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CHAIR’S WELCOME  ERIC BROWN

It seems like just yesterday we were waiting with anticipation for arrival of the new millennium. And here we are contemplating the decade of transition for the department of Biochemistry and Biomedical Sciences that has passed since then. We have seen some truly spectacular changes in the department in this time and so it is timely to take stock of the transformation in this Decade in Review.

Having taken the post of Chair in January of 2008, I have been a participant in change for most of the decade and not its lead architect. The department had three Chairs before me since 2000, John Capone, David Andrews and Gerry Wright. Gerry was Chair from 2001 to 2007 and gets the lion’s share of the credit for leading the department through particularly auspicious times. No doubt the most important growth in the department over the last decade has been in new faculty, especially young faculty.

In 2000 there were only 3 Assistant Professors and today we have 10! The pages of this Decade in Review offer lots of impressive statistics that describe an approximate doubling of the research and education enterprises of the department. I have the pleasure of providing some highlights of these retrospectives herein that have been provided by the department leaders, including our Associate Chairs and Institute Directors.

One of the most transformative changes in the last decade is surely the establishment of two research institutes endowed with a generous gift from local philanthropist Michael G. DeGroote. These are the Stem Cell and Cancer Research Institute and the Institute for Infectious Disease Research. These institutes and their founding leaders, Mick Bhatia and Gerry Wright, are inextricably linked to the department of Biochemistry and Biomedical Sciences through affiliated faculty and a commitment to research excellence, creativity and innovation that have been the hallmark of the last decade in the department.

Undergraduate education in BBS has advanced with a dizzying pace over the past decade. Michelle MacDonald, our Associate Chair of Undergraduate Studies, joined the department in 2001 and was given the mandate to make our undergraduate programs worthy of the new millennium. She advanced a sophisticated and energetic agenda for change to hands-on and self-guided learning that has seen our undergraduate laboratory courses overhauled and replaced with a discovery-based learning curriculum. This has been no mean feat while managing aggressive expansion of our undergraduate numbers and participation in new programs. The latter include the Bachelor of Health Sciences Program, the Integrated Science Program and a revamped Life Sciences Program. The last decade saw an extraordinary overhaul of curricula with an emphasis on integrating research and education. I expect these ‘experiments’ with curriculum will continue. It keeps the professors sharp and positions the learners to succeed and lead in the knowledge-based economy.
Graduate students and post-docs are the life-blood of the research enterprise of the department and the last decade has witnessed extraordinary expansion in the numbers of these trainees. Justin Nodwell, Associate Chair of Graduate Studies, has been our leader in the graduate post since 2000 and steps down this year with a remarkable record of expansion and innovation in graduate education. Enrollment has doubled and the graduate curriculum has been recast to emphasize depth and the research experience. Justin has become the face of our graduate program over the past decade and showed a tireless devotion to excellence in graduate student training. Our graduate students have responded to this with energy. We’re attracting the best from across Ontario and Canada and these students are more successful than ever at publishing with impact and attracting external scholarships. Our post-doctoral trainees have likewise been on the rise. Energized and organized from the grass roots by a new Post-doctoral Association, these trainees have been inspiring our faculty with their initiative of late. In my view, it’s just a matter of time before we have a full-blown post-doctoral training program in the department.

It has been a spectacular decade of research success in the department. The portfolio of Associate Chair, Research is a new one created late in Gerry Wright’s tenure as Chair (yours truly was the first appointee). Lori Burrows is the current leader of the research file and has put a focus on research infrastructure, faculty awards and grant pre-review. Under Lori’s stewardship we have had no less than 6 first-place finishes on CIHR operating grant panels in the past year or so. Operating grants to the BBS faculty have nearly doubled in the last decade and total research funding has seen some magnificent growth due in large part to repeated successes with research infrastructure funding. The interface of chemistry and biology has been a sweet spot for research expansion. Three successful, large CFI infrastructure projects have brought state-of-the-art instrumentation in structural biology, mass spectrometry, microscopy and chemical biology. There have likewise been big operating grants to support the establishment of the small molecule screening laboratory and most recently for chemical biology and stem cells. A survey of selected publications herein of the last decade reveals sustained productivity of remarkable impact. A final change worth highlighting is a symbolic one. This of course is the change of the name of the department from ‘Biochemistry’ to ‘Biochemistry and Biomedical Sciences.’ The name change was ushered in by Gerry Wright with wholesale support from all corners of the department. The new name reflects our interests and ambitions. We are biochemists to be sure and are interested principally in understanding biology at the molecular level. Nevertheless, our faculty and trainees have always put a focus on disease biology and medicine. And increasingly our efforts are directed toward the application of our trade to improve human health and benefit Canada’s economy. I have high hopes for the next decade that we will continue to deliver on these ambitions. Looking forward to what 2020 will bring!
The face of undergraduate education in the Department of Biochemistry & Biomedical Sciences has changed dramatically over the course of the last decade. In addition to offering our own longstanding program in Biochemistry (for which the first degree was awarded in 1970), faculty also contribute to the delivery of courses in the Bachelor of Health Sciences Program (a new program first offered in September 2000), the Integrated Science Program (a new program first offered in September 2009) and the Life Sciences Program (an existing program redesigned in September 2009). These are among the top performing programs in Science and Health Sciences at the University in terms of attracting and producing high quality and high caliber students, as represented by the number of students achieving the distinction of the Dean’s Honour List and Provost’s Honour Roll.
Our Biochemistry program is the second largest limited enrolment program in the Faculty of Science, with one of the highest averages required for admission, graduating on average 110 students per year. The significant blip in the enrolment that we experienced in 2004 was due to the “double cohort” secondary school reform in Ontario which eliminated the OAC year. Courses and programs were stretched to the limit in order to accommodate additional students in the university system.

Our Biochemistry program itself has also been revolutionized over the last decade. Our most critical strategies have been to focus on the development of the knowledge and skills of our graduates to ensure that they have the tools to compete against anyone, anytime, anywhere in the world. The reality is that not all science graduates will become university academics, but will work in diverse fields of science. These people need to be adaptive and flexible, able to respond quickly and with independent initiative demanded by private sector firms.

We offer our undergraduates inquiry and problem-based learning courses which emphasize higher levels of communication and problem-solving skills so that they are well-prepared to deal with challenges and opportunities that lay ahead in their future.

2009 — Long-awaited Home Base space opens doors to BBS Undergraduates

2006 — Murray Junop, Associate Professor, wins MSU Teaching Award to recognize outstanding all round teaching performance
To exemplify our renewed focus on skill development, we now bring students into the laboratory earlier in their undergraduate career by shifting the third year biochemistry laboratory course into second year. Furthermore, this course was radically transformed from a traditional 3 unit ‘techniques’ course where students sampled random techniques each week in discrete laboratory modules, into a more comprehensive research experience where students apply these techniques to continuous mini-projects mimicking the real research environment in a 6 unit course.

Our third year laboratory course further integrates research in teaching, as our graduate student Teaching Assistants expertly guide students through a project that is related to their own current research. Students are guided through the project from conception to completion by writing a full project proposal, supported by a budget, protocols, and including sources for reagents and chemicals. Students conclude the course by presenting and defending their findings orally and in a final written report. The focus of this course is about the ‘process’ behind research, as students are also expected to troubleshoot and repeat their experiments. They quickly learn that THIS is real science!

Students enrolled in our specializations have continued to contribute to cutting edge research in the Department through thesis courses in their final year, and we have also created additional opportunities for students to obtain hands-on research experience while earning 3 units of credit in our new project course, Biochemistry 3A03. This unique and flexible course allows students to complete the work on their own time and in the lab of their choice, either on campus or off-campus! Moreover, beginning in 2010-11 we have added a 6 unit third year project course and a 12 unit senior thesis course to our repertoire of choices for those students who are interested in pursuing a more research-intensive course of study.
We have also brought our two specializations into the 21st century by changing the designations from “Biotechnology and Genetic Engineering” to “Biotechnology”, and from “Molecular Biology” to “Biomedical Sciences” to be consistent with the name change of the Department to Biochemistry & Biomedical Sciences, and to better reflect the nature of the education program and research focus in the Department.

Of note are several key undergraduate teaching performance indicators: the Department has 1% of the faculty in Health Sciences and does 4% of the teaching; our undergraduate program enrolment currently stands at 352 with 94 students graduating in 2007/2008 with a cumulative average of 9 (51% of which were on the Dean’s Honor List). A 2007/2008 survey determined that in the year after graduation 46% of graduates went to graduate school, 25% pursued other further education, 12% got a job in a field related to their undergraduate degree. None of the remainder of our graduates was unemployed in the year following graduation.

In the future, we will not just focus on doing more, but on a strategy for doing things differently; next year we hope to offer, in conjunction with the School of Business, a program for our students who are interested in science/business innovation, a skill set that will accelerate the rate of innovation in services and processes. A more direct experience that combines business and science is offered to our Co-op students, who witness innovation first hand through problem-solving. This unique, tangible personal experience truly enhances the student’s education. We feel that the benefit is mutual between companies that sponsor Co-op programs and our Co-op students. Both gain new insights and innovative ideas from this interaction.

2008 — Felicia Vulcu, Assistant Professor, received the McMaster Students Union Merit Award for her outstanding teaching in her first year.
The last ten years have been a time of innovation and growth for our graduate program. At this time, we feel that our program is competitive with any in Canada and indeed with most programs in North America.

The number of doctoral degree completions provides a measure of the vitality of the department and the institution in educating new researchers (BBS has graduated 25 PhD’s since 2005). Our Department has been fortunate in the past several years due to the graduate expansion funding which allowed us to grow from 78 MSc and PhD students in 2004/2005 to a current figure of 113 full-time, in-time students. The Department’s record of graduate expansion is 44 students since 2002 (8% of the University-wide expansion). Our students currently hold $683,000 in external scholarship awards, a 235% increase since 2004/2005. Figures for 2009/10 look to be even higher with a recent Vanier scholarship awarded to one of our PhD students worth $150,000.

McMaster was awarded $20M for the Centre of Microbial Chemical Biology in 2006— an initiative between the Departments of Biochemistry & Biomedical Sciences and Chemistry. A new graduate program in Chemical Biology is being offered where chemical biologists study the composition, structure, properties, and interactions of chemicals in living organisms. The Program involves a multi-disciplinary investigation of phenomena at the interface between chemistry and biology. The program currently has 17 MSc/PhD students.

Graduate teaching assistants play a major role in the educational process at McMaster. In order to assist our TAs in the instruction, advising, and evaluation of undergraduates the Department held its first very successful Teaching Assistants Workshop on September 23, 2008. Students and faculty had a very interactive and productive discussion on what it means to be a TA, the considerable responsibility associated with it, as well as the experiences and challenges they face. They also brainstormed how to improve teaching and guiding undergraduates. We strive to instill in our TAs the extremely valuable opportunity a teaching assistantship provides for their professional development and to acquire a deeper understanding of their field that only teaching the subject can provide.

In 2000 our students were required to take 5 courses: 2 at the MSc level, 3 at the PhD level. At least three of these were required to cover what were regarded as core knowledge for biochemists: lipids, nucleic acids and proteins. This material was typically taught in a manner similar to our undergraduate courses though at a more advanced level. We have streamlined our programs so that students now take only two courses, both at the MSc level and these courses are based on current topics of direct relevance to faculty research in the department. This makes it easier for our faculty to bring their research interests to our students and has increased the relevance of the graduate teaching we do.
One area where we agreed additional instruction was required is scientific communication. Writing and public speaking are often areas of significant weakness for newly admitted graduate students: these skills tend to not be widely taught at the undergraduate level. In recognition of the importance of these skills, we introduced the course BCH720, “Scientific Communication”. This course has the heaviest workload of any of our graduate courses, requiring a major written paper, several in-class workshops on public speaking and writing, a departmental seminar and a number of smaller assignments. It is now taken by virtually all of our second year graduate students and, based on polling data, it is considered very helpful.

2009 — Suzanne Osbourne, PhD student in Brian Coombes’ lab wins prestigious Vanier Canada Graduate Scholarship
The goal of the department is to attract the best graduate candidates in Canada. To enhance our recruiting we instituted an annual graduate open house starting in 2004 held 4-8 weeks before our graduate application deadline. We publicize this event primarily through contacts in relevant undergraduate programs at other universities in Ontario and through our departmental website. Since its inception this event has consistently brought in highly ranked students who would not have otherwise come. It has also increased our profile province-wide.

We have made greater use of electronic media as a recruiting tool, including an updated departmental website. Most recently, we have added a new student-directed departmental site “biochemrocks.ca” that will provide our students and faculty with a new means of communicating our strengths and the excitement of working here.

Records showing the grades and university of origin of our students are not available from 2000 however, the incoming cohort from 2009 includes 29 students. Of these, 13 were McMaster undergraduates, 11 came from other Ontario universities and 5 came from out of province; 19 had undergraduate averages of A- to A+. It is clear therefore, that we are a major Province-wide recruiter of outstanding graduate students. We are also now seeing the first evidence that we are a truly national presence in graduate education in the life sciences.

2004 — Bernardo Trigatti, a former BBS PhD student, now Associate Professor, wins Alumni Arch Award in recognition of his unique and interesting contributions to society, the local community and to McMaster University.
To continue to lead, both within the university and nationally, we must continue to experiment with our program and our recruiting methods. At present we are working to bring to fruition a new initiative aimed at merging our comprehensive exam and transfer exam. The intent is both to further reduce our times to completion and to enhance the efforts we’ve made to improve performance of our students during the crucial first two years of MSc research. This will also formally implement our ‘Qualifying examination’ – a requirement for students who enter our PhD program directly from BSc or who have completed MSc degrees at other universities. This is expected to pass at Graduate Council in fall 2010.

Our challenge continues to be how to develop and sustain the right combination of talent, technology and infrastructure to support our mission.
POSTDOCTORAL FELLOWS

The period between obtaining a doctorate and acquiring that first ‘real’ job is critical to the development of a young scientist. Postdoctoral fellows receive training and research experience that equips them to head their own successful research efforts. The Department has attracted some very talented postdoctoral trainees (39 at present) and is committed to supporting post-doctoral training in the research laboratory and in career development. We have an energetic group of postdoctoral trainees who have taken the lead in organizing a local postdoctoral training program in the Faculty of Health Sciences. The goal of the program is to provide faculty and postdoctoral fellows with the necessary resources to help our postdocs succeed in their careers, to increase communication between laboratories and to provide a support network for individuals.

The Faculty of Health Sciences Postdoctoral Association (FHSPDA) was formed in the spring of 2009 as a result of a previous initiative from the postdoctoral fellows in the Department of Biochemistry and Biomedical Sciences. Three postdoctoral fellows from the Department of Biochemistry, Leslie Cuthbertson, Emma Griffiths and Eva Szabo, with the support of faculty in the department, organized a Career Planning Workshop that took place on October 21, 2008. There were 55 registered participants for the full-day workshop that included talks from nine speakers on topics including careers in academia and careers in government. The goal of the FHSPDA is to enhance the quality of the postdoctoral experience at McMaster and assist in preparing postdoctoral trainees for their future careers through training seminars and workshops. The FHSPDA will also provide both a social and professional support network for postdoctoral fellows in the Faculty of Health Sciences.

Since then, the FHSPDA has developed its own website http://fhs.mcmaster.ca/fhspda/, held a grant writing workshop and organized the 1st Annual Faculty of Health Sciences Postdoctoral Research Day which took place on June 3rd, 2010. This research day highlighted the work being done by postdoctoral fellows in the Faculty of Health Sciences with talks and poster presentations from close to 40 postdoctoral fellows. The FHSPDA is currently working with the School of Graduate Studies to formalize a training program for postdoctoral fellows.
Advisors and postdoctoral fellows form a unique partnership. We know that the position of postdoctoral fellow is a balancing act in which the postdoc must focus on an advisor’s research agenda while simultaneously becoming proficient at competing for funds and designing independent research programs. The postdoctoral fellow is neither student nor employee, tenure-tracked nor technician. Faculty endeavor to be helpful postdoctoral advisors, recognizing these apprentice scientists as their junior colleagues and mentoring them accordingly. The Department’s goal is to better capitalize on the innovative capabilities of this valuable group of researchers and to increase the number of postdoctoral fellows in the Department.
This past decade has been an absolutely transformative one in the Department, reflected in the name change to Biochemistry and Biomedical Sciences (BBS). The current name better represents the broad nature of our research endeavours, which span scientific disciplines from molecular modeling to stem cell biology.

One of the most visible changes over the past 10 years has been the development of world-class infrastructure arising from both successful CFI applications and the generous financial support of Mr. Michael G. DeGroote. Examples include the McMaster Biophotonics facility (2006) with a range of cutting edge imaging instrumentation, from confocal microscopes to a high content screening instrument; and the first academic high-throughput screening facility in Canada (2002) which was recently expanded as part of the Centre for Microbial Chemical Biology (2009), to include more chemical matter, new robots to support higher density screens and an unparalleled suite of synthetic and analytic instrumentation to follow up promising leads. The CMCB is part of the Michael G. DeGroote Institute for Infectious Diseases Research, a multidisciplinary entity that includes faculty from BBS as well as several other departments. The installation in 2008 of one of the world’s most powerful electron microscopes, the Titan 80-300, has provided an unparalleled opportunity for our structural biologists to gather data on biological molecules at incredible resolution. A world-leading Stem Cell and Cancer Research Institute opened its doors in 2006 with a $10M gift from Mr. DeGroote. The Stem Cell Institute continues to expand with a recent $15M investment from Mr. David Braley and an $11.5M award from the Ontario Ministry of Research and Innovation, both directed at using small molecules to probe stem cell physiology. These investments, and the new research directions that they have enabled, have completely changed the face of BBS research.
The conversion, also 10 years ago, of the Medical Research Council of Canada to the Canadian Institutes of Health Research was accompanied by a welcome infusion of federal funding upon which FHS and BBS have capitalized. FHS has nearly doubled biomedical research funding in the past decade from $19M in 2001-2 to $37M in 2008-9. BBS kept pace, increasing from $2M in 2001-2 to $4M today. The provision of associated indirect costs by CIHR over the last several years has had a welcome impact on the bottom line. In addition to our success in capturing MRC/CIHR and NSERC funding as well as funding from the U.S. NIH, we have garnered research dollars from a broad range of agencies, including the Canadian Cystic Fibrosis Foundation, the Heart and Stroke Foundation and the Ontario Institute for Cancer Research among others, reflecting the wide array of scientific interests in the Department.
Measuring the Department’s return on investment by the University and funding agencies has become a top priority. Of the $7,837,049 in total operating funds for 2008, $4,979,265 was Tri-Council funding (an increase of 40% since 2004/2005). The Department is research-intensive and prides itself on a reputation for excellence and rigor in biomedical research and brought in over 10% of the total amount of research monies to the Faculty of Health Sciences in 2007/2008. Of the 42 faculty members currently associated with BBS, 25 are core, 6 are joint members and 11 are associate members, 3 of which are clinician scientists. The Department culture is one where multiple investigator-driven grants are expected and encouraged (6 collaborative/partnership/team grants), whether it is multiple departmental members, consortia of investigators from across the institution, or multi-institution efforts. Most faculty members hold more than one peer-reviewed grant (total of 78 operating grants and 12 salary awards for 25 core faculty).

Our ambition is to be a premier site of biomedical research in the country and to be a hub of multidisciplinary research at McMaster. With the key investments made by the institution in both new and seasoned faculty working in forward-looking focus areas (including stem cells, infectious diseases and antibiotic discovery, chemical biology, cell biology and metagenomics), BBS is rapidly acquiring a reputation as one of the most desirable places in Canada to train at the undergraduate, graduate and post-doctoral levels. As an example of the stellar reputation and performance of BBS scientists, no fewer than 6 of our core faculty have been ranked first overall in their respective CIHR grant panels when applying for operating funds in the last two years, an unparalleled achievement.

In addition to producing top quality science, the faculty members of BBS are strongly committed to training the next generation of leading scientists. Our undergraduate program offers hands-on research experiences as early as the second year, and the majority of our undergraduate courses are tailored to expose our students to the latest techniques, equipment and innovations. Faculty frequently include real-life examples of novel discoveries from their own research programs in their classes, and specific courses are structured to allow small groups of undergraduates to work with senior graduate students on specific aspects of their research. Our graduate program has seen an incredible increase in enrollment that is reflected in the number of degree completions from 8 graduates (6 MSc and 2 PhD) in 2000-1 to 23 graduates (11 MSc and 12 PhD) in 2008-9.

2006—$20 Million awarded to the Centre for Microbial Chemical Biology, the largest CFI/ORF award at McMaster and one of the largest CFI awards in Canada
One of the major strengths in BBS is the cross-fertilization of ideas realized through collaborations, both within McMaster and outside, across disciplines that may not have traditionally worked together. The application of multiple approaches ranging from biophysics to cellular physiology to chemical biology to a single research question can result in an unprecedented ability to generate new insights.

2006 — Brian Coombes, Assistant Professor, won the prestigious ICAAC Young Investigator Award from the American Society for Microbiology in a world-wide competition.

Our intellectual capital has leverage, but imagination capital is the secret ingredient to our future success (core faculty currently have 34 provisional or published patents). It is part of the Department’s mission to pursue every avenue of research funding, collaboration and intellectual property available in order to compete and achieve results with the world’s best scientists. Awareness of and focus on global innovation, while managing our resources effectively, are necessary if we are to gain and sustain a competitive edge.

Looking forward, we aim to continue our upward trajectory, sustaining the excellence of our undergraduate and graduate programs and continuing to capitalize on new opportunities as they arise. Our vision is to be a globally recognized research enterprise with reputation for exceptional quality in scientific discovery, training and innovation.
MICHAEL G. DEGROOTE
INSTITUTE FOR INFECTIOUS DISEASE RESEARCH

The Michael G. DeGroote Institute for Infectious Disease Research (IIDR) was founded in 2007 to facilitate, stimulate, and encourage research at McMaster in virology, bacteriology, mycology, and parasitology that spans the bench to the clinic. Our founding principles of multidisciplinary and research excellence immediately lead to a natural alliance with the Department of Biochemistry & Biomedical Sciences. The traditions of scientific rigor, cross-disciplinary research, collaboration, and success in peer reviewed funding that are hallmarks of the Department are equally central to the IIDR. The IIDR immediately benefited from strategic investments in faculty, staff, and training in the Department made over several years. Indeed these resulted in a critical mass of researchers working on fundamental aspects of infectious disease that served as a nucleus to coalesce the establishment of the IIDR.

Over the past three years, the IIDR has worked together with the Department of Biochemistry & Biomedical Sciences to develop a world-class group of researchers, trainees, and enabling infrastructure that together make McMaster a key location of infectious disease research. Furthermore, the investments and focus of the Department in Chemical Biology, have served to distinguish the IIDR and McMaster as uniquely capable to explore infectious disease biology from a chemical perspective. Chief among these investments has been the establishment of the Centre for Microbial Chemical Biology that is managed by the IIDR with support of the Departments. This Centre brings outstanding infrastructure that support research at the interface of Chemistry, Biochemistry, Environmental Science, and Biology together in recently constructed multipurpose lab space. The Centre is the direct result of strategic investments made by the Department of Biochemistry & Biomedical Sciences over the past decade and now serves as a magnet for new faculty, trainees, and provides infrastructure to support world-leading research and opens up unique opportunities for translation and commercialization of fundamental research.

The present and future successes of the IIDR are the direct result of the vision of the Department of Biochemistry & Biomedical Sciences to support cooperation and collaboration across McMaster and to enable researchers to take risks and strive for excellence. The IIDR looks forward to working with the Department to support new initiatives and continue to maintain our common goals of excellence and innovation.

Gerry Wright, Director

2006 — Vanessa D’Costa, PhD student in Gerry Wright’s lab publishes a first author paper in the January 20th issue of Science
McMaster’s Stem Cell and Cancer Research Institute (SCC-RI) was founded in 2006 as part of the strategic vision of McMaster University within the Faculty of Health Sciences. Since then, SCC-RI investigators who are appointed to the Department of Biochemistry & Biomedical Sciences, have sought to exemplify the core values of the University by contributing to the body of scholarship in the area of stem cell and cancer biology through the pursuit of research excellence and training.

Over the past four years the Institute and the Department of Biochemistry & Biomedical Sciences (BBS) have forged a close alliance based on common goals held within a shared vision for the future of McMaster as a research-intensive university. The department’s standards for academic excellence have provided an exceptional pool of undergraduate and graduate students that enhance the Institute’s environment of learning and discovery. The SCC-RI and BBS also share a common vision for the importance of providing a first class training and mentorship program for post-graduates. Over the past two years, the Institute and the Department have worked together to provide opportunities for post-doctoral fellows and enrich their training experience at McMaster towards the goal of obtaining rewarding careers in science that embrace sectors beyond academia, and include government, industry and health care policy development.

The Department of BBS has been instrumental in fostering an environment that leads to collaboration and provides a foundation for research innovation. Together, researchers from the SCC-RI, the Michael G. DeGroote Institute for Infectious Disease Research and the BBS department have forged an important collaboration which integrates strengths across disciplines including stem cell biology, chemistry, high throughput screening and high content screening to develop a novel platform for drug discovery. This new initiative will further strengthen the relationship between the department and the SCC-RI by underscoring our common goals and demonstrated commitment to research excellence. The SCC-RI appreciates the continued support of the Department of BBS and acknowledges the importance of this relationship to its long-term success and sustainability.
David Andrews

The Andrews lab is investigating the functions of tail-anchored membrane proteins including: the molecular mechanisms by which Bcl-2 family proteins regulate apoptosis and the response of cancer cells to chemotherapy, the roles of tail-anchor proteins in the assembly of intracellular membranes and organelles, and signaling by tail-anchor proteins involved in differentiation of stem cells.


Paul Berti

The Berti lab studies enzyme mechanisms and transition states. Our goals are to better understand catalysis, and to create new enzyme inhibitors that will one day lead to new therapies. Trainees in the Berti lab use tools ranging from molecular biology to computational chemistry to understand how enzymes work.


Mick Bhatia’s research examines the parallels between the behaviour of human stem cells and the initial stages of the development of human cancer in order to advance understanding of how cancer begins.


Eric Brown

Eric Brown’s Laboratory is tackling multi-drug resistant bacteria with research into new avenues for antibacterial therapies. Trainees in the Brown Research Group are using the tools of bacterial genetics, biochemistry and chemical biology to understand and subvert the remarkable survival strategies of bacteria.

Chemical Genomics identifies an inhibitor of bacterial lipoprotein targeting.
Nature Chemical Biology, 5:849-56.

Known bioactive small molecules probe the function of a widely conserved but enigmatic bacterial ATPase, YjeE.
Chemistry and Biology, 15:1287-95.

Lesions in teichoic acid biosynthesis in Staphylococcus aureus lead to a lethal gain of function in the otherwise dispensable pathway.

Studies of the interaction of Escherichia coli YjeQ with the ribosome in vitro.
Journal of Bacteriology, 186:1381-1387.

High throughput screening identifies inhibitors of the SARS coronavirus main protease.
Chemistry and Biology, 11:1445-1453.

Russell Bishop

Russell Bishop’s Laboratory is focused on one of the most important and challenging problems in contemporary biochemistry; namely, the structure and function of membrane proteins. Trainees in the Bishop Research Group are integrating genetics, biochemistry, and chemical biology to determine how the bacterial outer membrane permeability barrier provides resistance to antibiotics.

PagP activation in the outer membrane triggers R3 core oligosaccharide truncation in the cytoplasm of Escherichia coli O157:H7.

Gauging a hydrocarbon ruler by an intrinsic exciton probe.
Biochemistry, 46:4565-4579.

Lipid trafficking controls endotoxin acylation in outer membranes of Escherichia coli.

A hydrocarbon ruler measures palmitate in the enzymatic acylation of endotoxin.
EMBO J., 23:2931-2941.

Solution structure and dynamics of the outer membrane enzyme PagP by NMR.
Lori Burrows

The Burrows laboratory studies bacterial motility, protein secretion and biofilm formation. We are interested in how complicated structures like type IV pili and type II secretion systems involved in bacterial virulence are assembled in the bacterial cell envelope and cross the peptidoglycan layer that holds the cell together. We are also interested in finding small molecules that affect motility, secretion and biofilm formation; such compounds have the potential to lead to new types of drugs that impair bacterial pathogenicity without actually killing the cells.


John Capone

The Capone lab studies Eukaryotic gene expression and regulation/mammalian and viral transcription factors/nuclear hormone receptor.


Brian Coombes

Brian Coombes’ laboratory performs research on the molecular and genetic basis of bacterial virulence. The aim of this research is to understand how bacterial pathogens alter host cell biology to subvert innate immunity, promote bacterial pathogenesis and to alter the progression and outcome of disease following infection of hosts.


Bradley Doble

Brad Doble’s Laboratory is studying the mechanisms regulating the unique properties of stem cells. Techniques used in the Doble lab include: targeted gene manipulation in cells and animals; stem cell differentiation assays (embryoid bodies and teratomas); live cell imaging; biochemical analyses of signaling pathways; and proteomic and genomic analyses.

GSK-3 is a master regulator of neural progenitor homeostasis.

The ground state of embryonic stem cell self-renewal.

Phosphorylation by p38 MAPK as an alternative pathway for GSK3beta inactivation.
Science. 320(5876):667-70.

Glycogen synthase kinase 3alpha-specific regulation of murine hepatic glycogen metabolism.
Cell Metab. 6(4):329-37.

Functional redundancy of GSK-3alpha and GSK-3beta in Wnt/beta-catenin signaling shown by using an allelic series of embryonic stem cell lines.

Jon Draper

Jon Draper’s research at McMaster seeks to expand our understanding of the mechanisms that guide the differentiation of human ES and iPS cells along discrete lineages into tissue that are relevant to clinical therapies and drug discovery.

Recurrent gain of chromosomes 17q and 12 in cultured human embryonic stem cells.

Specific Knockdown of Oct 4 and ß2-microglobulin Expression by RNA Interference in Human Embryonic Stem Cells and Embryonic Carcinoma Cells.
Stem Cells. 22(5):659-68.

Shared patterns of gene expression between human embryonic stem cells and human pluripotent germ cell tumours.
P.N.A.S. 100(23): 13350-5.

Preimplantation human embryos and embryonic stem cells show comparable expression of stage-specific embryonic antigens.
Stem Cells 20, 329-37. * JKH and JSD contributed equally to this work.

Surface antigens of human embryonic stem cells: changes upon differentiation in culture.
J Anat 200, 249-58.
FACULTY TOP FIVE PUBLICATIONS

**Richard Epand**

Richard Epand’s lab has an interest in the functions of biological membranes. The membrane provides a unique environment for organizing molecules and for dividing compartments. Studies range from the properties of proteins in membranes to the study of membrane components in living cells.


**Cécile Fradin**

Cécile Fradin’s lab is interested in studying the dynamics of single molecules inside biological systems using optical tools. Dynamics is essential to the survival of the cell, which is a biological unit in permanent evolution, and which has to be able to process and react to information. Dynamical processes inside the cell happen on a very wide range of length and time-scales, and are governed by complex and intricate rules and mechanisms. At the scale of the molecule, they are of interest for the physicist as well as for the biologist, since they involve basic transformation of chemical or thermal energy into mechanical energy. In order to unravel their exact mechanisms, in vivo quantitative measurements at the single molecule level are required, which recent developments in the domain of fluorescence techniques, single molecule detection, and recombinant protein technology now offers the possibility to do.


Alba Guarné

Alba Guarné’s Laboratory studies how cells coordinate DNA replication and DNA repair to ensure that their genetic information is faithfully passed onto the progeny. Trainees in the Guarné Research Group use X-ray crystallography, biochemistry, molecular and cell biology to understand the mechanisms that regulate these essential processes.


Crystal structure of a SeqA-N filament: Implications for DNA replication and chromosome organization. EMBO J 24(8), 1502-1511.

Crystal structure of the MutL C-terminal domain: a model of intact MutL and its roles in mismatch repair. EMBO J 23(21), 4134-4145.

Insights into negative modulation of E. coli replication initiation from the structure of SeqA-hemimethylated DNA complex.
Nature Structural Biology 9(11), 839-843.

Structure and function of the N-terminal 40 kDa fragment of human PMS2: a monomeric GHL ATPase. EMBO J 20(19), 5521-5531.

Radhey Gupta

The Gupta lab’s main research involves studies on functional and evolutionary genomics, studies on mitochondrial and heat shock proteins and studies on adenosine kinase and related enzymes.


Gupta, R.S. 2000.
Phylogeny of Proteobacteria: Relationships to other eubacterial phyla and to eukaryotes.

Soltys, B.J., Kang, D. and Gupta, R.S. 2000

Soltys, B.J. and Gupta, R.S. 2000.
Mitochondrial-matrix proteins at unexpected cellular locations: Export of proteins from mitochondria from an evolutionary perspective.
Int. Rev. of Cytology. 194: 133-196.
John Hassell
The Hassell lab’s main research areas are cancer biology, therapeutics and biochemistry.

Role of the PEA3 Ets transcription factors in mammary gland development and oncogenesis.
J. Mam. Gland Biol. and Neoplasia 8:175-188.

Role of Ets transcription factors in mammary gland development and oncogenesis.

Ras Regulation of the Cyclin D1 Promoter.

b-catenin and the PEA3 subfamily of Ets transcription factors synergistically activate matrilysin transcription.

The PEA3 Ets transcription factor comprises multiple domains that regulate transactivation and DNA binding.

Paul Higgs
The Higgs lab’s main research areas are Biophysics and Bioinformatics.


OGRe: a relational database for comparative analysis of mitochondrial genomes

The influence of predator-prey population dynamics on the long-term evolution of food web structure.

Higgs, P.G. 2000.
Quart. Rev. Biophys. 33, 199-253.
Decade in Review - Biochemistry & Biomedical Sciences

Top Five Publications

Murray Junop

Research in the Junop lab is focused on understanding the molecular mechanisms governing the repair of various types of DNA damage. Bacterial, yeast and human repair pathways are studied using a variety of genetic and biochemical tools with the primary emphasis being determination of macromolecular structure using X-ray crystallography.

Structural and functional interaction between the human DNA repair proteins DNA ligase IV and XRCC4.

Rifamycin antibiotic resistance by ADP-ribosylation: Structure and diversity of Arr.

Crystal structure of human XLF: a twist in nonhomologous DNA end-joining.

Composite active site of an ABC ATPase: MutS uses ATP to verify mismatch recognition and authorize DNA repair.
Mol Cell. 7(1):1-12.

Crystal structure of the Xrcc4 DNA repair protein and implications for end joining.
EMBO J. 19(22):5962-70.
Yingfu Li

Yingfu Li’s Laboratory investigates novel functions of DNA and RNA as enzymes and receptors and utilizes these so-called ‘functional nucleic acids’ for innovative applications in areas including biosensing, and biomedicine and nanotechnology. Researchers in the Li Group explore a variety of chemistry, biochemistry and chemical biology approaches to discover desirable functional nucleic acids and study their properties.

Nucleic acid aptamers and enzymes as sensors.

In vitro selection of structure-switching signaling aptamers.

Dinucleotide Junction cleavage versatility of 8-17 deoxyribozyme.

Structure-switching signaling aptamers.

An efficient RNA-cleaving DNA enzyme that synchronizes catalysis with fluorescence signaling.

Nathan Magarvey

The Magarvey lab’s research includes Natural Product Biosynthesis & Drug Discovery, Microbial Metabolomics, Small molecule/chemical signaling.

Staphylococcus aureus Nonribosomal Peptide Secondary Metabolites Regulate Virulence.
Science (DOI: 10.1126/science.1188888).

Gatekeeping versus Promiscuity in the Early Stages of the Andrimid Biosynthetic Assembly Line.

Polyunsaturated fatty acid-like trans-enoyl reductases utilized in polyketide biosynthesis.

A transglutaminase homologue as a condensation catalyst in antibiotic assembly lines.
Nature 448, 824-827.
The Melancini lab is primarily interested in two main fields of research: the allosteric conformational switches that control signaling pathways and the early steps of amyloid fibril formation.


**Joaquin Ortega**

Joaquin Ortega’s Laboratory is studying the structure and dynamics of macromolecular machines that are responsible for vital cellular functions. Trainees in the Ortega Research group use cryo-electron microscopy to describe the structure of these subcellular assemblies that are either too large or too heterogeneous to be investigated using other structural techniques.


**Justin Nodwell**

Research in the Nodwell laboratory concerns the phenotypic responses of bacterial cells to antibiotics, intermolecular signals and other small molecules. These responses include antibiotic resistance, antibiotic biosynthesis and changes in developmental state.


O’Connor, T.J., Kanellis, P. and Nodwell, J. 2002. The ramC gene is required for morphogenesis in Streptomyces coelicolor and expressed in a cell type specific manner under the direct control of RamR. Molecular Microbiology. 45: 45-57.
Bernardo Trigatti

Bernardo Trigatti’s Laboratory is investigating the molecular mechanisms involved in the development of atherosclerosis, with a particular focus on influence of the metabolism and cellular responses to high density lipoproteins. Trainees in the Trigatti Lab utilize molecular targeted genetic approaches in mouse model systems and cell biological tools to probe a variety of cellular pathways that impact lipoprotein metabolism and vascular remodeling.


**Ray Truant**

Our laboratory is interested in how proteins move throughout the cell’s organelles in humans. We have successfully implemented and developed new tools to look at how proteins move within live cells. We are also interested in the discovery of new protein-protein interactions by biochemical methods in vitro, and analysing these interactions in living cells in vivo. We are currently focusing our research on a series of genetically inherited neurodegenerative diseases that all have one basic biochemical defect in common: CAG DNA sequences >36 repeats in the gene’s open reading frame that translate to glutamine amino acid stretches in the disease protein. These diseases are collectively referred to as Polyglutamine expansion diseases.


**Geoff Werstuck**

Geoff Werstuck’s Laboratory is searching for the molecular mechanisms that will explain why four out of five people with diabetes mellitus will die from heart attack or stroke. The lab uses a broad investigations, to identify potential therapeutic targets.


Gerard Wright

The Wright lab is interested in several aspects of antibiotic chemical biology. These include mechanisms and evolution of antibiotic resistance elements through a process called Genomic Enzymology, new ways to overcome resistance, and determination of the mode of action of antibiotics and identification of new antimicrobial targets and agents. The latter includes manipulation of antibiotic biosynthetic genetic programs, high throughput screening methods, and natural product isolation.


The Antibiotic Resistome: The nexus of chemical and genetic diversity.

Sampling the antibiotic resistome.

Assembling the glycopeptide antibiotic scaffold: The biosynthesis of A47934 from Streptomyces toyoaensis NRRL15009.

DeLaBarre, B., Thompson, P.R., Wright, G.D. and Berghuis A.M. 2000.
Crystal structures of homoserine dehydrogenase from Saccharomyces cerevisiae suggest a novel catalytic mechanism for oxidoreductases.
Nature Struc. Biol. 7:238-44

Daniel Yang

The Yang lab’s research includes protein crystallography, protein engineering, structure and function of anti-freeze, ice nucleation and bone proteins.

An engineered right-handed coiled coil domain imparts extreme thermostability to the KcsA channel.
FEBS J. 276(21):6236-46. Epub

Characterization of the C-terminal Domain of a Potassium Channel from Streptomyces lividans (KcsA).

Self-cleavable stimulus responsive tags for protein purification without chromatography.

Theoretical study of interaction of winter flounder antifreeze protein with ice.

Bone recognition mechanism of porcine osteocalcin from crystal structure.
Boris Zhorov’s Laboratory develops and applies computational methods to better understand structure and dynamics of ion channels. These transmembrane proteins play important roles in cell physiology. We simulate interactions of ion channels with toxins and medically important drugs and formulate hypotheses, which are tested in collaboration with experimentalists.


