

COLLEGE OF BIOLOGICAL SCIENCE

INTEGRATED PLANNING SUBMISSION

2011/12

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1. Executive Summary

Since the institution of the Integrated Planning process, the College of Biological Science has achieved several of its goals and made significant progress on others. These include:

1. The successful introduction of a new program in Kinesiology with the University of Guelph-Humber with a total of over 300 students enrolled since its inception in 2008
2. A successful \$17.5M application to CFI/MRI to build a Centre for Biodiversity Genomics, expanding the scope and capacity of the Biodiversity Institute of Ontario.
3. Approval of an integrated suite of three modular first year units to improve the undergraduate learning experience in the first year of science Majors and other programs which access these courses, and which has also lead to revision of second level offerings.
4. Complete overhaul of the Microbiology undergraduate program with new courses approved for Fall 2011.
5. Continued consolidation of courses to minimize duplication and maintain quality and diversity in undergraduate classes.
6. 14% increase in domestic eligible graduate students over the previous year.
7. Relocation of the Human Anatomy undergraduate laboratories to new facilities in the Ontario Veterinary College
8. Managing continued pressure on undergraduate enrolment, with intake figures which are now higher than during the peak of the “Double Cohort”.
9. Expanded outreach into high schools, community colleges and private colleges through the Anatomy program, which will now be expanded into other areas of activity.
10. Continued success in the number of Early Researcher Awards (MRI) and Leaders Opportunity Funds (CFI) received by young faculty.
11. Development of budgetary and management plans for the Advanced Analysis Centre.
12. Development of fundraising goals in areas related to the Better Planet Project.
13. Identification of savings which will be made to address the fiscal targets identified in the University’s Multi Year Plan.

Our future plans include:

1. Increasing revenue generation through collaborative partnerships with community/private colleges.
2. Construction of the Centre for Biodiversity Genomics, with anticipated completion in 2011.
3. Evaluation and revision of 2nd level foundational courses in Genetics, Cell Biology, and Molecular Biology to build on the new First year Biology experience
4. Expansion of the Guelph-Humber Applied BSc in Kinesiology through maintenance of 3rd level entry via a Summer bridge semester, in parallel with flow-through from students completing the first two years. This will raise the anticipated steady-state number of students from the initial target of 200 to approximately 350.
5. Extensive fund-raising activities as part of the University’s 2014 Campaign aimed at securing strategically important Chairs, infrastructure and scholarships.
6. Establishment of a business plan for the Biodiversity Institute of Ontario

2. Vision

The College of Biological Science is an internationally renowned centre of excellence for basic and strategic research and learner centredness in life science at the University of Guelph. It will continue to play a major role in fostering innovative, interdisciplinary, and discipline-based studies across campus and beyond. To meet the expanding demands of the knowledge-based economy and the need for highly qualified personnel with the appropriate balance of skills, innovative thinking, and social responsibility, we will expand our role in graduate education in key areas related to Food, Health and the Environment, and foster pedagogically-driven enrichment of the undergraduate curriculum. We will enhance our ability to attract the brightest and best scholars at all levels from around the world, and encourage internationalism through expanded collaboration and partnerships. As a research intensive College we will develop the necessary infrastructure to sustain and expand our activities and provide leadership in areas that link the Life Sciences (including OAC and OVC) with the Physical Sciences, Mathematics and Computing. As the Life Sciences continue to dominate innovation, technology and global conservation in the 21st century, with profound impact on culture and society, we will seek to develop a shared vision with constituencies concerned with matters of ethics, public policy, and business to ensure effective knowledge transfer that is respectful of our role in stewardship and the shaping of societal values.

3. Mission

Our mission is to make fundamental discoveries in the life sciences and to disseminate these for the betterment of humankind and the sustainability of the natural environment.

Our goals are to:

- understand the fundamental mechanisms that underpin life from the level of the molecule to ecosystems in humans, plants, animals and microorganisms
- build and apply knowledge through our teaching and research, fostering enquiry-based approaches and skills development
- enhance the human condition and that of our biologically diverse planet through a better understanding of health, disease, and the interplay between preventive and remedial intervention
- comprehend the causes and consequences of biological variation and environmental sustainability
- focus our collective efforts on helping bring Guelph its due recognition as one of the leading international centres for biological research and education

4. Planning and Horizons

4.1 Direction

- A. In order to position the College to take full advantage of its own resources and to foster excellence in research and teaching and to meet the challenges of the future, CBS embarked upon a process of integrated planning in 2002. This culminated in the reorganization of the College, approved by Senate in May 2004 and the establishment of a bold hiring plan that has provided a strong foundation for:
- enhanced academic interactions and appointments in areas such as Structural Biology, Biocomplexity, Comparative Animal Physiology, Developmental Biology, Evolutionary Biology, and Human Health and Metabolism
 - external recognition through discipline-based and interdisciplinary research funding, exemplified by four major CFI infrastructure awards (“Membranes and Surfaces in Diseases and Natural Environments”, “Applied Evolution”, the “Biodiversity Institute of Ontario and most recently the Centre for Biodiversity Genomics ”)
 - a renewed focus on the quality of the undergraduate experience with proposals for significant curriculum redevelopment, particularly in first year.
- B. Over the remaining period of this plan we will, within the College and in collaboration with others:
- continue to provide new learning experiences for students that will prepare them for the future through a revitalized curriculum, and provide them with the tools necessary for lifelong learning
 - recruit the most promising students and at the graduate level provide funding that is competitive with our peer institutions
 - enhance our physical infrastructure to prosecute more effectively our goals in research and teaching through the acquisition of new facilities and improved laboratories
 - foster multi and inter-disciplinary initiatives within the College and beyond to create new opportunities and provide critical mass in emerging areas such as bioinformatics, health and food, biodiversity, bioengineering, water, and nanoscience
 - sustain and enhance our international links and opportunities for students through collaborative ventures with partners outside Canada
 - recruit leading scholars from around the world to join our faculty
 - enhance our fundraising activities as part of the University campaign “The Better Planet Project” in areas of Health, Food, Environment and Communities.

4.2 Fiscal environment

The University is faced with a structural deficit which requires that a total of \$46M be removed from the operating budget by 2012. The College of Biological Science is faced with a reduction of \$4.4M in operating dollars over this period, representing more than 22% of current costs.

	Savings Targets (\$ thousands)				4 Year Total
	2008/09	2009/10	2010/11	2011/12	
CBS	481	1,571	1,550	798	4,400

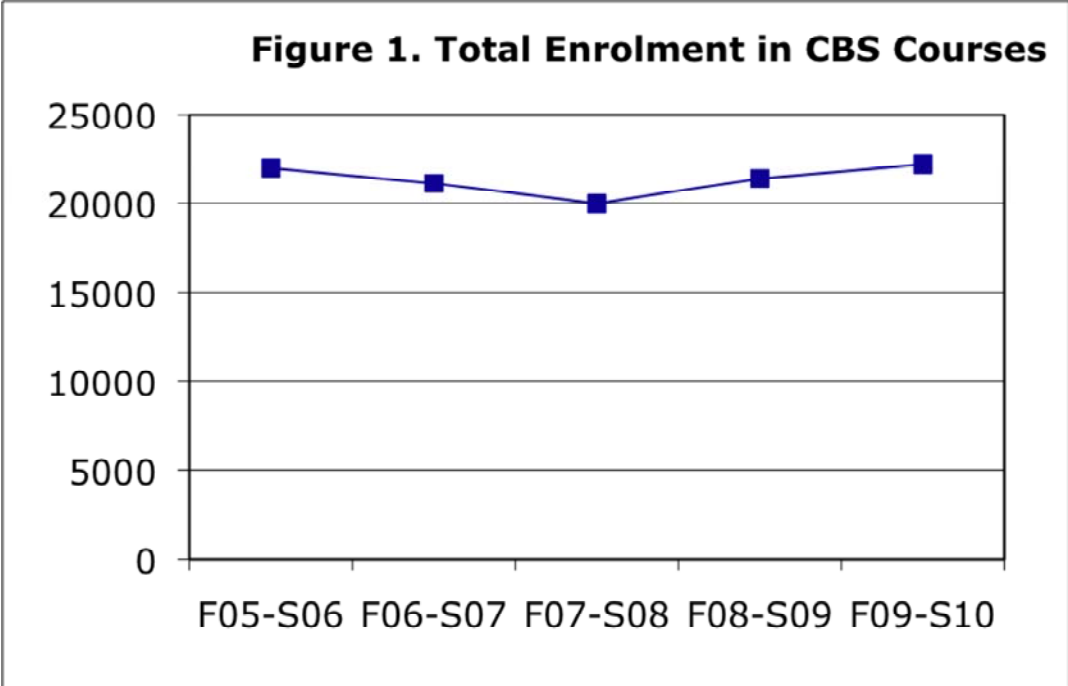
The College has identified approximately 100% of its overall target, achievement of which will be phased beyond 2012. The Dean is working with the Provost and AVP Finance to develop a strategy to meet the targets whilst maintaining program integrity. A significant, actual reduction in base costs may be possible in the next two years but is largely dependent on faculty turnover which is uncertain and beyond the College's control. The College will continue to pursue all aspects of fiscal restraint necessary in the achievement of the planned reductions in operating budget, but is faced with a significant challenge because of demographics, coupled with the dilemma of how to maintain quality in its graduate and undergraduate programs. In order to reach these targets there is little opportunity for strategic decision making and, by and large, we have had to capitalize opportunistically on resignations and retirements. The College restructuring of 2004 resulted in significant economies of scale through consolidation of departments, centralization of purchasing in the Science Complex, and centralization of graduate administrative support through the office of the Associate Dean Research. Thus, any further staff reductions will have serious ramifications for program delivery. Revenue to the university is also being generated by a highly successful undergraduate program in Kinesiology at the University of Guelph-Humber which has expanded significantly.

5. Curriculum

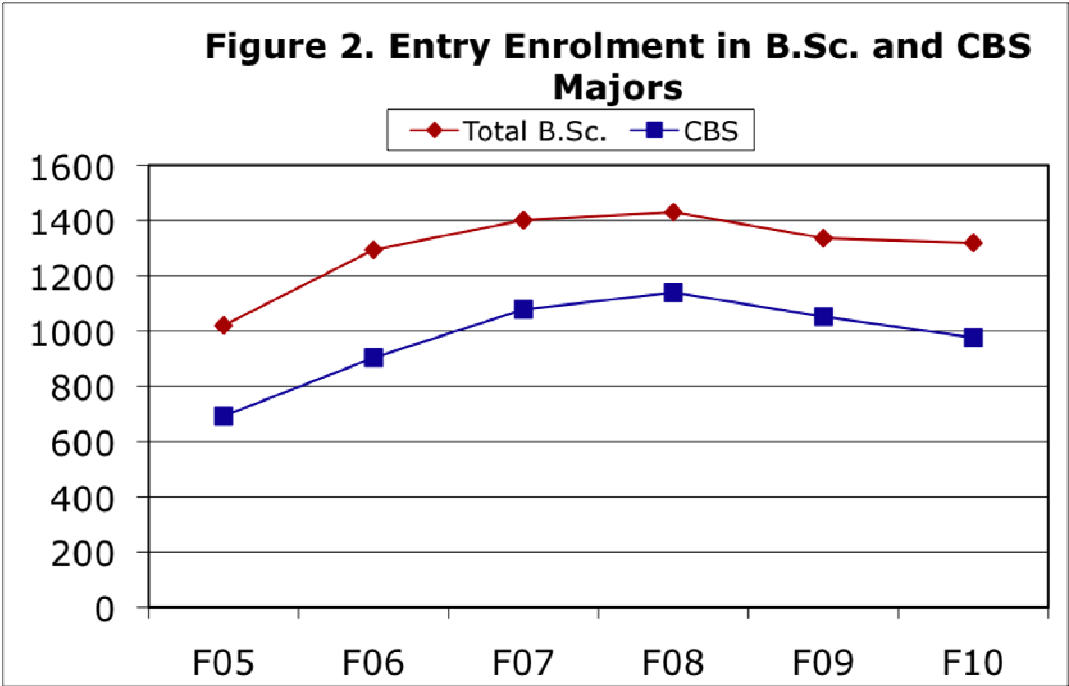
5.1 Undergraduate

5.1.1 Current Status

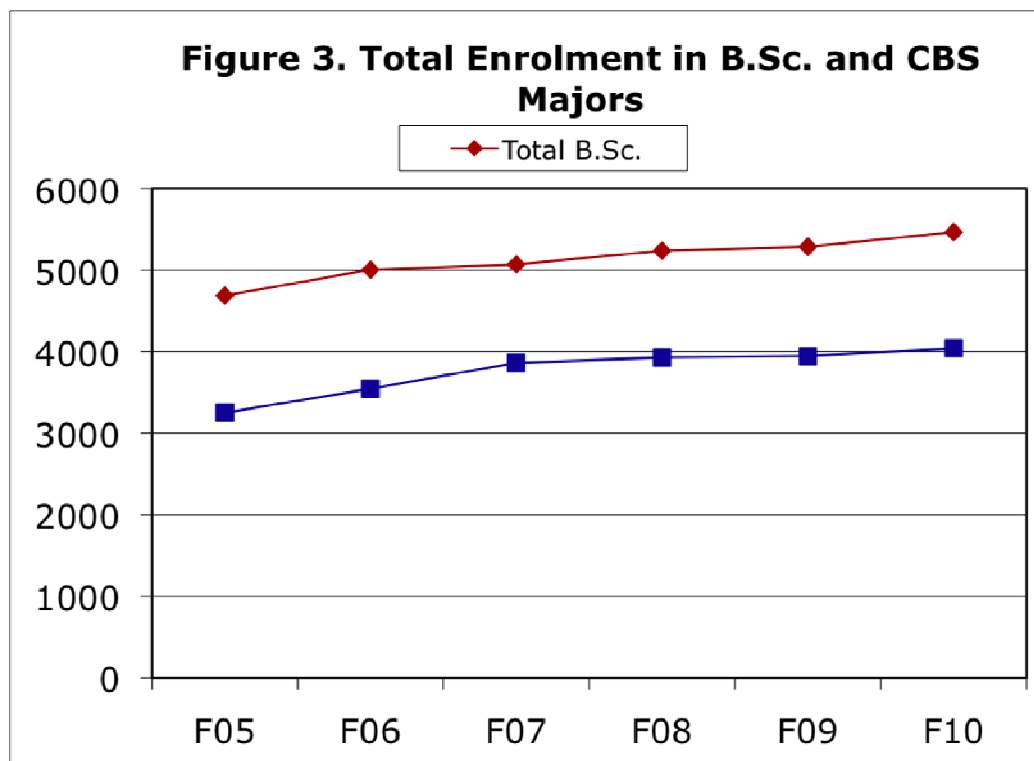
The College of Biological Science offered 165 undergraduate courses (counting multiple offerings) last year including 9 at 1000 level, 28 at the 2000 level, 41 at the 3000 level and 87 at the 4000 level. Over the five-year interval between 2005/2006 and 2009/2010, CBS courses had a 1% increase in total enrolments (total enrolments for 09/10 = 22217; Figure 1) and a 4% increase in FTE undergraduate enrolments (FTE for 09/10 = 2339; trend not shown).



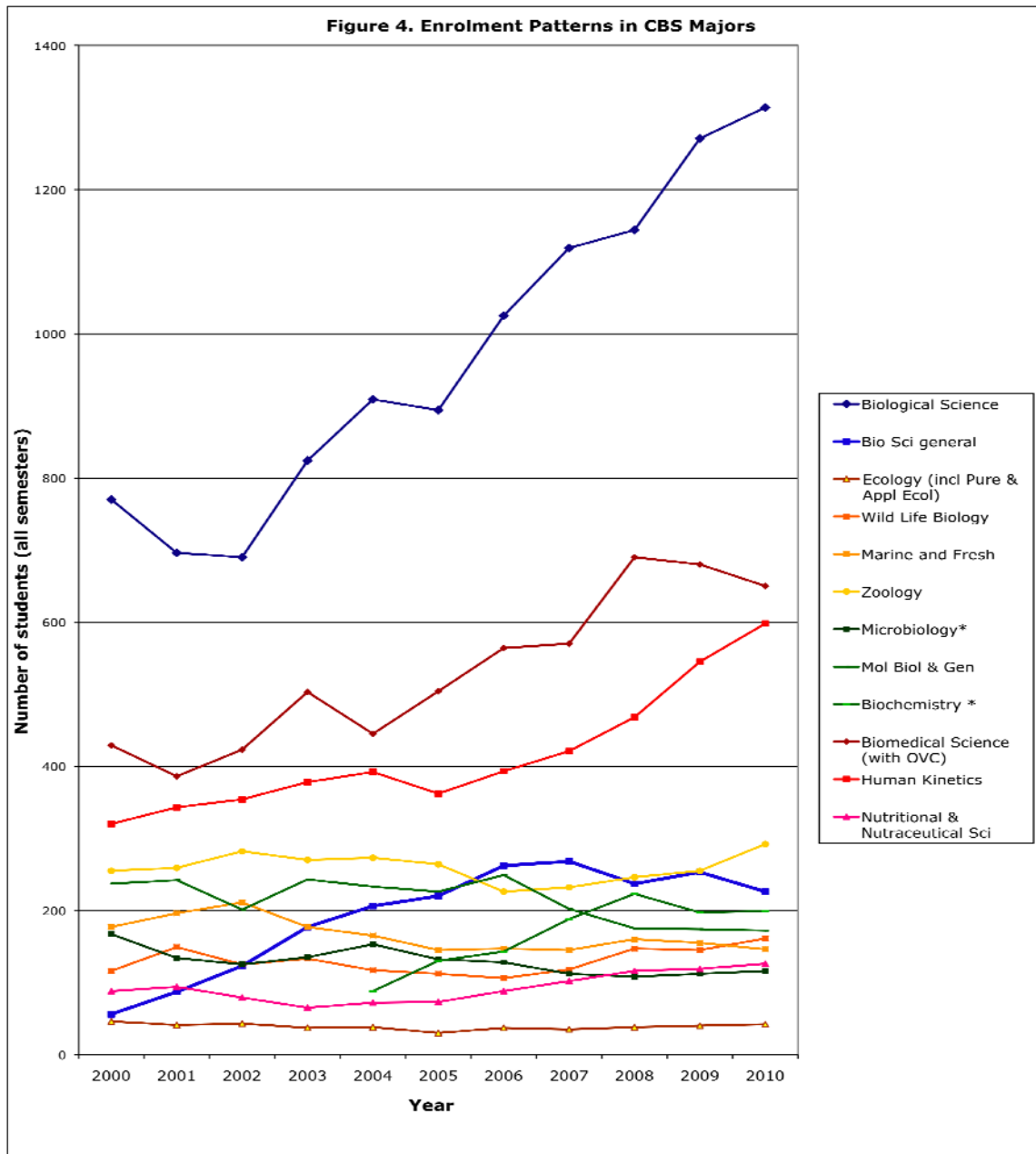
In Fall 2010, the entering enrolment in the entire B.Sc. program rose by 29% over fall 2005 levels, while entry into CBS majors rose by 41% over the same time interval (Figure 2). Compared to Fall 2009, entering enrolment dropped by ~7% (Figure 2). This trend is likely associated with attempts to manage rising enrolments in some already large CBS specializations (e.g. Biomedical Science). Nevertheless, the number of students entering CBS Majors exceeds the intake level during the “Double-cohort” year (F03) by 4.5%, and this continues to add pressure to course offerings as students flow through to senior level courses.



Across all semesters, the number of students enrolled in CBS majors (+ Bio Sci General) was 4042, a rise of 24% since fall 2005 (Figure 3). These students represent 74% of the entire B.Sc. student body.



Most students in the B.Sc. program participate in a common core in first year, which provides a foundation in biological and physical sciences and serves as a platform for flexible choice in subsequent years. Approximately 74% of students who enter the B.Sc. program are registered in one of 11 CBS Majors (not including PLSC and TOX, which are reported as OAC and CPES, respectively), which integrate concepts from the level of molecules to ecosystems, cover all kingdoms of organisms and, through opportunities for independent study, make direct linkages to the university's strategic research strengths in Health, Food and Environment. In Fall 2010, enrolment patterns remained stable or increased in 8 of the 11 Majors (Figure 4). Considerable growth (>10%) occurred in Wild Life Biology (11%), Zoology (14%) and Human Kinetics (10%). The three largest majors - Human Kinetics, Biomedical Science and Biological Science - continue to attract large numbers of students and pose particular challenges for maintaining a high quality learning experience. However, total enrolment in Biomedical Science declined by 4% this year, possibly due to competition with biomedical-related programs in neighbouring universities and at University of Guelph.



Within CBS, students have a diversity of learning opportunities and experiences available to them. The new first year biology courses (BIOL*1070, 1080, 1090) emphasize inquiry-based learning, through inquiry-skill workshops and case studies, and promote integration and group work through cross-course interactions. Field and laboratory work starting in year two are a critical component of all CBS Majors and reinforce inquiry-based approaches through opportunities for experiential learning. **It is in these areas that our ability to sustain the quality of the student experience has been most challenged.** Opportunities for integrative and independent inquiry are central to some 3000 level and several 4000 level research project courses. In the average academic year, some 550 fourth year CBS students participate in hands-on, laboratory- or field-based independent research projects, ranging from 1-2 semesters. These

opportunities are supported largely by externally funded, faculty research operating grants. Workplace experience is gained through two particularly strong Co-op programs in Microbiology and Biochemistry. Complementary to lecture, laboratory work and fieldwork, other pedagogical innovations are being developed in our courses to offer a range of learning experiences, including: development of hybrid-format (increased out-of-class and web-supported learning, online discussion groups, improved student-web interface) in first-year biology, widespread use of newly developed online tools for writing and peer review, simulations and DE delivery. We also contribute to inter-disciplinarity at the undergraduate level through specializations in Ecology (BSES), Plant Science (B.Sc.), Toxicology (B.Sc.), Neuroscience (B.Sc. minor), and the Bachelor of Arts and Science.

5.1.2 Integrative Planning Goals

National and local student surveys (NSSE, CBS) suggest that students are engaged and satisfied with their programs in relation to comparable ‘deep’ schools in the United States, however recent pedagogical research and guiding documents such as the U of Guelph 21st Century document reinforce the potential for further enhancing the student experience. In an attempt to maintain and enhance student learning throughout programs, our main goals in undergraduate education are to:

- Increase student engagement in first year through reform of foundational core and increase focus on integrative problems, broad concepts and skills of inquiry.
- Improve the progression of skills and knowledge into second year and throughout the curriculum using curriculum mapping exercises, coordinated planning across courses and appropriate reform;
- Develop a sustainable and flexible curriculum by seeking efficiencies, removing redundancies and strategically supporting signature courses and value-added programs.

5.1.3 Recent Progress

In the last iteration of the integrated planning process, a number of initiatives were highlighted. Substantive progress has been made in several areas and begun in others, including:

- The Life Science part of the B.Sc.
- The new Guelph-Humber program in Kinesiology is in its third year and continues to attract large numbers of students. In fall 2010, a total of 136 new students were admitted through the bridge semester into 3rd year (58) and at entry level in 1st year (78). In total, 301 students are currently enrolled across all years, well above the original enrolment target (200).
- A business plan was approved to expand the Guelph-Humber program in Kinesiology. In contrast to the original intent, this model would continue to admit students into 3rd year through the bridging semester. As a result, we expect total enrolment in the program to grow from the original 200 students to 352.
- The Anatomy teaching lab, which supports the expanding demand for courses in our Majors, the Guelph-Humber program and a very successful outreach program, has been relocated to a new anatomy lab in OVC. This is now supporting teaching of anatomy for humans (both dissection and prosection offerings) and animals and represents a unique opportunity for collaboration between CBS and OVC.

- After approval in Fall 2009, the new 1st year biology modules were offered for the first time in Fall 2010. They comprise three interconnected modules – Biological Concepts of Health, Discovering Biodiversity, and Introduction to Molecular & Cellular Biology- corresponding to the major research and teaching axes in Life Science at Guelph and aims to increase student engagement through: 1) active analysis of authentic problems; 2) earlier access to major-specific context and concepts; 3) increased integration from molecules to ecosystems; and 4) increased attention to skills and knowledge of inquiry. By all accounts, the first offering was very successful. A pre- and post-test analysis of student knowledge and attitudes will be completed this year to evaluate our success at meeting student outcomes.
- In concert with the transformation of 1st year Biology, CBS continues to engage OAC, CPES, CSAHS and OVC to reform the entire 1st year science curriculum following recommendations of the 21st Century and 1st year Science Review Committees.
- Following on reforms to 1st year biology, CBS (MCB in particular) received approval to revise the 2nd year foundational courses in Genetics, Cell Biology, and Molecular Biology. The new courses in Molecular Biology & Genetics and Molecular Biology of the Cell will be offered starting Fall 2011.

The challenge of providing a high quality undergraduate experience in the face of rising enrolment and limited resources is significant. At the 1000 and 2000 level, course enrolments range from 400 – 1900 students. Many senior courses have in excess of 100 students/semester, and indeed some 4000 level courses exceed enrolments of 200. Key laboratory and field courses, such as Human Anatomy, Lab Methods in Molecular Biology, and Ecological Methods are transformational learning experiences, but are necessarily resource intensive and in high demand. CBS continues to make decisions to protect these valuable learning experiences. Through course suspensions or deletions from the calendar.

5.2 Graduate

CBS is committed to the training of graduate students and strives to provide opportunities that are competitive at the highest of international levels. In Fall 2010, CBS recorded its highest number of domestic eligible students (Table 1). The 225.5 graduate students represent a 17 % increase over the numbers in 2004. Over 90% of graduate students in CBS are in traditional M.Sc. and Ph.D. programs that involve research-based theses. The major programs are M.Sc. and Ph.D. programs in HHNS, IB and MCB. The latter two programs were approved by OCGS in 2008. There is a successful M.Sc. by coursework program in HHNS that focuses on nutritional sciences. There were 34 students in this program in Fall 2010. CBS faculty also participate in a number of multidisciplinary graduate programs. This included 10 students enrolled in the Biophysics, 6 in Toxicology, 9 in Neuroscience and 1 in Bioinformatics and these students were spread across all three departments. The total graduate student enrolment in Fall 2010 including domestic eligible students, over term students, international students and part-time students was 298. Given the faculty complement this works out to about three graduate students per faculty member.

Table 1. Domestic eligible graduate student numbers in CBS in 2004 through 2010 (Fall reporting date).

Graduate degree	2004	2005	2006	2007	2008	2009	2010
MSc	124.9	115.5	121.2	142.9	140.2	127.8	149.9
PhD	67.3	72.9	74.9	77.6	73.3	69.3	75.6
Total	192.2	188.4	196.1	220.5	213.5	197.1	225.5

The College was one of the first to implement a standardized minimum funding formula for its students in traditional M.Sc. and Ph.D. programs. Students in the M. Sc. program (by research thesis) receive a stipend of at least \$17,814 while those in the Ph.D. program receive at least \$18,664. In 2010, graduate students received approximately \$5,400,000 in support. Funding was provided through GTA positions (25), GRA funds from faculty (44%) and external scholarships (29%). These values are typical of past years. The college attracts high quality students. To illustrate, over the period of 2004 though 2010, 14 to 18% of the students held major scholarships.

CBS has seen a progressive decline in the number of international graduate students. Over the last three years the numbers have declined from about 12 % of the graduate student population in 2007 to less than 7% in 2010. The primary factor for the reduced numbers of international students is the high cost of their tuition. To assist with these high costs, the College requires that faculty contribute a minimum of \$2988 over and above the funds provided to domestic eligible students to support international students in both MSc and PhD programs. Starting in 2006, the College created the CBS International Graduate Student Award to assist international students with the rising costs of tuition but this program was eliminated in Fall 2009 owing to budgetary constraints.

The College aspires to reduce the number of students that are beyond the period of eligibility. For the last few years more than 20% of the graduate students have been domestic ineligible students and little progress has been made in reducing the number of these students. Several factors may be contributing to these high numbers. Some students are taking employment before completing their programs; others are working while in program to meet their financial needs. This has forced a high number (10) of these students to move to part-time status. Efforts continue within the Departments to get students engaged in their research, writing their proposals and interacting with their committees earlier in their programs. It is expected that reducing the number of over-term students would open space in research labs for recruitment of domestic eligible students.

5.2.2. The Future of Graduate Programs in CBS

The training of graduate students is a priority for the college and its faculty. Despite an uncertain funding environment, the college projects that the numbers of graduate students will increase by about 8% to 242 students in Fall 2011. Our concern in meeting this target is that the vast majority of our graduate students are in traditional M.Sc. and Ph.D. programs and these are dependent on faculty research funding. Faculty research funding provides about 44% of the

support towards student salary costs and this is over and above the direct research costs that are paid by the faculty. Changing demographics and recent recruitment is enabling the college to continue to grow its graduate numbers. In the last couple of years, the college has made several new hires particularly in HHNS (Brown, Mutch, Simpson, Wright, Zettle) and IB (Adamowicz, Hajibabaei, Smith) and also has a large cadre of junior faculty, all of whom are ramping up their graduate programs. It is the growth of these programs that are outpacing the reductions in graduate student recruitment by faculty who have recently retired, changed universities or are in the final stages of their academic careers and are winding down their graduate programs. The College has also implemented a 4 semester offering in the coursework MSC program in HHNS. This provides the students with an opportunity to develop a more in-depth project as part of the research component of their training. We currently have 8 students who have opted for the 4 semester MSc program and these are captured in our growth projections.

The college is also under pressure to provide the funds necessary to the GTA positions required to meet the minimum funding levels provided to graduate students. Dean's Council is considering ways to preserve GTA funding in light of the current budget reductions to the college.

CBS is committed to finding new funding opportunities for our graduate students. This includes investigating new ways of using the Graduate RAG funds to support faculty and graduate students. In 2010 the College initiated the CBS PhD award. This provides support for faculty to take on additional Ph.D. students who without this funding would not be recruited to Guelph. In this case the college and department each provided \$6500 over each of 4 years to faculty who were recruiting an additional Ph.D. student. In 2010, 5 Ph. D. students were supported by this program. The college also continues to provide awards of \$1125 for each of the 32 graduate students entering the course work M. Sc. program in HHNS and support of a staff member (\$60,000) to deal with the increased numbers of coursework students in HHNS. These investments totalled \$434,000 in calendar year 2010. In the past, The College used the RAG envelope to fund: (1) the CBS Faculty Research Assistance Award valued at \$12,500 per year that was provided to faculty who did not have the resources to support the stipend of an additional student, and (2) a new domestic eligible program that provided awards of \$5,000 per year for all domestic eligible graduate students recruited to traditional M.Sc. and Ph.D. programs in calendar year 2008. These two programs continue to support students in 2010 as they flow through their period of entitlement. It is important to note that the high-points in graduate student numbers seen in 2007 and 2008 (Table 1) correspond to the largest supplementary funding support from the RAG and College sources, reinforcing the fact that the external funding climate represents a significant impediment to enrolment.

The college is supporting the development of applications to new programs such as the CREATE program through NSERC which supports collaborative training opportunities for graduate students. The college is trying to find ways to take advantage of the HQP program offered through OMAFRA. To date, two students have been funded by this program. There are related concerns in ensuring that research infrastructure and associated technical support vital to our research programs are maintained and enhanced. To this end, CBS is investigating various ways of using both Tri-council and contract related overhead funds to support the research enterprise in the College.

CBS has been integral to the development of a new graduate program in Bioinformatics which started enrolling students in fall 2009. While there is only one student attributed to CBS, we are co-advisors to several other students. CBS has also begun to attract students in the collaborative MA/MSc/PhD program in Neuroscience and has been engaged in discussions surrounding possible graduate programs in Cardiovascular Sciences. The college continues to investigate whether there are ways of developing a graduate program in the area of Biodiversity Sciences to capitalize on the expertise in the Biodiversity Institute of Ontario and the International Barcode of Life project.

6. Research

The College is renowned for its research intensiveness in the life sciences and has forged multi- and interdisciplinary links with other colleges on campus and beyond. As we look to the future our objectives in research are:

- (1) To strengthen and promote research opportunities for our faculty and their collaborators which support the institutional strategic plan and position our faculty to be at the forefront of research in the life sciences.
- (2) To develop and maintain infrastructure that is central to our research intensiveness.
- (3) To develop and promote partnerships which support our research.

6.1. People

The strength of research in CBS rests on the talents of our faculty. In fiscal year 2009-2010, CBS faculty attracted over \$28,425,000 in research funding including an impressive \$9,485,000 from the Tri-council agencies and the NCE programs. On a per faculty basis, Tri-council and NCE funding is the highest on campus. Success is also reflected in the numbers of faculty who hold NSERC Discovery grants, which is 86% (80 of 93) of eligible faculty members. A further eight faculty in emeritus positions also hold NSERC grants. CBS faculty have consistently held the highest amount of CIHR funding on campus and we have one faculty member with a grant from SSHRC.

A high proportion of CBS faculty hold prestigious research positions. Eight of our faculty hold Canada Research Chairs and six of these were successfully renewed in the last three years. CBS has two University Research Chairs, Steven Rothstein (recently renewed) and Rob Mullen. We have two faculty (Dawson and Jones) who hold faculty awards from the Heart and Stroke Foundation and CIHR, respectively. The college has five faculty who hold NSERC Discovery Grant Accelerator awards, the highest number in all of the colleges on campus, and the only Human Frontiers of Science grant (Merrill) held at Guelph

Our successes are not restricted to our more senior faculty. Over the last three years, seven of our faculty (Mathur, Maherali, Norris, McAdam, Tursetsky, Bent and Fudge) received the highly

competitive Early Researcher Awards from the Ministry of Research and Innovation. This success outpaces that of all other colleges combined.

Our immediate challenges are to continue to attract and retain research intensive faculty and to assist them in obtaining competitive funding to support their research. To this end, the College and Departments continue to be active in mentoring new faculty. A second objective was to replace the CRC position that was vacated by the passing of Terry Beveridge. To this end, CBS successfully argued to retain the position and convert it to two tier II positions. This has led to the recruitment of David Wright in HHNS and the appointment of Nina Jones in MCB. The resignation of John Klironomos and completion of the term of Arend Bonen's CRC has prompted the College to submit applications for their replacements. These applications are pending.

6.2 Infrastructure

CBS has had considerable success in obtaining funding from both federal (CFI, NSERC RTI) and provincial infrastructure programs (MRI, OCE) and these have been used to leverage support from the private sector and philanthropic sources. This support has been used to transform the campus. Recent successes have included major CFI awards for Applied Evolution (Husband), Biological Membranes and Surfaces (Whitfield), and Aquatic Sciences (Van Der Kraak). Through the efforts of Paul Hebert, two CFI awards have been received to support the Biodiversity Institute of Ontario. Collectively, these awards have contributed:

- \$43M to the development of core facilities within the Science Complex that are available to the rest of the university community
- Establishment of the Biodiversity Institute of Ontario, and a second grant for the creation of a Centre for Biodiversity Genomics for which construction started in late 2010.
- Expansion and upgrades to Hagen Aqualab, the Institute of Ichthyology and the Alma Aquaculture Research Centre.
- Relocation and expansion (metabolic kitchen and sensory laboratory) of the HNRU to the location within the Food Science Building/GFTC

CBS faculty have had considerable success in obtaining funding from CFI through the Leaders Opportunity Fund. Since 2002, 37 CBS faculty have been supported through the LOF and this has brought in greater than \$10,000,000 in research infrastructure to the College.

CBS, along with CPES, have been major players in the formation of the Advanced Analysis Centre (AAC). The AAC is a group of research facilities occupying the main floor of the new Science Complex plus some existing specialized facilities in the MacNaughton Building. The AAC occupies approximately 400 m² and contains approximately \$30 M of CFI, Ontario Research Fund (ORF) and NSERC funded research equipment. The commissioning of the AAC represents a 15 year vision of the University to provide modern, centralized, highly serviced space for large-scale advanced analysis facilities including state-of-the-art Nuclear Magnetic

Resonance, Mass Spectrometry, X-ray Diffraction and Scattering, Electron and Confocal Microscopy, Fermentation Technologies, and Genomics instrumentation. The AAC is providing an unequalled range of capabilities for research and advanced education at the interface of the physical and the biological sciences.

CBS has played a major role in developing and implementing a 5-year operating budget and management plan to support the AAC, the Science Complex Greenhouse/Plant Growth Facilities and faculty who are recipients of LOF support through CFI. This involves a \$9.4 M operating budget over the period of 2006-2011 and includes \$4.7M in Infrastructure Operating Funds (IOF) from the CFI. Over the next 5 years, CBS will expend over \$888K from its operating budget in support of personnel within the AAC who are providing services to science faculty across the university. The College is actively engaged in discussions with the Vice President Research in developing a plan to sustain the AAC and Greenhouse/Plant Growth facilities in the future.

The immediate challenges are to continue to develop research infrastructure within the College and university and assist our new faculty in getting their labs established and funded through CFI. It is expected that CFI will announce the next competition in late fall 2011 and the College has been proactive in developing proposals for the LEF/NIF competition. Proposals are under development for enhancements to the AAC (Whitfield, Mullen, Lam and Crease), Phytotron Plant Growth Facility Maherali, Husband) and the Animal Wing in HHNS (Ma). Several of our junior faculty have LOF applications pending while others are preparing submissions. Mentoring at the college and departmental levels are integral to these submissions. Dean's Council is investigating ways to invest funds associated with the Tri-council indirect costs program and contract research overhead to support research infrastructure.

6.3 Partnerships

CBS has been active in developing and sustaining research partnerships. This has ranged from the establishment of research centres and institutes through to collaborations with external sponsors who fund faculty positions in the College. The latter includes the joint-funded Memorandum of Agreement with the Chippewas of Nawash, linking research in fisheries management with First Nations' priorities and supporting a faculty position in IB (Crawford). CBS has also pioneered new arrangements with external agencies such as the Great Lakes Fisheries Commission which support two faculty appointments in IB (McDonald, McLaughlin).

The continuing successes of the Health and Performance Centre, and the Human Nutraceutical Research Unit have not only enhanced research and undergraduate learning opportunities but provide a valuable link and benefit to the health of the wider community. The HNRU has relocated to space within the Guelph Food Technology Centre in 2008 and this is facilitating greater interaction with industry as well as the Department of Food Science and GFTC.

Biodiversity Institute of Ontario

The Biodiversity Institute of Ontario has developed an international alliance involving 25 countries which constitutes the International Barcode of Life project. This involves support of NSERC, Genome Canada, The Ministry of Research and Innovation and the Ontario Genomics

Institute.

Five faculty and more than 50 researchers, technicians, informaticians and administrative staff are members of the Institute. In November 2009, more than 20 BIO researchers travelled to Mexico City to join with 350 colleagues from 54 countries for the Third International Barcode of Life Conference. Sujeevan Ratnasingham was selected for the 2010 Ebbe Nielsen Prize from the Global Biodiversity Information Facility (GBIF), the first time that this prestigious award has been received by a Canadian, as architect of the Barcode of Life Data System, the informatics platform used by the global DNA barcoding community. Genome Canada provided a second instalment of \$4.6M and the Ontario Ministry of Research and Innovation (MRI) expanded its prior support with a new commitment of \$8.1M over five years. The three most recently appointed BIO faculty received NSERC Discovery Grants. Finally, the International Development Research Centre approved a \$2.2M award for a three-year project that will support barcode research in five developing nations.

July 2010 saw Dr. Peter Freeman take up his appointment as Executive Director of iBOL. 120 members of the iBOL Scientific Steering Committee assembled at Guelph in September 2010. This group includes representatives from all of iBOL's 26 member countries and its 20 Working Groups.

In fall 2010, construction began on the Centre for Biodiversity Genomics (CBG), an \$18 million facility, funded largely by the Canada Foundation for Innovation and by MRI. The CBG, which is slated for completion in late 2011, will house the iBOL Secretariat and key infrastructure needed to support iBOL research.

6.4 Directions

Research within CBS contributes to enhancing the University's strategic research goals and to the research themes which define the institution. The themes include:

1. Environment, ecology and biodiversity
2. Agriculture, food and bioproducts
3. Physical and biological structures: function, dynamics and interactions
4. Promoting health and preventing disease
5. Cultural transformation and social change.

The College is committed to the development and advancement of each of these areas and this has been reflected in our hiring plans, the infrastructure we continue to bring to campus and in our ongoing and proposed research initiatives.

Environment, ecology and biodiversity are central to the research within IB and the Biodiversity Institute of Ontario. One of the underpinning themes in this area is to understand and predict the responses of organisms, populations and communities in aquatic and terrestrial ecosystems to environmental change. Studies on the ecological and evolutionary significance of variation at all levels of biological organization (molecules to ecosystems) have been facilitated by the awarding of four major CFI grants (Applied Evolution; Enhancing Fish Performance: from Genes to Populations; Biodiversity Institute of Ontario; Centre for Biodiversity Genomics) totalling over \$40 M. These initiatives, plus the Canadian and International "Barcode of Life" Projects in

which Guelph is at the international forefront, will provide the cutting-edge tools and infrastructure (e.g. controlled environmental systems, bioinformatics) needed to understand species diversity and evolution. This is an area where CBS has made a number of key hires in recent years that have enhanced our expertise in Ecology (Cottenie, McDougall, Norris, Turetsky), Evolutionary Biology (Adamowicz, Gregory, Griswold, Hajibabaei, Hanner, McAdam, Smith) and Comparative Animal Physiology (Fudge, Gillis, Heyland, Laberge).

CBS faculty have been at the forefront of advances that support the theme of physical and biological structures: function, dynamics and interactions. CBS has three tier 1 CRCs in this area (Whitfield, Lam and Sharom) whose research contribute to strong and growing cadre of researchers investigating aspects of interactions of biomolecules in health and disease. This includes research in areas such as bacterial membrane proteins which may represent new targets for antibacterial drug development, cell signalling in cancer biology and probing structural biology. CBS faculty along with their partners across campus provide the University of Guelph with a critical mass of researchers who are at the forefront of biophysical research of biological systems. Their projects include studies of the mechanisms of enzyme-substrate reactions, toxin-receptor interactions, and the roles of ABC transporters in drug transport or in carbohydrate transport. Research in this area has been bolstered by a Human Frontier Research Program-funded project on time-resolved structure studies of toxins (Merrill). The College has made a number of recent hires that bring in new expertise in the area of Structural Biology (Graether, Kimber and Khursigara joining in 2009) that will ensure long term strength in this important theme area.

CBS has an increased presence in the theme area of agriculture, food and bioproducts. The College has unique strengths that enable exploration of questions which transcend studies of food and nutrition from the level of the genome, metabolome through to natural variation (diversity) in population responses. Multidisciplinary research in CBS addresses issues such as functional food and nutritional quality, agricultural yield, salmonid breeding, disease diagnostics and prevention in production systems, toxicology and sustainability. As a consequence the College has received a significant increase in funding from OMAFRA, and also AAFC in the sphere of Food, Nutrition, and Health and the Agricultural Bioproducts Innovation Program (ABIP). The College, the Department of Food Science in OAC and the GFTC have developed a joint strategy for the relocation of the HNRU, the development of a food sensory lab and laboratories for a new industrial research chair in cereals. Relocation of the HNRU to the GFTC/Food Science building will promote stronger interactions between CBS, OAC and GFTC and facilitate relationships with OMAFRA and GFTC. CBS faculty have had considerable success in funding through OCE and Genome Canada in the area of plant biotechnology and are active in utilizing genomic approaches to contribute to sustainable agriculture (Rothstein, Colasanti).

The College has considerable strength in the area of promoting health and preventing disease. In HHNS there is a heavy emphasis on the links between lifestyle and health and the twin themes of disease prevention and remediation. Ongoing research on cardiovascular health, nutrition, type II diabetes, cancer, and osteoporosis is examining the interaction between environment and genetics. The interplay between nutrition, metabolism, and gene expression (Metabolomics and Nutrigenomics) is a rapidly expanding field where Guelph is becoming a lead player and where recent faculty recruitments (Brown, Ma, Mutch, Holloway and Simpson) and the recent

recruitment of David Wright as a tier II CRC will enhance our impact. The College is also actively involved in the development of plans for two CRC positions in the areas of Food, Health and Aging. The College will also capitalize on the success of the \$18M CFI award for studies of “Membranes and Surfaces in Diseases and Natural Environments” for studies at the molecular level, focused on structure-function relationships of key proteins and ligands. These are providing new opportunities for drug discovery in the realms of infection, immunity, cancer, heart disease and stroke, multi-drug resistance, as well as insights into developmental abnormalities and other genetic disorders. Here, recent hires are bringing new opportunities in the areas of cell signalling (Jones, Van Raay) and gut microbe interactions (Allen-Vercoe).

The College also contributes to the theme of cultural transformation and social change. Here there are developments in the areas of adaptive management of natural resources and traditional (first nations) knowledge that are beginning to inform policy decisions at the provincial and national levels. The College continues to explore new partnership arrangements that will increase our contribution to this area.

The immediate challenge will be to sustain and grow our research base in the face of uncertain economic times. One of our strengths as a College is the diversity and depth of our expertise. Much of the science in the College involves understanding the response of organisms, including humans, to change and perturbation. Information is integrated at different levels of exploration from genes, proteins, and small molecules to individuals, populations and ecosystems. The ability to comprehend biological systems and variation demands a concerted effort integrating experimental biology with the formulation of theoretical, testable models. This is as true for the understanding of infection processes, and the identification of biomarkers for diseases, such as obesity and cancer, as it is for understanding the response of ecosystems to global climate change, and involves integrating information over both short and evolutionary time scales. Consequently some future academic appointments within CBS will focus on areas that integrate across different scales of exploration, combining bioinformatics and computational biology linked to experimentally induced and natural variation. The College will also promote research opportunities that benefit the societal good. For example through the development of novel therapies for the prevention and remediation of disease as a result of new information on protein-ligand interactions, the improvement of selection processes for desirable traits, and the generation of novel products such as drugs or functional foods are all examples of applied research where CBS faculty can have immediate impacts. Collectively, a goal of the college is to promote interdisciplinary research that builds partnerships within the campus and the broader scientific community.

7. University Campaign 2014

The strength of the College is through its faculty, students and staff. As such the major focus for CBS within the upcoming University campaign “The Better Planet Project” will relate to supporting excellence through fundraising for faculty Chairs, scholarships for undergraduate and graduate students, and infrastructure which enhances our research and undergraduate programs in key strategic areas. An aggressive campaign goal has been identified at Dean’s Council with

valuable input from Alumni Affairs and Development. Whilst it is recognised that the campaign plans are a “living” document which will be refined by time and opportunity, the following summarises significant elements of the plan:

- A series of targeted developments in areas in which the College has established excellence or a perceived need, including Chairs in:
 - Human Health, Lifestyle and the Genome
 - Biodiversity including Informatics and Polar Biodiversity
 - Biological Mass Spectrometry
 - Integrative Biology “from Genomes to Biomes”
 - Nano-biology: pathogenhost biology
- Merit-based graduate scholarships which will support domestic and international students, and wherever possible will leverage funding from other sources
- Merit-based undergraduate scholarships focussed primarily on recognising excellence in upper-year students
- Establishment of an Undergraduate Laboratory Equipment Fund and a
- Major Research Facilities Fund, including enhancement of infrastructure in the Advanced Analysis Centre

These priorities resonate closely with the aspirations of the academic departments within the College as each has been establishing its own vision and direction since the restructuring of CBS in 2004, as well as being captured within major themes of the Campaign including Food, Health and Environment and Communities. The College’s Senior Development Officer is actively engaged with the Dean’s Office, departments and individuals in pursuing a diversity of fundraising opportunities

7.1 CBS Development and Alumni Affairs

The Development activity at CBS increased slightly in the past year – impact reflecting limited Alumni Affairs & Development human resources shared between two/three colleges. With support from the Dean, CBS has started the process of building the foundation for development and alumni affairs activities in 2010/2011 and we have received positive responses from Alumni, Corporations and friends of the University.

The objective of CBS’ Development activities are to:

1. Engage 5% (~830) of our alumni over the next three years using alumni giving and volunteer activity as key metrics.
2. Build college wide capacity to engage alumni, friends, corporations and foundations
3. Enlarge opportunities for alumni to contribute to CBS and UG as volunteers and donors
4. Establish a culture of engagement among students and young alumni
5. Create a Dean’s Advisory Board and Campaign Cabinet to support and advocate for the college’ Better Planet Project priorities

CBS’ fundraising activities have resulted in further engagement of senior leadership, including the President, VP Advancement, Dean, Director of BIO, faculty and our student leadership. This has enabled the Development Team to steward existing donors, provide strategic messaging related to CBS’ research and teaching strengths-aligned with the Better Planet Project to

prospective donors, and cultivate relationships which we aim will lead to financial support for the college.

Fundraising Activities	# participated		Results
	2010/2011	2011/2012	
Perspective Donor Meetings including Dean, Associate Dean, Chairs and Director	12 (Alumni and Corporations)	50	Marketing for UG and CBS, alumni engagement, corporate partnerships, funding
\$ secured	\$120K Scholarships (\$100K) CBS Highest Priority (\$20K)	\$2M Health & Wellness Professorship (\$1M) Scholarships (\$500K) Infrastructure – BIO (\$500K)	Support of the CBS strategic and integrated plan

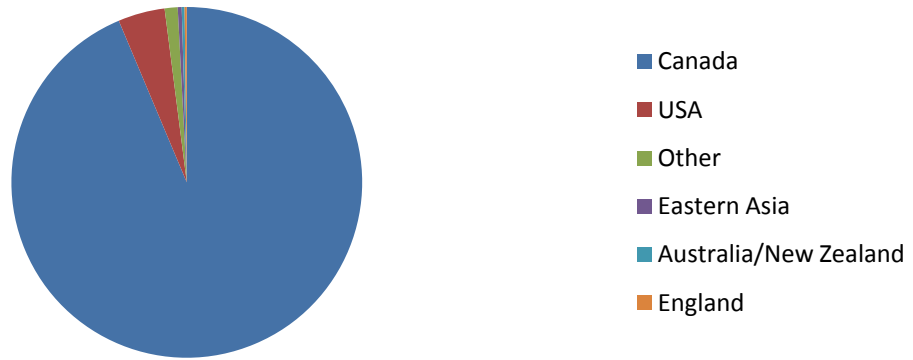
Other key objectives for 2011/2012 include:

- Building and rolling out the CBS Dean’s Advisory Board and Campaign Cabinet, group of 4-5 key volunteers who will support the College’s goals for the Better Planet Project
- Secure the support and involvement of all CBS senior leadership (Associate Deans, Chairs and Associate Chairs) in the Better Planet Project and Alumni Engagement, and identify key faculty champions for our fundraising priorities
- Grow the CBS Development team as appropriate and provide adequate resources and support
- Finalize the CBS Communication material which will be used in conjunction with the Better Planet Project brochure to broaden Guelph’s reputation
- Increase communication/marketing and publicity opportunities for CBS faculty, students, and alumni
- Develop strategic events and programming to engage and cultivate alumni, friends, corporations, and foundations
- Roll out the Better Planet Project to the College through leadership from department Chairs and Student Leaders

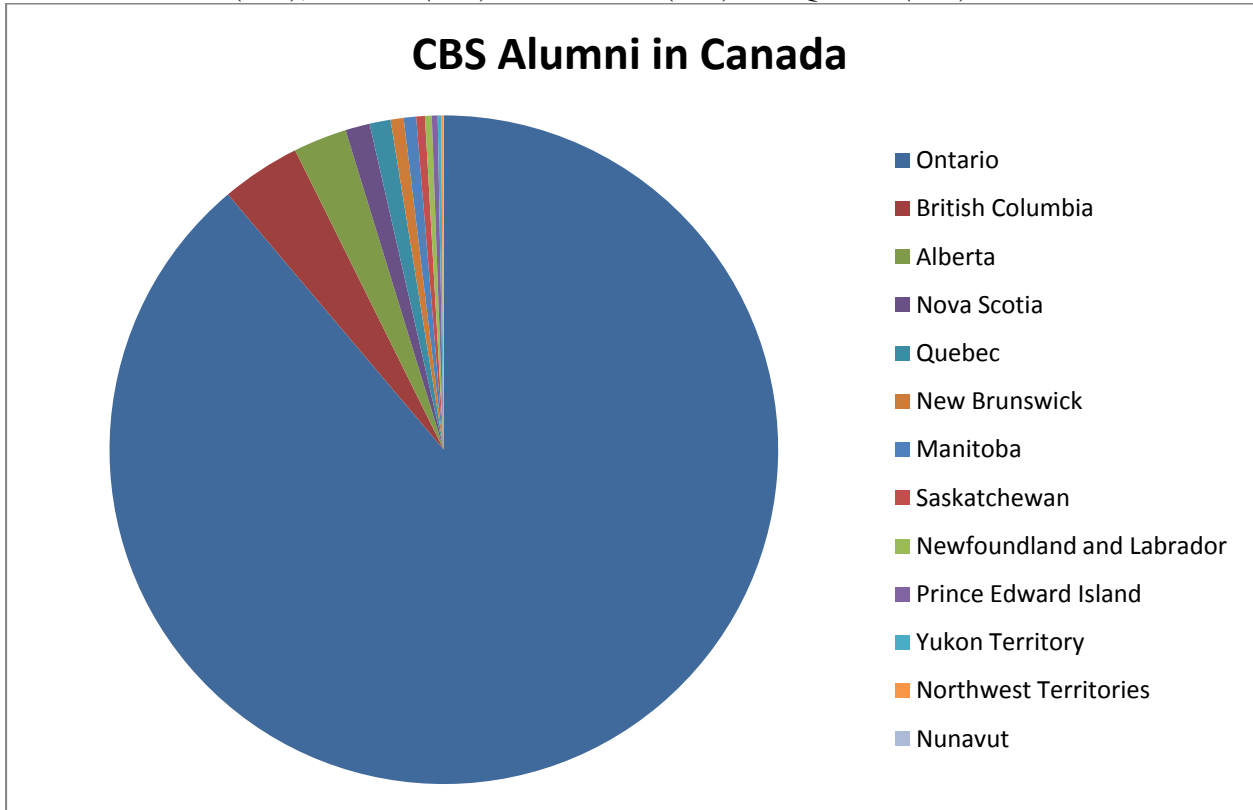
CBS Alumni Stats:

CBS has over 16,500 alumni worldwide, with 15531 in Canada, and over 700 alumni in the US and 60 in Eastern Asia.

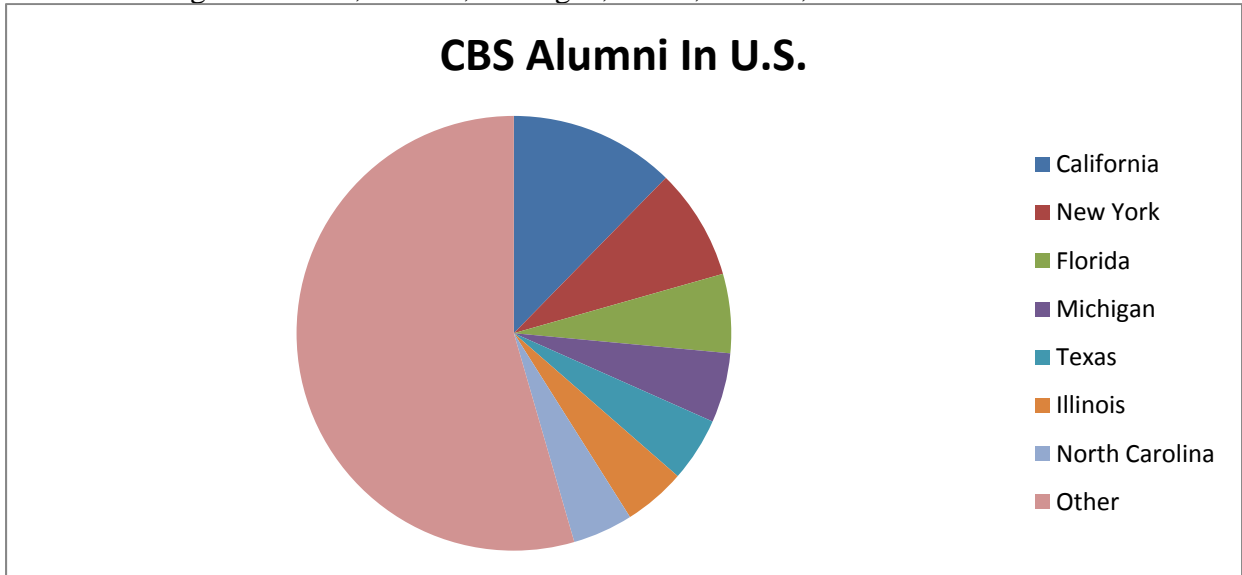
CBS Alumni Worldwide



In Canada, CBS has over 13,790 alumni in Ontario, with the remaining majority of alumni in British Columbia (595), Alberta (402) Nova Scotia (184) and Quebec (158).



With over 700 alumni in the U.S., CBS has 90 alumni in California, and between 50-30 alumni in the following States: NY, Florida, Michigan, Texas, Illinois, and North Carolina.



8. Resource Allocation Plan

The scale of the fiscal challenge to CBS has been outlined in section 4.2. Besides addressing these through savings, CBS is pursuing revenue generation in several ways.

Revenue from the joint program with Guelph-Humber in Kinesiology is being directed towards ensuring the success of this initiative and the hiring of new faculty. Monies allocated from CFI Infrastructure Operating Funds are being used to underpin current and future staff hires associated with the Advanced Analysis Centre, the Controlled Environment Facilities (Applied Evolution) and the Biodiversity Institute of Ontario as well as incremental costs associated with maintenance of the infrastructure. Relocation of the HNRU, interactions via the Food Innovation Network, and in association with the GFTC will increase the revenue generated by HNRU. There are significant opportunities to create a revenue stream through further development of outreach activities with local community colleges in relation to the Anatomy program, and these are being pursued actively. The University's Resource Allocation Guideline on tri-council overheads should generate significant benefit to the College which will be used to offset eligible indirect costs.

Revenue generation through use of undergraduate laboratory space in the Science Complex

Most laboratory classes are held in the Fall and Winter semesters with relatively fewer courses held over the summer, during which time staff also deal with issues of equipment maintenance and course development. Consequently we will explore the potential for these laboratories to be used by other post-secondary institutions, which lack such infrastructure, in the Summer semester. There has been some expression of interest from local colleges and we will explore the potential for revenue generation. We will also explore the potential for revenue generation from short workshops in these laboratories, linked to bringing high school teachers up to date with current aspects of life science. These activities would be compromised with further reductions in staff.

9. Research and Teaching Activities Related to the OMAFRA Contract or External Funds

The College receives no funds through the OMAFRA Agreement in support of faculty or core staff positions. Faculty held approximately \$900K of OMAFRA research support in open, competitive grants in 09/10 maintaining the improvements of previous years.

Eight faculty hold CRCs.

Tier I – Hebert, Lam, Whitfield, Sharom

Tier II – Husband, McCann, Jones, Wright

Two (Rothstein and Mullen) hold University Research Chairs.

Two faculty positions are fully funded by the Great Lakes Fisheries Commission, \$50K is provided by CIHR to provide release time in support of research for a faculty member in MCB.

One faculty position is funded by 50% by the Chippewas of Nawash

10. Space

The College currently occupies the Science Complex, the Axelrod Institute of Ichthyology, Hagen Aqualab, Zoo Annex II, the Biodiversity Institute of Ontario, portions of the OVC which house the Anatomy program (relocated in late 2009) part of the Powell Building associated with Physiology and Biomechanics, the HNRU and part of the Animal Sciences building.

Completion of the Science Complex in 2007 facilitated the consolidation of the Departments of Molecular and Cellular Biology and Integrative Biology in the Science Complex into shared, open-plan, research laboratories. The recently funded Centre for Biodiversity Genomics will add about 37,000 square feet in research space including a new home for the University of Guelph Herbarium. The success of BIO has meant that the old Zoology Annex has been demolished and that two undergraduate teaching labs and the vertebrate collections repositioned to the Science Complex.