue a role in this burgeoning research area at the forefront of disruptive technologies. Supported through new laboratory facilities, a new interdisciplinary focus is emerging on the design and use of intelligent systems and machines to enhance human productivity, creativity, safety, and quality of life. Research spans the continuum of expertise from artificial intelligence, machine learning, and cyber-human systems, to robot control, chemical and biological systems and chematronics, smart sensors and mechatronic devices. The growth of machine learning and AI at Queen's embraces fundamental research in both computing and engineering, and has yielded a Management in AI program. Queen's will leverage significant existing strengths across disciplines against exciting new advances in the fields of intelligent systems, robotics, and mechatronics.

Ensuring smart and secure societies will increasingly depend on robust information and communication technology to improve fundamental and applied aspects of interconnected and data-driven computational and physical entities. A significant concentration of researchers at Queen's are working within the engineering and science disciplines to shape the future of cyber-physical systems and smart infrastructure. Queen's research labs support this leading-edge information and communications research on topics ranging from next generation wireless communications to the Internet of Things to Cloud computing.

Critical infrastructure research relies on durable and sustainable materials in the areas of new construction and retrofitting of existing structures and buried infrastructure, with the aim of increasing longevity of infrastructure and minimizing maintenance activities. Queen's expertise addresses several areas including those on the effect of extreme temperatures, fire and environmental exposure, structural integrity monitoring using sensors, and the development of fibre-reinforced polymer as a replacement for steel bars in concrete construction. Queen's is home to the first Moving Load Simulator for bridge testing and Large Scale Buried Infrastructure Laboratory facilities, each the first of their kind in Canada, allowing world-class research to be conducted with a new level of realism and measurement resolution.