

The Department of Biological Sciences



April
2016

Combined Review of Academic Programs – Self-Evaluation Report

The whole Department of Biological Sciences contributed to this Report through data collection, review, discussion, and writing. In particular, we gratefully acknowledge input by Chairs and members of the Undergraduate Curriculum Committee, the Graduate Studies Committee, the Honours Thesis Committee, and the Adjunct Professor Committee; the Associate Head (Research & Infrastructure); Department Council; non-academic staff; graduate and undergraduate students (past and present); and the Department Head.

TABLE OF CONTENTS

ACADEMIC UNIT	8
Programs and associated credentials	10
Themes in the undergraduate program	10
Previous reviews of graduate programs in Zoology and Botany	12
Teaching summary	14
Strengths	15
Weaknesses and challenges	16
Fit into current strategic plans - Institutional, Faculty and Department	20
Collaboration, Cooperation and Community	20
Service teaching	20
Collaboration with other units internal to the UM, and with other institutions	21
Responsiveness to current or future needs of Manitoba and/or Canada	22
Departmental enhancement of the national/international reputation of the UM	23
Student Success	24
Procedures and resources for student advising and career counselling	24
Other student support	25
Programming and support toward Indigenous and international student success	26
Student feedback on the programs	28
Surveys of the student body	30
Employment for graduates of the programs	32
UNDERGRADUATE BSc PROGRAMS – general overview	35
University-1	35
Undergraduate Curriculum Committee - UGCC	35
Evaluation of programs	37
Formal evaluations	37
Informal feedback as secondary evaluations	38
Sample Program Listing, BSc Programs – Table 1	38
BSc HONOURS – Program structure	40
Honours Thesis Committee - HTC	40
Biological Sciences Core Courses	41
First Year	41
Admission requirements to the BSc Honours program	42

Core requirements – second and third year.....	42
Program Chart – BSc Honours program (sample theme).....	43
Course requirements – required and elective, by Theme	43
Thesis procedures and regulations in the Honours Thesis Course	45
Specialty and novel or innovative features.....	45
Strengths.....	47
Weaknesses or challenges	48
Transferability of course credits from post-secondary institutions	51
BSc MAJOR – Program Structure	51
Objectives of the BSc Major program.....	51
Areas of speciality and any novel/innovative features of the BSc Major program.....	52
Strengths.....	52
Weaknesses	55
Student progression	55
Skills development	56
Fieldwork courses.....	58
Admission requirements to the BSc Majors program.....	60
Course requirements – required and elective.....	61
Cell, Molecular, and Developmental Biology Theme.....	62
Ecology and Environmental Biology	63
Evolution and Biodiversity	64
Environmental and Integrative Physiology	65
Integrative Biology	66
Evaluation procedures for the BSc Majors program.....	67
Individual course content or prerequisite changes.....	67
Thesis, practicum or comprehensive procedures and regulations.....	67
Transferability of course credits from post-secondary institutions	67
Enrollment and VW rates, by course, theme, or programs year – Figures 1-6	69
Grade distributions by course, course level, or year – Figures 7-13.....	74
BSc GENERAL – Program Structure	80
Objectives of the BSc General program.....	80
Areas of speciality or novelty of the BSc General program	80
Strengths.....	80

Weaknesses or challenges	81
Admission requirements to the BSc General program	82
Program Chart	82
Course requirements – required and elective.....	83
Evaluation procedures for the BSc General program	84
Transferability of course credits from post-secondary institutions	84
Current ideas for program change.....	84
UNDERGRADUATE STUDENT BODY	87
Undergraduate Student Body and Enrollment Trends – Table 2.....	87
Enrollment Trends in Undergraduate Programs	87
Undergraduate Programs in Biological Sciences, Progression & Majors – Table 3	88
Undergraduate Programs, Graduation Count for past 5 years – Table 4.....	90
Major undergraduate student awards, Honours, and publications in the past 5 years.....	91
Undergraduate Course Offerings – Table 5	91
Undergraduate Grade Distributions, Summary – Table 6	93
Undergraduate Grade Distribution, Multi-Section Courses – Table 7.....	93
GRADUATE PROGRAMS – general overview.....	96
Graduate Studies Committee - GSC.....	96
Adjunct Professor Committee.....	98
Areas of specialty	100
Novel or innovative features	100
Strengths.....	101
Major awards, honours and publications to graduate students in the past 5 years	103
Weaknesses	104
MASTER OF SCIENCE	106
Objectives of the MSc program	106
Novel or innovative features of the MSc program	106
Strengths of the MSc program.....	106
Weaknesses of the MSc program	106
MSc - Program Structure.....	107
Admission requirements to the MSc program	107
Course requirements of the MSc program	107
Evaluation procedures for the MSc program	108

Thesis procedures and regulations for the MSc program.....	108
Transferability of course credits from post-secondary institutions	109
Sample Program Listing, MSc – Table 8.....	109
STUDENT BODY - MSc Program	110
Graduate Student Body and Enrollment Trends for past 5 years - Table 9.....	111
Financial Support of MSc Students – Table 10	112
Enrollment Trends.....	114
MSc Students by Year in Program – Table 11.....	115
Graduate Programs in Biological Sciences, Graduate Counts for past 5 years – Table 12.....	116
MSc in Biological Sciences, Time to Completion – Table 13A.....	117
MSc In Botany, Time to Completion – Table 13B.....	117
MSc In Zoology, Time to Completion – Table 13C.....	117
DOCTOR OF PHILOSOPHY.....	119
Objectives of the PhD program.....	119
Novel or innovative features of the PhD program.....	119
Strengths of the PhD program	119
Weaknesses of the PhD program	120
PhD Program Structure	122
Admission requirements.....	122
Course requirements – required and elective.....	122
Evaluation procedures for the PhD program	123
Candidacy Exam procedures	123
Thesis procedures and regulations	125
Transferability of course credits from post-secondary institutions	127
Sample Program Listing, PhD - Table 14.....	127
STUDENT BODY – PhD Program.....	128
PhD student financial support – Table 15	128
PhD Student by Year in Program – Table 16.....	132
PhD Time-to-Completion – Table 17.....	132
Graduate Course Offerings for past 5 years – Table 18	133
Special Topics Graduate-Level Courses - Enrollment by year and term - Table 18A	135
SERVICE TEACHING.....	137
Undergraduate Teaching Loads by Course Level – Table 19.....	137

Credit hours by course-year level in Fall 2014 and Winter 2015 terms – Table 19A & Figure 14	138
Graduate level	138
Undergraduate level.....	139
Trends related to course offerings in the Department	139
Possible new courses	140
Distribution of course-teaching load	140
Taught-to, Taught-by, Undergraduate Course Offerings – Table 20 and Figure 15	142
HUMAN RESOURCES - ACADEMIC STAFF	144
Academic Staff by Specialty and Role – Table 21	144
Courses Taught by Academic Staff, Undergraduate and Graduate – Table 22	147
Student Supervision and Advisory Committees	147
Academic Staff Thesis Supervision and Committee Participation – Table 23	148
Research Activities	150
Academic Staff, Research Activities – Table 24	151
HUMAN RESOURCES - SUPPORT STAFF – Table C	151
PHYSICAL RESOURCES	154
Space	154
Infrastructure Challenges and Future Opportunities	154
Space use within the Department – Table A	156
Major facilities and equipment operated by the Department – Table B	159
Equipment	160
Research Equipment	160
Additional Support	160
Expected Changes in Resources	161
Computer Resources	163
Library Resources	164
CONCLUSION	165
Overview	165
Strengths	165
Challenges	166
Conclusion	167
APPENDICES	167

SUMMARY

The Department of Biological Sciences is the largest department in the Faculty of Science. The areas of our research are embodied in the many contributions and successes of our students, staff, and faculty – those areas are also the foundation of strong undergraduate and graduate education programs at the forefront of biological sciences. The Department contributes significantly to teaching undergraduate students and has the second-largest ratio of students per full-time equivalent academic staff member in the Faculty of Science. Department members have dynamic research programs, and actively contribute to outreach, institutional administration, and service to the profession at every level. The same scope enriches our many strengths and collaborations in research and scholarly activity, and in mentorship – the scope and richness are celebrated internally and recognized externally, as integral to the healthy biodiversity of the Department and its endeavours as it evolves, discovers, innovates, adapts, and takes leadership.

The Biological Sciences programs were launched in September 2009 and are supported by the Undergraduate Curriculum Committee and the Graduate Studies Committee, each with designated staff support. Contributing support by other standing committees (Adjunct Professors, Honours Thesis, Scholarships and Awards, and Student Recruitment and Retention Committees) and ongoing discussion at Department Council actively guide priorities and programs.

The strengths of the Department and its research and teaching programs are many.

- We cherish the rigour and quality of the research projects by our Honours students, and celebrate the successes of *all* the students who enter and complete programs in Biological Sciences.
- We collaborate to develop plans, recruit to build diversity and depth of expertise, and debate issues to reach consensus. We are colleagues and enjoy our work together.
- We fulfill our teaching responsibilities, engage in research, student training and mentorship in research, outreach, and professional service commitments.
- We discuss programming and research, and their respective challenges, openly, and we address them by changing course offerings, content, and delivery, committee structures, and supplemental regulations; evaluating data, questioning decisions, and giving input.

The challenges to the Department and its programs relate primarily to our ability to sustain and evolve, include:

- our ability to extend the breadth, richness, and competitiveness of the programs, particularly hands-on laboratory experiences and research opportunities in undergraduate and graduate education,
- the need for secure and long-term funding from diverse sources, for research and educational programs
- the need for sufficient and timely renovations of laboratories for both teaching and research,
- the ability to sustain student and researcher access to reliable equipment and facilities,
- the need for more administrative staff support for financial reconciliations, student appointments, program support, and oversight of research compliance, especially during system changes and budget cuts,
- the need for additional technical staffing to sustain core services and facilities,
- the need to maintain flexibility in the face of faculty and staff renewal, and anticipated changes in enrollment, budget, and institutional changes, and
- the ability to support expected and unexpected changes to teaching and research programs.

As a result of our program review, we find that our considerable strengths and robustness, combined with our collegial governance and shared goals support strong educational programs and bring student success. The aim is sustain and grow our educational programs, incorporate innovations, and further foster the success of our students as well as our many activities in research, teaching, and service.

ACADEMIC UNIT

The Department of Biological Sciences is a dynamic and integrative unit with 39 faculty, including 1 CRC Tier 2 and 1 Industrial Research Chair; over 90 graduate students; and over 200 Major and Honours students. It evolved from a merging of the Departments of Botany, Zoology and the Biology Teaching Unit (in July 2007) and continues to evolve and embrace a unique scope of research and teaching strengths reflecting the organismal and methodological diversity of biology and its sub-disciplines. The undergraduate and graduate programs under review were launched in 2009, with first intake in September. This academic program review is the first review conducted on the Biological Sciences BSc, MSc, and PhD programs. The Department is pleased to participate in the institutional piloting of a combined process that integrates our reviews of undergraduate and graduate programs.

The Department offers entry-level and advanced instruction to undergraduate programs in 5 theme areas for students in our programs and as service teaching to other units; we provide about one-quarter of the undergraduate CHs delivered by the Faculty of Science. Undergraduate students typically enter into University-1 for first year and transition to the Faculty of Science in their second or third year; they may declare a Major as late as fourth or fifth year. With the second-largest ratio of students per academic staff member in Science departments, every member of the Department makes a large contribution to the educational endeavours of the Faculty of Science and the University of Manitoba. The core of our undergraduate curriculum includes courses in a broad range of organisms, approaches, pedagogies, and evaluations. The Department celebrates its breadth, collegiality, and inclusive culture of research, pedagogical, professional, and service activities.

The Department has 36 research laboratories in 4 buildings: Biological Sciences (BSB), Buller, and Duff Roblin (DR, rooms numbered as “WXXX”) Buildings, and the Crop Technology Centre (CTC). The tally of research labs includes 3 large, shared labs (BSB 409, Buller 522, W478), 1 lab in the CTC, the microscopy suite (Buller 518), a core molecular biology lab (W436), a core physiology lab (W442 with 4 controlled-environment rooms, to be completed in Winter term, 2016), an analytical suite (W418-W430, shared with Human Nutritional Sciences), and 1 lab (W370) used by an Emeritus professor. The tally does not include the Herbarium, Greenhouse, plant-growth facilities, or research-procedure rooms in the Animal Care Facility.

The Department teaches in lecture rooms across campus and in 19 teaching laboratories, 4 in BSB (110, 211, 223, 305), 9 in Buller (211A, 211B, 212A, 212B, 215, 216, 314, 435, 523), and 6 in Duff Roblin (W232, 230, 240, 270, 346, 332, 240). This tally does not include any of the preparatory-lab areas (e.g., BSB 211A, 221, 305A, 305B, 403A; Buller 108, 217, 220, 221, Buller Greenhouse; Duff Roblin W270, 232, 230A, 260A, 442-growth chambers). The Department space houses shared facilities for light and electron microscopy; confocal microscopy and digital imaging; analytical biology; 2 small computer labs, animal and plant-rearing; culturing of tissues, cells and organisms; and DNA and RNA sequencing. The Department also holds a wide range of collections of plants (living and preserved), cryptogams, mammals, insects, birds, fish, amphibians, and reptiles which are housed in the Herbarium (Buller 426), Stewart Hay Museum (W216, W230), a volatiles-storage facility for the fish and herpetology collection, and various research labs.

The Department weathered the challenges of responding to a major fire in the Duff Roblin Building, March 28, 2009. While the fire had significant impact on researchers, research productivity, the Department office, communications, and indeed the whole Department (directly and/or indirectly), and

it took more than 4 years to re-occupy the affected building, we sustained our teaching and launched the new Biological Sciences programs. The University of Manitoba and the Faculty of Science recognized the many major generous and heartfelt contributions from the Department (necessitated on an emergent basis, through the prolonged trials and frustrating logistics of clean-up, design, and restoration of the building) of all members of the Department (staff, faculty and students) in the response.

Our current strengths and expertise lay within an unusually broad range of organisms used as model research systems by our investigators; this forms a rich environment for intellectual, technical and collaborative pursuits. We recognize the important foundations of biological investigations that include: expertise and research programs in a very broad scope of biological and scientific fields; the mentorship and professional development of students, faculty and staff; excellence in teaching; a rich curriculum in programs that foster our students in gaining knowledge and skills through classroom and hands-on experiences in laboratory and field research; the interdependence of research and teaching; the space in Biological Sciences, Duff Roblin and Buller Buildings; and the broad range of infrastructure (facilities, equipment, and human resources) that support our activities.

The values of the Department of Biological Sciences identify the essential nature of a 'biodiversity approach' to research, teaching, and service through a strong foundation in understanding organisms and their interactions and adaptations to the environment in which they live. We recognize the importance of sustaining and enriching organismal expertise in the broad range that is so critical to biology, life sciences, a healthy environment and organismal health, and also that the discoveries of today lead to future developments of biotechnology and intellectual property. Thus, our recruitment strategy has embraced the biodiversity approach to sustaining and building expertise that allows flexibility and evolution of research directions while it strengthens our teaching programs.

The mission of the Department of Biological Sciences is to sustain and advance research and teaching that integrate classical approaches and concepts with emerging themes and new discoveries in biological sciences, in the context of rapid changes in the university and externally. Our vision is to be recognized for leading contributions to the biological sciences at all levels, and adapt to changes on a local and global scale.

The Department's overarching goal is to explore through its research learning and teaching, the interactions among living organisms that shape biodiversity, environmental health, and the capability for normal and adaptive physiology, molecular and cell biology that underlie evolutionary theory and concepts. In addition to current strengths, we have general and biology-specific aims (see Appendix 1, Department of Biological Sciences Strategic Plan), including: supporting the professional development of faculty and staff that enables people to meet new challenges and sustain ongoing demands in service, research and teaching; building new collaborations nationally and internationally; and developing our research clusters through recruitment, retention and interactions at the interface of disciplines. We aim to support and strengthen the opportunities for researchers and graduate and undergraduate students to interact, as they leads to student engagement in scientific inquiry; and successful, funded and collaborative research, discovery, and innovations.

We also aim to meet our social responsibilities in the general and professional communities, while supporting the Faculty of Science and University initiatives to recruit and support more and better-qualified students from a wide range of sources, including international, non-Manitoban and Indigenous populations, while we sustain and increase the level of support and success in research. To do this, our

goal is to be flexible in addressing challenges to our major functions as the world changes, and contribute to community development and public education.

These goals include discipline-specific aims to inspire the potential for inquiry across the spectrum of biological sciences using modern equipment and facilities, and recruit into areas of expertise represented by conceptual approaches or taxonomic (organism) specialization. This will need us also to succeed in strengthening the capacity of our animal- and plant-rearing facilities to support teaching and research, and find ways to improve facilities, and sustain initiatives through changes in space use or allocation.

Programs and associated credentials

The Department of Biological Sciences offers undergraduate and graduate programs.

The graduate program offers study toward two research thesis-based degrees.

- MSc Biological Sciences
- PhD

The graduate program is supported by the Graduate Studies Committee and a member of the administrative staff who is knowledgeable about the program, attends meetings, takes minutes and has daily/regular interactions with the Chair and members of the Graduate Studies Committee, the Chair and members of the Adjunct Professor Committee, graduate students, and staff in the Faculty of Graduate Studies. There is no course-based graduate program in the Department.

The undergraduate program in Biological Sciences offers the following degree programs.

- BSc (3-year General)
- BSc Biological Sciences (4-year Major)
- BSc Honours Biological Sciences, which includes a research-based thesis.

There is a BSc Co-op option in both the Honours and Majors BSc programs. We also contribute to the management and course offerings of Honours and Majors programs in Genetics (with a Co-op option) administered through a multi-faculty interdisciplinary committee, to be reviewed in 2017-18.

Themes in the undergraduate program

Undergraduate program offerings span 5 themes and integrate the scope of classical biology, recent discoveries and observations, and emerging concepts. Each theme has one or more courses required above the core courses required of all students enrolled in undergraduate program in Biological Sciences. The themes are:

Cell, Molecular and Developmental Biology

Students in the Department of Biological Sciences with an interest in the exciting field of cell and developmental biology can select the Cell, Molecular, and Developmental Biology theme for focus. This theme provides students a selection of courses that highlight fundamental principles and many important advances in this rapidly growing area of contemporary biology. Students can concentrate on aspects that deal with the molecular structures and processes of cellular life and their roles in the function, reproduction, and development of living organisms. The theme is structured such that students can choose from a broad range of disciplines, including biochemistry, molecular biology, morphology, genetics, cell biology, and developmental biology. The organisms under study in this theme are equally diverse, ranging from microbes through to invertebrates, vertebrates, plants, and fungi. The Department collaborates with other life sciences departments and this theme allows student to develop

a highly flexible course portfolio that includes courses from the Departments of Biological Sciences, Chemistry, Microbiology, or Plant Science.

Ecology and Environmental Biology

Ecology is the study of interactions between organisms and their environment, both in natural settings and human-influenced habitats. In our society, ecology and environmental biology provides a scientific link to the living world. Ecologists study the lives of many organisms including animals, plants, fungi, protists, and bacteria in many habitats. Interactions among these organisms are investigated at many scales ranging from the microscopic to the global. At the individual level, ecology investigates the impact of environmental factors on organisms through their physiology and behaviour. Ultimately, ecologists link these factors to survival and reproduction in variable environments. At the population level, ecology examines the causes of fluctuations in numbers and changes in distribution of a single species. This work is often the focus of agencies concerned with exploitation, extinction, and rehabilitation of both commercially and esthetically important species. At the community and ecosystem levels, ecology considers many coexisting species. It examines the interactions between species within the communities (competition, predation, parasitism, mutualism, etc.) as well as broader investigations of community structure and composition. Ultimately, the skills developed within this theme prepare students for future careers in academia, government agencies, private consulting companies, or NGOs whose mandates encompass ecological and environmental concerns.

Environmental and Integrative Physiology

The Environmental and Integrative Physiology theme will be of interest to a wide array of students interested in pursuing employment opportunities in the environmental, consulting, pharmaceutical, healthcare, and professional job markets. Based on the suggested courses and sub-themes within this program, students will be able to graduate with an all-inclusive degree or specialize in particular disciplines ranging from molecular physiology to whole-organism physiology and eco/environmental physiology, a subject area that is at the interface between ecology and physiology. Students will be exposed to modern research techniques in labs and classes, and will be taught by instructors and faculty with active research programs within the Department of Biological Sciences.

Evolution and Biodiversity

Evolution is broadly defined as “descent with modification” and is the process that generates the earth’s biodiversity. The theory of evolution provides a unifying framework for biology because all organisms are descended from a common ancestor. As a result, evolutionary principles permeate research and teaching throughout biology. Evolutionary biology addresses two overarching questions. (1) What was the history of life? (2) What processes account for adaptation and diversification? Systematics reconstructs the history of life by studying relationships among species, and involves comparisons of physical appearance, development, biochemistry, genetics, behaviour, ecology, and biogeography. Evolutionary Genetics investigates how processes such as natural selection, mutation, and migration interact to cause evolutionary change within populations. Evolutionary history, genetics, and ecological context are required to fully understand the evolution of traits, for example body size, wing shape or leaf structure. Thus evolution integrates knowledge from a wide spectrum of sub-disciplines within biology. Evolutionary biology has wide-ranging practical applications. Principles of evolution are required to understand: the evolution of pathogens such as HIV and avian influenza; domestication of wild species and consequences of genetic modifications; the identification of natural products; long-term responses to environmental change; and human biology. Courses from this theme will prepare students for academia, medicine, and government agencies or non-governmental organizations that emphasize the cataloguing and conservation of biological diversity.

Integrative Biology

The Integrative Biology theme will be of interest to students planning to pursue careers in the various biology sub-disciplines and who wish an undergraduate degree that is “interdisciplinary” within the life science departments and cuts across the traditional boundaries. This program will suit students who are interested in the “after degree” program in Education or who are intending to apply to a professional program (e.g. Medicine, Dentistry, Pharmacy, Medical Rehabilitation) and who would like a broad background in the Life Sciences. With the appropriate choice of Biological Science courses, it would be possible to indicate the Integrative Biology theme along with a second theme from the Department.

The undergraduate program is supported by the Undergraduate Curriculum Committee (UGCC) and a member of the administrative staff who is knowledgeable about the program, attends meetings, takes minutes and has daily/regular interactions with the Chair and members of the Undergraduate Curriculum Committee, undergraduate students, and staff in the Department, the Dean of Science office (including advisory staff), and the Registrar’s Office.

The graduate and undergraduate programs were developed through a reflective process of leadership by faculty from the whole Department in 2008; “melding” committees worked to establish program goals, design, and courses, starting from the significant experience and expertise of our members in offering the programs from the founding Departments and the Biology-Teaching Unit. Based on experience and vision, the melding committees worked creatively from first principles and the resources of course offerings by established instructors; committees designed the programs, merged courses, selected particular approaches or subjects, and omitted others, to develop the groups of core courses, the themes, and the lists of optional/elective courses in each program. The melding committees also worked together to draft terms of reference, membership, and responsibilities for the 5 original standing committees of Department of Biological Sciences Council (the Undergraduate Curriculum Committee, Graduate Studies Committee, the Scholarships & Awards Committee, the Adjunct Professor Committee, and the Honours Thesis Committee). Under the leadership of the head, each of the melding committees then brought their work forward to Council for discussion, input, revision, and recommendation. These 5 standing committees have continued to guide, manage, and govern the programs, even as they have evolved since being implemented.

Previous reviews of graduate programs in Zoology and Botany

The founding Departments of Zoology and Botany each had a graduate program review in the years prior to the formation of the Department of Biological Sciences (see Appendix 2 for the reviewers’ reports and the respective responses).

The Department of Zoology had its graduate program review in February 2004, with recommendations to:

- Establish a minimum (and higher) level for funding graduate student stipends
- Have the University of Manitoba (UM) and the Faculty of Graduate Studies (FGS) make strenuous efforts to implement support for a program of GS funding
- Find additional space for graduate student carrels
- Make renovations to support all research programs in the department
- Reduce graduate program course loads by half (from 12 CH to 6 CH)
- Provide graduate course offerings that build desired, specific skills and experiences

- Publish a 3-year schedule so students know graduate-course offerings and can plan their program
- Give faculty credit for teaching graduate-level courses
- Publish a survival guide for graduate students
- Improve the website to facilitate student recruitment
- Reformulate the candidacy examination so it is in the area of a student's research
- Bring external examiners to PhD defences (UM to help offset costs)
- Have UM/FGS screen faculty for membership in FGS
- Have DMFS [Delta Marsh Field Station] redefine its commitment to research and teaching (scheduling of activities)
- Have UM commit to filling vacant faculty positions within the Department
- Form an aquatic sciences research group
- Allow transfers from MSc to PhD within first 18 months in the Master's program
- Remunerate Teaching Assistant (TA) hours, and at a better rate, and
- Establish a social club for grad students.

The Department of Botany had its graduate program review in November 2004, with recommendations to:

- Provide a minimum level of financial support for graduate student stipends
- Streamline graduate programs especially the Master's, to reduce time-to-completion
- Solve the crisis of greenhouse space and technical support
- Remove requirements for a degree in Botany for admission to Master's program
- Establish a requirement for adjunct professors to have designated co-supervisor from the Department
- Improve the level of funding success for faculty applying to NSERC by mentoring and pre-review
- Reduce graduate program course load in MSc and PhD programs
- Establish a venue for a graduate student seminar program
- Publish a graduate student survival handbook
- Establish a TA-training program, and
- Update the Department website.

For the most part, these recommendations were addressed through thorough consideration by each of the departments, to the limits of their energy, consensus and advocacy (and the apparent constraints of institutional support), prior to the formation of the Department of Biological Sciences. The reviews and recommendations were also considered by the melding committees and Department Council in developing the Biological Sciences graduate programs in their discussions toward implementation (2008-2009). The Department of Biological Sciences was allocated the Biological Sciences Building (formerly the Pharmacy Building), the Faculty implemented an internal pre-review for grant applications by new and established faculty, and the graduate programs in both Botany and Zoology Departments reduced their course loads to 6CH each. A few outstanding matters either could not be solved, or were not implemented. The list of outstanding matters included improving funding for graduate student stipends (a minimum stipend), solving the crisis of greenhouse space, and increasing technical support.

For some recommendations in the Review Reports, the Department (Zoology or Botany) did not receive a response from the Faculty of Graduate Studies and/or the University. However, the process of building consensus in the Department of Biological Sciences (e.g., using melding committees), and the iterative design processes used to develop the program proposals for each of the BSc, Master's and PhD

programs were all well-received by the Faculty of Science, the Faculty of Graduate Studies, and the Vice-Provost (Programs and Planning) prior to processing through the Senate Committee on Curriculum and Course Changes (BSc programs) and the Faculty of Graduate Studies (graduate programs), and Senate toward their implementation.

In addition to the BSc (General, Majors, and Honours), MSc, and PhD programs above, the Department is currently coordinating the inter-Faculty BSc Genetics programs (Honours and Majors) jointly with the Departments of Microbiology (Science), Biochemistry and Human Genetics (Health Sciences, College of Medicine), Plant Science (Agriculture and Food Science), and Anthropology (Arts). The Chair of our Undergraduate Curriculum Committee is currently Chair of the Genetics Program committee. The Genetics program will be reviewed separately, beginning in the Winter term, 2017.

Teaching summary

The Department provides slightly less than 50% of its teaching to units outside the Faculty of Science, and ~35% to University-1 (similar to other departments in the Faculty); we therefore have a very large “service” role in teaching contributed by 39 full-time faculty members, as of December 2015.

Undergraduate Student Credit Hours by academic year	Biological Sciences (BIOL)	Faculty of Science Total (% BIOL/Total FOS)	
Fall 2015 (as of Nov 2015)	17,874	67,856	(26.3%)
Summer 2015	5,041	16,492	(30.6%)
Fall 2014 – Winter 2015	33,120	126,174	(26.2%)
Summer 2014	4,710	12,447	(37.8%)
Fall 2013 – Winter 2014	32,957	127,687	(25.8%)
Summer 2013	4,272	12,447	(34.3%)
Fall 2012 – Winter 2013	33,303	125,302	(26.6%)
Summer 2012	4,014	11,781	(34.1%)
Fall 2011 – Winter 2012	32,076	120,251	(26.7%)
Summer 2011	1,452	3,852	(37.7%)
Fall 2010 – Winter 2011	30,078	120,013	(25.1%)
Summer 2010	1,650	3,792	(43.5%)
Fall 2009-Winter 2010	28,842	115,781	(24.9%)
Summer 2009	1,467	3,564	(41.1%)
Fall 2008-Winter 2009	27,204	110,478	(24.6%)
Summer 2008	1,275	3,315	(38.5%)
Fall 2007-Winter 2008	25,845	111,219	(23.2%)
Before merger of 3 units into current Department:			
Fall 2006-Winter 2007	26,559	114,330	(23.2%)

The above table shows a very significant contribution by the Department to teaching at the University, and therefore, the ongoing replacement of vacant faculty positions is essential. The Department has developed recruitment plans by consensus at Council, and has strategically reduced teaching provided by Sessional Instructors over the past 5 years. In part, the reduction was due to budget considerations, and also aimed to: provide more consistent instruction across the programs, better integrate teaching

with research, and provide a level of pedagogy and evaluation that we direct. The number of Majors, Honours, and graduate students in the Department continues to rise.

Strengths

Documents related to Council Bylaws and Standing Committees are viewed as living documents that can evolve depending on needs and demands on the Department. Currently the Department Council has seven standing committees for administering academic matters: Undergraduate Curriculum Committee, Graduate Studies Committee, Adjunct Professor Committee, Honours Thesis Committee, Scholarships and Awards Committee, the Student Recruitment and Retention Committee, and the Museum and Collections Committee.

Operational committees of the Department, for example, the Greenhouse Committee, Theme Group Committees, the Seminar Committee, Safety Group, IT Committee, thesis-advisory committees for each student in Honours, MSc, and PhD programs, and the Local Animal Users Committee, all make significant and important contributions to the Department, Faculty, and University.

The Department has an excellent track record of recruiting energetic and enthusiastic new faculty and staff who bring, support, renew, and refresh our modern approaches to research and teaching. Their skills and interests continue to improve the excellence of teaching and administration, and strengthen the breadth of research and collaboration in the Department.

Undergraduate and graduate students make excellent contributions to the Department, and lead their peers and others by example, in their academic, research, and social activities and citizenship. The active engagement and strong contributions of the Biological Sciences Graduate Students Association (BSGSA) and the Biology Undergraduate Students Association (BUGS) are recognized locally, regionally and nationally.

We have an attractive undergraduate program with a strong core of course requirements. These programs span organismal biology and principles of ecology, five theme options, and many course offerings, including laboratory-based courses at entry and advanced levels, and a wealth of research opportunities for undergraduate students through summer, Honours, and Co-op projects.

Our Support Staff are engaged in the Department's mission and work closely in making significant contributions to sustaining our programs of teaching and research, program delivery, and organization and planning, as well as other activities alongside faculty and students. Dedicated staff and students work together with faculty members and higher-level administration (including the Faculty of Science Dean's Office staff) to improve the way we do things and serve as valuable citizens of the unit and the institution.

The Department is recognized internally and externally, as having collegial and respectful interactions among its academic and support staff, students, and visitors. Our academic staff members are very largely active in research, teaching, student supervision/training of HQP and scholarly activities; they are all committed to being successful teachers and researchers and making service contributions to the Department, university and their professional fields. Our faculty have a broad and diverse range of research interests, approaches and technical skills that bring new ideas, mutual mentorship, collaborations and new funding opportunities that benefit individuals and the Department as a whole. This has resulted in a research environment that is attractive for recruiting graduate students and new faculty to the Department.

Another strength of the Department is the availability of a significant amount of newly-renovated research and teaching space in four buildings (Duff Roblin, BSB, Buller, and the Crop Technology Centre).

Our teaching is viewed as consistently strong by Department members and students, and we make ongoing improvements to sustain the scope and high standards of our programs while responding to system changes, staffing changes, evolving demands within our budget, and advocating for reasonable and justifiable increases in support and improvements to facilities. The increasing demand for our courses, and increasing enrollment in many courses is both a strength and a challenge. Faculty members also communicate well with one another to cover teaching needs, anticipate sabbaticals and the need to cover teaching responsibilities in the various programs, and to address ongoing mentorship in teaching and service activities.

The Department also holds a strong consensus that fieldwork, collections, greenhouses, growth chambers, and animal care facilities are all essential to the research successes of the Department, and therefore also critically important to our successful teaching and to student learning. Our outreach activities continue to expand; the level of outreach activity is quite high as so many Department members are dedicated to building community and educating the public. Collections and organism-growth facilities are also a strong asset for outreach.

Weaknesses and challenges

In our previous strategic planning exercise (2014), the Department identified challenges as academic and organizational, or related to infrastructure and facilities.

For challenges in academic work and organization, the Department noted that maintaining our strengths in teaching undergraduate and graduate programs and sustaining the breadth and excellence of those programs, will be important, as we face ongoing faculty recruitment and retirement. This includes turnover of senior faculty and the Department Head (term ending December 2017). It is our goal to maintain what we do well, in the face of changes to the departmental budget. This includes maintaining HQP training in the face of uncertain levels of funding available from national granting agencies.

Funding HQP training is not a trivial matter, and is one of the main, long-standing issues from previous graduate-program reviews across Canada, and certainly across the Faculty of Science and the University of Manitoba. For instance, the International Graduate Student Entrance Scholarship is equivalent to ~50% of graduate-program fees over the first 2 years. The Graduate Enhancement of Tri-Council Stipends (GETS) program provides matching funding from the Faculty of Graduate Studies to faculty members who are paying student stipends from their Tri-Council grants. This program is unique to the University of Manitoba, and essentially doubles the value of an NSERC grant for stipend support.

The main avenue of scholarship funding to graduate students is through University of Manitoba Graduate Fellowships (UMGFs), which are available to Canadian and international students; those and other awards go directly to graduate students. UMGFs are allocated based on the total number of eligible graduate students in a program, with eligibility defined as a student within the first 2 years of a Master's and the first 4 years of a PhD program. However, in 2014-15, the Department had 29 applicants, most of whom (25) were eligible for a UMGF as they had a 3.75 GPA or higher. The Department was able (by its allocation of UMGFs) to forward only 5 names. However, one student (out of the 5 names forwarded), received the Vanier Scholarship, 2 students received NSERC PGS awards (available only to students who are Canadian or Permanent Residents), and the remaining 2 applicants

decided after a long delay, not to come to the University of Manitoba, because while they were waiting to find out about UMGF funding, they accepted more certain or more well-paid offers at another university. The UMGF program has recently devolved (based on allocations from the Faculty of Graduate Studies) to decisions at the Department level, and we are now coordinating the new process which should be more expedient and useful in recruitment, at least within our allocation. We recognize that allocation of UMGFs will increase in tandem with a decline in the time-to-completion in our graduate programs.

It clearly will continue to be challenging, as well as exciting and fulfilling, to manage a large and strong Department with sizeable (and growing) undergraduate and graduate programs, considerable infrastructure, and many teaching labs, research labs, and offices spread across 4 buildings. This is especially the case, when there is expectation that the Head and two Associate Heads should be successful at research, teaching, service, and professional activities. Part of the Department's challenge is to improve and maintain effective communication among members when there are so many individuals and such a barrage of emails (even without social media). We anticipate that institutional and personnel changes will have differential effects on different subsets of people, places and programs. Website improvement and making effective use of social media for information flow and to raise the profile of faculty research, student successes, and the programs and activities in the whole Department, are ongoing challenges, despite our at least annual renewal of effort and attention. In part, these challenges are due to institutional and program changes, and changes in staffing and communication practices (and technical issues with making input available to websites) in many offices including ours, so we will need to redouble our efforts.

We aim to ensure students can progress predictably through our Majors and Honours programs and are minimally impeded by resource limitations, as interest in Biological Sciences courses continues to grow. In part, this means that we will need to help limit or facilitate the accommodation of the impact of learning new administrative systems, especially if staffing levels do not rise. This has become a significant issue for our large department, particularly related to Concur (for travel and expense claims) that are increasingly difficult to settle, given changing regulations, stipulations, staffing in travel services, and the stringency of oversight related to issues of research compliance (in particular for, but not limited to, the use of Tri-Council funds). The reconciliation of expense claims is onerous and frustrating (e.g., claims for fieldwork expenses, advances to cover student travel on field research, research trips overseas, claims for costs expensed online from internet orders with the corporate expense card, etc.). These frustrations are major impediments to daily progress through paperwork, despite the excellent support by administrative staff in the Department office. As would be expected, staff assist faculty and students in entering and justifying hundreds of details; it needs to be stated that the staff does this very well, and also handles our frustrations (and theirs) when claims are returned multiple times, for further attention or corrections.

A challenge we recognized only recently, is the new focus by the University on Departments meeting bona fide requests for reasonable accommodation (BFARS) in teaching, including lab and fieldwork courses in undergraduate (and presumably graduate) programs. We do not yet know the details of how much effort by individual faculty members and technical staff (and possibly TAs) will be required to accommodate the increasing number of students who are on record as having a disability with Student Accessibility Services. A committee at the Faculty level is facilitating this planning, and fully understands the Department's concerns about the need to balance the need to accommodate requests and the reasonableness of how such accommodations might happen.

In challenges related to infrastructure and facilities, we prioritize the greenhouses, growth chambers and animal-rearing facilities, collections and multi-user facilities (e.g., imaging, sequencer, electron microscopy, etc.). All of these are vital to our research and teaching. The periodic or consistent pressure to reduce/shrink or close facilities is difficult to counter. The support of the whole Department, and advocacy on the Department's behalf from the Dean's office has been invaluable in sustaining the animal care facility, but we are frustrated that the greenhouse is not placed higher in the priority of the institution for funding toward replacement or significant upgrade (e.g., in the capital campaign). Finding ongoing support for these facilities is essential, and will be a challenge; ongoing, long-term plans are so much more important than one-off support at times when emergency repairs or renovations are necessary to meet particular requirements (e.g., from Canadian Council on Animal Care). As another example, the level of use for the transmission electron microscope (TEM) has been declining since the provincial veterinary lab contract lapsed (virology/pathogen screening) in 2013. The current use doesn't fully justify the large expenditure required for a service contract, so we anticipate that at some point, the microscope will need costly service or become inoperable. Until then, we will hope to avoid major problems with malfunction or breakdown, and at least in the last year, have received support from numerous units including monies from the Department and Faculty of Science, after urgent requests to help maintain the TEM facility.

We need to replace the aging, dilapidated, single-paned Buller greenhouse with a new modern and energy-efficient facility that is connected to our teaching and research spaces. This is an ongoing issue, particularly with the visibility for and profile of the greenhouse having increased significantly in the past 3 years (e.g., <http://news.umanitoba.ca/our-oasis-buller-greenhouse-open-to-campus-community/>). The value of this facility is far more tangible to those outside the Department than it was previously, and even more important for internal users of the living-plant collections and the facilities of the greenhouse for generating specimens used in teaching and in research projects conducted by students and faculty. The Faculty of Science is supportive of initiatives to upgrade and renovate the greenhouse, and we have garnered some steel benches and refurbished swamp coolers from the closure of the Agriculture Canada greenhouses. Longer term, there is a private-funding initiative to which members of the Department have contributed, although this has not yet borne fruit. We had opportunity to conduct a design and feasibility study for a new greenhouse in 2011-12, and although the plan was well-received by higher administration, the cost was excessive and no plans for full design, re-costing or eventual construction were initiated.

The challenge to modernize the Biological Sciences animal care facility (housed on the W100 level of the Duff Roblin Building) is of importance, as the University must uphold national standards set by the Canadian Council on Animal Care. This is an ongoing issue, and is very strongly supported by the Faculty of Science, and all the animal users in the Department led by the Chair of the Local Animal Users Committee, Dr. Mark Fry. We would love a new animal facility, or at the least, a long-term plan by the institution, for animal holding and maintenance on campus in an area that is reasonably contiguous to our research laboratories, but to date there is no information available on such a plan.

The Department has needed for some time, to find support and funding to renovate the Stewart-Hay Zoological Museum space in the Duff Roblin Building; the facility should have the benefit of modern displays and improved capabilities for teaching and outreach (as well as research) using our many collections. This is a major initiative for the Department, again strongly supported by the Faculty of Science. The Department learned recently (February 2016) that there is potential for significant financial support toward major renovations that would enable new facilities for outreach and other events, and also accommodate teaching needs. Modest requests for support for tables, chairs, projector and

computer through support from Endowment funds have been very helpful, although the space could indeed contribute much more to teaching and outreach programs with attractive renovations and modernized displays. The recent formation of a Museum & Collections Committee as a standing committee of Department Council, has relaunched the initiative to improve the museum and curation of our many collections, and we do look forward to renewing the value of this facility. There is now a new Faculty-level committee to begin design for a Science Museum that could serve the whole Faculty of Science in outreach and internal interactions.

Finding support and funding to renovate teaching laboratories in Duff Roblin Building (4 labs on the 200 level, plus museum) and Buller Building (especially 523, 217, and 221) is also very important at this juncture, and is again a significant challenge following recent recruitments and faculty renewal (which brings the need to renovate space for research labs). These are major spaces used in teaching, year over year, by many students in our undergraduate BSc Majors and BSc Honours programs. The teaching labs in Duff Roblin Building are on the 200 level, and did not need restoration after the fire in 2009. Renovation of teaching and research labs is costly, and all these spaces are on the list for renovations, every year as it is not known when or if budgets will allow for renovations and continue to advocate for these projects at the Dean's office and other levels. Recent announcement of funding specifically for the renovation of teaching spaces, from a major donor to the University of Manitoba, brings promise that the long list of labs in the Science complex will get better attention in the near future.

It is also important that we find support and especially funding to renovate research laboratories in Buller Building (531, 316/319) and Duff Roblin Building (W314, W370). We also need funding to do ongoing maintenance and upgrades of other research laboratories, based on needs for research facilities and space. These laboratories were not upgraded during the 15-year reconstruction of the Buller Building or after the fire in Duff Roblin; although functional, they will require renovation and upgrade (e.g., to meet codes for Occupancy from the City of Winnipeg, and Health and Safety from the Province), for any current faculty member who has need for additional research space and for new faculty who need to begin research programs in the Buller or Duff Roblin Buildings.

In addition to the TEM service contract, it is important to recognize that the Department be able to maintain financial support for service and maintenance agreements that sustain the growing and increasingly complex suite of infrastructure (e.g., imaging instrumentation, sequencers, preparatory and analytical instruments) in the face of changing funding patterns and programs, and changes in user base for each instrument over time. From at least 2007 to 2014, all faculty recruited to the Department were expected to apply for infrastructure funding from Canada Foundation for Innovation (CFI) and the Manitoba Research and Innovation Fund (MRIF). Indeed, all did so, very successfully. Their many initiatives brought significant equipment to research labs, and much of the major equipment is still accessible to researchers throughout the Department through collaborations and increasingly, user fees (as outlined in the original proposals). Those fees support the maintenance of service contracts for each instrument (e.g., confocal, sequencers) past the end of the initial funding from CFI/MRIF. However, the user fees may not fully sustain all costs of services, as use fluctuates, and new instrumentation comes online. In 2014-15 there was no call for CFI proposals by the University, which adversely affected 4 new members of the Department who would have been eligible to apply. Some interim "CFI-like" funding was generously made available by competition (funded by the Faculty of Science jointly with the Vice-President Research), and there were significant monies provided in funding much of the proposals from Department members (although at much lower levels than would have been proposed to CFI). As of this review date, some service contracts are in place for the shorter and medium term, while others have been dropped. The decisions to drop service contracts were made due to lack of funds to an individual

or group of researchers, and/or funds available to the Department and prioritized for this type of support over other renovations or equipment purchases and upgrades). However, there will likely need to be a plan for longer-term support of service contracts and/or repairs for equipment that is or comes off contract.

Fit into current strategic plans - Institutional, Faculty and Department

The activities and strategic plan (dated September, 2013) of the Department of Biological Sciences are broadly designed on goals and vision, and specifically attuned or aligned to the then-current strategic plans of the Faculty of Science (redrafted Fall/Winter 2015-16), and the University of Manitoba (passed by Senate in Fall 2015, "Taking Our Place"). There are caveats to the notion of strictly 'aligning' the Department's goals to fit within the strategic directions of the University, in that some of the language (e.g., in the previous Strategic Planning Framework, and the current Strategic Research Plan) has not allowed all members of faculty to be able to identify what they do (for examples, in fundamental or basic science research in evolution, ecology, limnology, or endangered species) as part of the stated vision and priorities of the University of Manitoba.

Nonetheless, our activities are valued as part of the foundation of the University; the large majority of numerous recruitment requests are successful, due to the strength of our justifications that a requested recruitment (of a new member of faculty) does demonstrate alignment of the Department's plan and goals with those outlined in Strategic Plans of the Faculty and University. Since 2007, the Department's success in recruiting 14 new members of faculty is quite remarkable. This has included successful proposals for new positions including 2 CRC tier 2 positions (now one), 1 Industrial Research Chair position, 1 incremental position related to the Industrial Research Chair, and 1 new Instructor-I position (net 4 new positions) and recruitment of the following faculty members (in alphabetical order): Drs. Belmonte, Chen, Detwiler, Fraser, Garroway, Kormish, Marcus, Roth, Stacey, Stout, Treberg, Waterman, Zelmer, and Jeffries (to arrive July, 2016). Prior to 2007, the Department Head, Dr. Judy Anderson, was recruited into a new position, specifically to lead the merger of the 3 founding units. The Department also shared the recent recruitment process to fill the position of a Life Sciences Instructor (to start in mid-2016), for which the new recruit will choose which unit will be their 'academic home'; the plan is that this individual (TBA) will have teaching duties assigned equally in the two Departments of Biological Sciences and Microbiology. Thus overall, the 'fit' with strategic plans is evidenced by our success in being awarded academic positions in well-justified alignment with those plans, and then successfully doing so. The Strategic Plans of the Faculty of Science and University of Manitoba appear in Appendix 3 and Appendix 4.

Collaboration, Cooperation and Community

Service teaching

The Department makes a huge contribution to service teaching for students outside the program, and outside the Faculty of Science. This is most easily seen (later in the document) in Table 20 (Taught-to Taught-by) and Figures 14 (all service teaching) and 14A (for service teaching at the first-year level). For example, of students enrolled in taking 33,120 undergraduate CHs in Fall 2014-Winter 2015, 46.6% were in Science, 34.1% in University-1, 7.9% in Arts, 3.9% in Extended Education, 2.6% in Agriculture, 1.9% in Environment, etc. This is one indicator of the extent of service teaching and academic/teaching support to other programs and units, internal to the University. Notably, this service teaching is not, and cannot be formally separated from teaching to students in Biological Sciences programs, and to some extent, the institutional data on University-1 courses can obscure information that would be useful in evaluating

programs in the Department or the Faculty of Science. For example, the high school grade at entry to the University, or course-grade distributions may differ widely, depending on the home faculty or the program a student declares in their second year, after leaving University-1.

There is little formal service teaching to programs/units external to the University, unless the data include delivery of distance/online courses to learners who are not registered as students at the University of Manitoba. However, that number is very low (less than 5% of those registered, from a survey to students taking the Distance Education offering of BIOL 2410 in summer 2015).

Informally, the Department is contacted and responds to thousands of questions brought to the main office, the Head and Associate Heads, and individual members of faculty and staff about program and course information. There are also thousands of requests for advice on registration, examinations, VW/AW, student advising brought to the same people and also through biograd@umanitoba.ca (for information on the graduate program), that form part of our interactions with the broader community. These interactions typically occur on an *ad hoc* basis. Although these tasks are distributed to many people as part of “and other duties that may arise” in job descriptions (especially to the person staffing the reception desk in the Department), such inquiries are sometimes more than copious (e.g., during course registration and revision periods). Nonetheless, the Department is very appreciative that staff and faculty are highly cooperative in addressing the requests and accommodating the need for this service. It provides timely responses and directions to posted information and the offices of people who can provide more specific information.

Members of the Department including graduate students also respond graciously and very generously to requests from individuals (e.g., school teachers, counsellors, students from K-12) for help with projects (e.g., Science Fair projects, class assignments, growing plants). Students, staff and faculty also give workshops at schools and on campus for particular schools, groups, teachers, or grade levels, and many members of the Department (faculty, graduate students, and technicians) help in the community by judging science-fair events (often contributing to multiple events, every year). Department members also answer inquiries from the public, and faculty and students are often involved in interviews in the public media. The Department contributed numerous judges and a Chief Judge at the Canada-wide Science Fair that was held on campus in 2009, and always provides judges at the Winnipeg, Manitoba Schools and other local or regional Science Fairs, the Sanofi Biogenious Canada Challenge, and similar events. All these interactions with the community are engaging for everyone, reinforce the value of science and science education. One faculty member said, “*This is why I’m an educator; I love seeing the spark of interest in learning science, in these kids!*” The interactions are also excellent opportunities to listen to the interests of others, and consider other activities that might benefit the community. Notably, BSGSA organizes three very successful public ‘named lecture’ events each year in conjunction with the Department (the Hanna, the Lubinsky, and the Barrett-Hamilton lectures), which bring further interactions for the Department with the broader community.

Collaboration with other units internal to the UM, and with other institutions

The Department is collaborative with other units at the University of Manitoba in administration (committees) and research. Faculty and staff contribute to committees related to academic matters (e.g., Senate and subcommittees including Executive, Admissions, Instruction and Evaluation, University Discipline, Appeals, and Faculty of Graduate Studies Committees, including Awards, Appeals, Programs and Planning. Faculty also contribute to committees related to research matters (University and Faculty of Science Strategic Planning committees, chair PhD defences (for FGS), Field-Work Support Program committee). Members of the Department are also elected or invited to serve on search committees in

Faculty of Science departments or for department heads or in higher administration (e.g., for Provost) and have served on the Board of Governor, and in many positions on the Executive and Board of Representatives with the University of Manitoba Faculty Association (UMFA). These many activities are in addition to our engagement at Faculty of Science Council, COCAP, student discipline committees, and other meetings including monthly meetings of Department Heads Administrative Council (DASH), quarterly meetings of the Research Advisory Committee, meetings of the Graduate Chairs Committee with the Associate Dean Research, the Awards Committee, the Endowment Fund committee and the Field Work Support Program committee, and regular meetings of Undergraduate Chairs with the Associate Deans (Undergraduate). Members also attend (with graduate students), the seminars in many programs, form new series of seminars and provide workshops through personal interest and expertise (e.g., “R” workshops by Dr. Darren Gillis), and attend (and also chair) thesis-defence presentations by students in other units (Faculties and Departments) due to interest in the topic area. Members of the Department serve on thesis advisory committees (sometimes a very large number of committees) in many Departments in the Faculty of Science, and in other Faculties (e.g., Agriculture and Food Science, Environment, Health Sciences, Arts, Kinesiology, Dentistry, etc.).

Responsiveness to current or future needs of Manitoba and/or Canada

The Department aims to provide an excellent level of education that includes:

- a strong focus on biological principles, informed by faculty staying current with the literature and engaging in professional development opportunities,
- discipline-specific content delivered at an appropriate level of detail (1000, 2000, 3000, 4000)
- modern course content with reference to current events and recent discoveries,
- new courses that reflect recent shifts in direction of biology and science (e.g., Biological Sustainability, Biology and Society under Special Topics in Winter 2016, Genes and Development, Molecular Biology Techniques for Eukaryotes – DNA, Molecular Biology Techniques for Eukaryotes – RNA, Experimental Parasitology, Molecular Population Genetics/Genomic (in development), etc.,
- relevance to particular issues in the local, regional/provincial and national/federal environment, such as Experimental Lakes Area, Lake Winnipeg, Lake Manitoba, conservation (watersheds, water quality, habitat, biodiversity, species- or ecosystem-specific issues), etc. The Department strongly supported Dr. Gary Anderson’s application for an Industrial Research Chair (Manitoba Hydro-NSERC), including the requirement to allocate a tenure-track position (future retirement) toward a new recruitment to the Department who would complement the work on Lake Sturgeon Conservation,
- adding course sections where possible to meet demand when post-secondary institutions are needed to increase the number of qualified graduates (e.g., added 2 large-enrollment sections in BIOL 1410 in response to Province of Manitoba initiative to increase training toward Nursing programs),
- agreeing to develop new courses for other programs, for example the Human Reproductive Physiology course that will become a required course in the midwifery program in the Faculty of Nursing, currently under review toward approval and funding at the Province of Manitoba,,
- maintaining laboratory teaching experiences in many courses (including first-year majors courses BIOL 1020/1030), since skill development is essential for 2000-level and higher courses, and for employment opportunities,
- maintaining and building fieldwork experiences into courses required in our programs and/or required or recommended in our Ecology and Environmental Biology theme,
- highlighting research in the Department, to build awareness of our research and opportunities for students this begins with the 5-minute videos posted on the website as “Talking to a Biologist”

<https://www.youtube.com/user/BioSciUniMan/videos?view=1>, a long-standing initiative of our Senior Instructor who directs the BIOL 1020 and 1030 courses, Mr. Michael Shaw,

- fostering research opportunities in summers, within laboratory and fieldwork settings, and in Co-op terms
- listening to feedback from students given to instructors and student advisors, and
- developing recruitment strategies to build expertise in areas of research and knowledge (for teaching) that are recognized as required for modern biology programs; for example, recently adding and recruiting to fill positions plant molecular physiology and molecular population genetics/genomics, and fish physiology.

Departmental enhancement of the national/international reputation of the UM

The Department brings positive recognition to the institution, through activities such:

- recognition as an Outstanding Workplace, as profiled on the University website (2012-13),
- contributions to service on grant-review panels, and as *ad hoc* reviewers of grant applications and manuscript submissions for a very long list of international funding agencies and journals, and service as journal editors,
- contributions by members of the Department who take leadership roles in organizing conferences (at University of Manitoba or elsewhere) as program chairs, officers, or presidents of scientific societies,
- contributions by faculty in leadership and committee roles on COSEWIC (Committee on Species of Endangered Wildlife in Canada), Lake Winnipeg Consortium, Water Stewardship, Canadian Consortium for Fisheries Research, the Great Lakes Fisheries Commission, etc.,
- international and national collaborations involving research faculty and students (e.g., exchange visits)
- collaborations on research proposal to national agencies,
- patenting inventions,
- in numerous excellent outreach initiatives by individuals and committees such as the Student Recruitment and Retention Committee in the Department,
- contributions to public education through seminars, presentations (e.g., Extended Education, media profiles (Nature of Things, Scientific American) and outreach (e.g., Café Scientifique, Science in Action, Science Fairs),
- giving invited seminars at other institutions, and delivering keynote lectures and invited presentations national and international conferences,
- service as External Examiners for PhD dissertations defended at other universities (e.g., in Lyons, France; University of Toronto; University of Winnipeg; University of Minnesota)
- contributions by faculty to program and unit reviews, and academic investigations inside and external to the University,
- contributions by faculty in senior administrative roles at the University of Manitoba (e.g., Associate Deans in Science (for Undergraduate Students) and in the Faculty of Graduate Studies) which lead to active roles at the forums of national or Western-Canada Deans' meetings,
- giving seminars at other units in the university of Manitoba (and subsequent spin-off invitations), and
- a strong initiative by the Department, to encourage students and faculty to attend and present their research at conferences at the national and international level, toward the networking and career advancement of researchers and students. This occurs through the Department's contributions toward travel awards for 35-40 students each year (graduate and undergraduate students) to present their work and network at conferences.

Student Success

Procedures and resources for student advising and career counselling

Student advising results from a combination of program advising by the theme Chairs and the Associate Head in the Department. The latter especially, provides information on the details of specific course content in relation to discussion of a particular student's interests, goals, and capabilities. Five academic advisors in the Faculty of Science office also advise students from our Department and they help ensure course and program requirements are met. Career advising is also provided by Department faculty members who teach, mentor and advise students in research, coursework and voluntary activities. The Career Center in Student Affairs also has advisory activities regarding employment, and the Co-op office in the Faculty of Science brings opportunities for many students to consider career choices through direct exposure to a variety of work placements.

The advising may be informal, such as when a student approaches a faculty member after class with questions, or it may be more formal. Formal advising occurs when students apply for entry to a program or are continuing within a program in the Department for Majors and Honours programs. The BSc General program does not require completion of a form (with departmental signature) and students can declare the 3-year BSc General program using Aurora Student. The theme chairs and the Associate Head (Undergraduate) meet with students through scheduled office hours or by appointments made when the student phones or emails to schedule a discussion. Sometimes students will drop in and a formal discussion is then initiated. The students are asked various questions on their academic work, their interests, their primary goal as well as alternative plans, and their problems, and their online (unofficial) transcript is usually examined and triggers additional questions and discussion. The program approval form is then signed and the student is informed where to submit the form for further processing. Other advising activities involve problems that students encounter with program requirements or course prerequisites. These are dealt with either through the Faculty of Science office or the theme chairs forward them to the Associate Head who works with the student and the Faculty of Science office to resolve the problem. Special permission to register in a particular course or section comes first from the course instructor, although many inquiries about such permission need to be redirected to the instructors when students approach the Department office or Head.

The academic advisors in the Faculty of Science office also support students formally and informally. When students accumulate more than 24 CH of F grades, they are contacted formally, by mail/e-mail, and the account/registration is put on HOLD until they see an advisor to discuss their situation. The student is told that the Faculty of Science would like to better understand their situation, inform them of the resources available (and outline them), and see if there is a reason for the F grades. If necessary, the students will be advised on appeal procedures. If the student continues to fail courses, they will be placed on HOLD each time (i.e., each term). Informal advising occurs when the advisor comes across a student's file or transcript that indicates poor performance, or something anomalous. The student is then contacted and requested to contact the Faculty of Science office to discuss the situation. This may happen when the advisors are checking student files for reasons unrelated to performance, such as in filing change-of-grade forms or organizing grade appeals, or any time the advisors happen to notice poor performance. It may also happen when students come in to see the advisors either to talk about their poor performance or to talk generally about their academic situation, goals or other problems. The Faculty of Science will often do follow-ups from meetings with students. If it was recommended that a student seek help from Counselling Services, the most successful strategy to ensure the student attends a counselling session is to tell them to make an appointment with someone specific in the Faculty of Science office after the session.

Evaluation of student success within the programs is done through different types of indicators, such as the number of graduates, number of VWs per course, and other indices. These are usually obtained through the Office of Institutional Analysis (OIA). The Head's office and support staff also monitor student success or difficulties, which is another form of program evaluation. The monitoring of students that run into problems is sometimes done because individual instructors in the Department raise issues with the Associate Head, the Head, or the advisors in the Faculty of Science office. This may occur if the instructor finds reason to think the student is in trouble in terms of odd or disruptive behavior, academic or other dishonesty, or complaints by a student about a classmate. Students are also monitored through the Faculty of Science office where the academic student advisors meet with students who have accumulated too many "F" grades, have asked to repeat a course too many times, or who have run into medical or compassionate troubles or mental health issues that are serious and/or occur repeatedly.

Other student support

Supports available to students internal to the Department include the main office staff who frequently answer student questions and help them achieve their goals. Faculty members also support students with their curriculum through office hours, appointments, or informal meetings. The theme chairs and the Associate Head often make themselves available for students. If specifically-requested support or advice cannot be acquired, students will be referred to someone else or another unit (e.g. Student Affairs) who can provide the support needed.

The Biology Undergraduate Students (BUGS) are provided a fairly large study room on the 100 level of BSB by the Department, for use exclusively by BUGS members. Undergraduate students interact with and support one another during their formal and informal meetings, study, or plan BUGS events using that facility.

Supports available to students external to the Department include the Faculty of Science office where five academic advisors meet with students daily to discuss their programs, academic accommodations, disciplinary and other problems. Four Office Assistants in the front office of the Faculty of Science provide technical support for students such as help with registration, requests for course forms, program forms, and other types of general questions. Classroom-space issues are also dealt with through the Faculty of Science office. The Biological Sciences website also provides student information and is found at http://umanitoba.ca/science/biological_sciences/student/.

The Faculty of Science website (<https://umanitoba.ca/faculties/science/undergrad/index.html>) provides support for new students. The Science and Technology library also provides advice and help with assignments, and writing tutors are provided in the Science and Technology library through a program coordinated by the Centre for Advancement of Teaching and Learning (CATL). The Faculty of Science has study space for students outside the main office in Machray Hall and the basement of Parker Building. This space is used for studying as well as other purposes such as an informal meeting space, for lunch, and many other informal gatherings. The Science Students Association (SSA) provides studying and meeting space for all science students and also provides a free tutoring service that has been recognized as valuable help for students for many years.

The University of Manitoba Office of Student Affairs makes a number of services available for students, as described online (<http://umanitoba.ca/student/current/>), including the Academic Learning Centre, Career Services, Student Advocacy, University Health Service, Student Counselling Centre, Student Accessibility Services, Migizii Agamik for Indigenous students, and the International Centre for Students for international students. The University of Manitoba also has centrally-organized support for students and faculty members for disruptive, or violent behavior called Student Threat Assessment Triage

Intervention Support (STATIS). The support of the STATIS service has been useful 3-4 times in the past 2 years in helping students, faculty, and staff discuss and resolve delicate personal or important safety issues (which can be single issues) as they arise (a health-related matter, concerns raised by a student's email correspondence and/or student behaviour in class or within University facilities).

Programming and support toward Indigenous and international student success

In recent years, the Faculty of Science undertook to focus on building Indigenous student success, coordinated by the former Dean, Dr. Mark Whitmore and an "Indigenous Achievement Full Committee." A number of sub-committees were struck in late 2014, for coordinating, communications, alumni, outreach, curriculum and education, and research and graduate opportunities. The work of the full committee was shaped around a strategy that built on foundations from The University of Manitoba including its Strategic Plan, the Strategic Enrollment Management Planning Framework, and the Pathways to Indigenous Achievement document, plus other opportunities at the University of Manitoba, the Faculty of Science, and externally.

As of 2015, there is a Faculty of Science Strategic Plan for Indigenous Achievement (Appendix 5); it notes that *"The University of Manitoba campuses are located on original lands of Anishinaabeg, Cree, Oji-Cree, Dakota, and Dene peoples, and on the homeland of the Metis Nation. We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration."* This is stated at the start of all formal University of Manitoba events, to reflect the history of Manitoba and this institution and the commitment of the Faculty of Science to collaborating to improve the learning experience of all our students, including Indigenous students.

A number of short and longer-term initiatives were undertaken by members of the committee working with other offices and officers at the University and externally, as summarized in the Faculty of Science Report on Indigenous Achievement for 2014-15 (Appendix 6). As detailed in the report, the number of self-declared Indigenous students in Science in Fall 2014 (229) was approximately twice that of 2008 (114), representing about 5.6% of total student enrollment. In addition, about 1% of our total graduate student population in the Faculty of Science were self-declared as Indigenous students in 2014. However, to quote from the report: "We do not, however, have good information that goes beyond these numbers. For example, there are other university-level data that imply student success rates are relatively low. We have very little information on where our students come from (schools, communities), where they go (our alumni), or what contributes to their successes. We have discovered that our current self-declaration protocol precludes identifying, and hence "tracking" our students." This is one of the greatest challenges to fostering success specifically for any one group of students, regardless of the need, urgency, institutional prioritization, or potential benefit. Nonetheless, we are increasingly active in promoting, supporting and mentoring Indigenous students (inclusively with all students) in coursework, research engagement, and overall academic success, when opportunity arises, as we recognize the huge value of education for Indigenous students in bringing significant potential to benefit society in general as well as to benefit those students and their career opportunities. For instance, the Faculty of Science and Department actively encourage students to apply for the summer research scholarship designated for Aboriginal students.

The Department has at least 5 members of faculty involved in the Full Committee and many activities of the committee and its subcommittees. This is particularly led and coordinated through our Student Recruitment and Retention Committee (which may be renamed in the near future to reflect a growing involvement and success in outreach activities as well as student recruitment/retention. One initiative, to open doors for Indigenous students and others to engage in Science, was a series of presentations in the Science Research Talks series, organized by Dr. Justin Rasmussen. Talks by faculty members on their

research and what might be of interest to Indigenous students, were delivered at Migizii Agamik in 2015-16. This series included 5 presentations by members of the Department (Drs. G Anderson, J Anderson, J Kormish, J Marcus, and K Fraser) and other volunteers from the Department are scheduled for 2016-17. Dr. Rasmussen is the Lead for Indigenous Graduate Student Success; in this role, his work is focused on enhancing research and graduate-level program experiences for Indigenous students. Justin is a graduate of the BSc Zoology (2006) and MSc Zoology programs (2008), and also has a PhD (2014) in Biological Sciences from the University of Canterbury (Christchurch, New Zealand) in 2014. He now works under the supervision of Dr. David Collins, Vice-Provost (Academic Planning & Programs), as part of a team that is dedicated to delivering programs and services for Indigenous students. The team includes both academic and support staff from the Office of the President, the Indigenous Student Centre, Access and Aboriginal Focus Programs, Asper School of Business, Community Health Services, Engineering, Enrollment Services, and the Student Counselling and Career Centre. Justin's leadership, stemming from his life-changing experience receiving an Aboriginal-USRA during his BSc program, has even involved students in the Faculty of Arts as reviewers of the Science Research Talks program at Migizii Agamik. Those Faculty of Arts students interviewed the 5 presenters before they talked and afterward, about their plans and expectations in thinking about the program to improve Indigenous student success in Science. The reviews were part of a course called Introduction to Aboriginal Community Development (NATV 2110), which further raised awareness among students outside the Faculty of Science.

The growing visibility of initiatives toward Indigenous student success at the levels of the University and Faculty of Science is facilitated by engagement and collegiality of the faculty, staff, and students in Biological Sciences. The Department recognizes that Indigenous student achievement and success are indeed feasible and celebrated in the Department. An increasing number of initiatives arise from the University, many through the office of the Executive Lead for Indigenous Achievement, Ms. Deborah Young, in coordination with the President's office and the Provost and Vice-President (Academic). Initiatives have included: workshops for academic administrators (e.g., Pathways to Indigenous Achievement, Dec 7/12; Treaties, Indigenous Success, & the University of Manitoba Academic Experience, Feb 28/14; Decolonizing the University, Feb 6/15; and Indigenous Student Experiences in Post-Secondary Education. Mar 11/16) and a presentation to the Faculty of Science by the Treaty Relations Commissioner of Manitoba, Mr. Jamie Wilson (Jan 29/16). Even though these workshops have relatively small attendance, there is growing awareness of the issues and an increasing number of opportunities to learn about and celebrate student achievement and student success in winning awards directed toward Aboriginal or Indigenous students (offered through the Office of Financial Aid and Awards).

Precise enrollment data on the number of Indigenous students registered in the Department programs is not known (FIPPA Privacy regulations preclude surveys or collection of that information, available only to those offices receiving information on individual self-declarations at specific intervals (e.g., admission to the university, eligibility for bursaries). However, we know from our personal interactions with students in discussions and in labs and courses, and the involvement of individual faculty on award-review panels and writing reference letters for many students, that there *are* Indigenous students in the undergraduate and graduate programs, and that they *indeed* succeed among other successful students, in academics, service, citizenship, and research engagement and accomplishment, through targeted undergraduate summer research awards from the Faculty of Science, and through many other opportunities.

The Department has many international students in the undergraduate program. Some of these come

through University-1, inter-institutional or international agreements (e.g., Science without Borders – Brazil). Others come from taking courses equivalent to those at the University of Manitoba, through the International College of Manitoba (a private, for-profit institution that is established on campus through a contract with the University). It is generally considered that many international students have difficulty understanding the English language and especially writing in English, despite having achieved an acceptable score on an English-language proficiency test (TOEFL, IELTS, etc.).

There are many supports available on campus for students to learn writing skills and conversational English, including courses and programs at the International Student Centre, and writing tutors staffed by the University and located in the Science Library. In addition, instructors are generous with constructive feedback, particularly for students who find challenges in writing term papers or lab reports. Faculty are also very responsive to students who try their best to succeed by being pro-active in anticipating their need for help. One of the challenges of having a large cohort of international students (some on scholarships, and some who struggle academically) is that the incidence of academic dishonesty, particularly plagiarism, seems much higher among international students, perhaps for cultural reasons. Faculty take considerable steps to educate students about plagiarism, and try to be rigorous in applying the same standards to all students.

To date, there are no courses or options in Biological Sciences that are specifically designed to recruit Indigenous or international students to the BSc, MSc, or PhD programs, or to provide content tailored specifically to teaching Indigenous or international knowledge. However, courses make reference to a wide variety of examples of biology related to environmental change, conservation, biological sustainability, wildlife management, medicinal plants, species native to Manitoba and the Arctic, and evolution, behaviour and ecology that emphasize knowledge in domains of interest considered important to students of all backgrounds. These examples and topics are provided regardless of being visibly part of a minority group or any self-identification by students. We have plans for a garden of plants native to Manitoba and the Prairie region close to the Buller Greenhouse, and the director of the Greenhouse facility, Dr. Carla Zelmer, has received funding to purchase seeds and plants from international niches or that are used by Aboriginal peoples, for use in teaching research and outreach.

Student feedback on the programs

Students complete a survey called Students' Evaluation of Educational Quality (SEEQ) by ranking the teaching they receive by faculty, for each course and section delivered across the University. The bubble-sheet surveys use a Likert scale to record the student scores on 32 questions; input is analyzed centrally at the institution, and a printed summary is sent to the Department. In turn, the Department tallies the scores for those who contribute to teaching each term, selectively on the basis of 3 questions: Q30 is comparison with other courses; Q31 is comparison with other instructors; and Q32 is overall ranking of an instructor at UManitoba. The SEEQ survey includes 29 other questions on which students rank the teaching and interactions with their instructors and space for written comments. The entire process is anonymous unless a student signs the survey sheet; a signed sheet is exceedingly rare. SEEQ scores are generally not available for graduate-level courses (unless the enrollment is about 10 students), or for small-enrollment undergraduate courses (e.g., at the 4000 level), for privacy concerns.

The Department has had considerable discussion at Council, at UGCC meetings, at theme group meetings, and in informal discussions over the years, about the value of SEEQ scores. Scores vary by the students' year in the program (lower in first-year courses), section size (lower in large classes), the year and term of a course offering (particular cohorts are tough to impress, and Fall scores sometimes seem lower than scores in Winter term), the time slot of a course (lower in 'unpopular' time slots), students'

previous experience and exposure to courses at the University, and the extent of students' preparation for university-level learning (lower when class average is low). SEEQ scores also vary between full-time and sessional instructors. Moreover, we recognize within the Department, that a popular course for which the instructor receives high SEEQ scores is not necessarily a "good course", and inversely, that a course for which the SEEQ scores are low may be unpopular or challenging but is not necessarily poorly taught or a "bad" course. Nonetheless, instructors teaching even excellent courses, and having considerable expertise and experience in teaching, often note that they struggle to improve SEEQ scores in their courses, and also struggle to understand the basis or severity of some of the students' scores and comments.

In 2015, the Department led the formulation of a proposal to the then-new initiative by the Dean of Science, to fund small proposals for novel research collaboration. The proposal was submitted as a collaboration (with Dr. J Anderson, as the lead co-investigator) by at least one member of each department in the Faculty, to study the current SEEQ survey tool in the context of pedagogy and published literature on evaluation of teaching. The observations were to be directed to reformulate the questions to better serve needs of the Faculty of Science in general, and in particular to enable students to evaluate their teachers in the laboratory setting separately from the standard SEEQ evaluation of the lecture component of a course. Laboratory teaching is more often (but not always) provided by teaching assignment to our Instructors than our research faculty members, and Instructors would benefit by having student feedback toward their ongoing improvement of lab instruction, and for use as part of their dossier for future application for promotion. Biological Sciences is one of few departments in Science, in which Instructors have assignments for teaching lectures as well as the more common assignment to teach in laboratories. However, the SEEQ scores are used by the faculty as feedback on their teaching, and by the Faculty of Science and the University of Manitoba as an index of one of the many aspects of teaching effectiveness (e.g., in considering applications for promotion or tenure, or for merit award nominations). SEEQs can be useful in suggesting how to respond to student comments that might relate, for instance, to changes in instructor approach or interaction with a class. This is especially the case when SEEQ scores can be viewed longitudinally over a number of years of teaching by a single instructor or a group of instructors, and hopefully in context of the many variables that can affect the numerical SEEQ scores).

Generally, our Department's average SEEQ scores are as follows (example calculated for Winter 2015 courses). For Q30 (comparison with other courses), 73% of students rank instructors at "good to very good" categories, and 94% rank at "average to very good" categories. For Q31 (comparison with other instructors), 77% of students rank instructors at "good to very good" categories, and 93% rank at "average to very good" categories. For Q32 (overall ranking of an instructor), 80% of students rank instructors at "good to very good" categories, and 94% rank at "average to very good" categories. One of the frustrations of using any of the SEEQ survey data, is that the scores are available only on paper. This means that all the data have to be re-entered (and proof read for accuracy), in order to analyze and interpret any interactions (e.g., by correlating responses to two or more questions over a cohort of students). Each of the departments in Science also tallies a different subset of the questions and thus extracts a different index or score system, which can confuse the discussion about teaching performance when a dossier is evaluated as part of an application for promotion or tenure. It is also the case, that relatively few instructors add additional questions to the SEEQ survey (for further information and feedback), or administer a separate survey with written comments, that students could return directly to them for more directly constructive feedback.

Surveys of the student body

As part of the initial evaluation of student success in our programs, the Undergraduate Curriculum Committee conducted a brief survey of upper-level undergraduate students in March 2012. The findings were used as feedback to the committee, in anticipating this self-evaluation. There were 118 respondents, 48 from the Majors program, 35 from the Honours program, and 35 from the BSc General program. Respondents in the Majors and Honours were registered across 5 themes. Most respondents felt the program was useful in helping them choose a career track, and that the skills they had acquired would be helpful in obtaining a job and were not too specialized and they were satisfied with the teaching lecture and lab facilities. They indicated at the time, that they had received information on course selection from science advisors, other students, university publications, theme advisors, and Biological Sciences instructors. About 10% of respondents indicated that courses offered through the Biological Sciences were not sufficient for their needs. About 50% of respondents said that alternate-year courses were not workable for them.

Respondents to the 2012 survey had plans to enter a health profession (~25%), further education (~30%), teaching or research (~8%), government (5%), or either did not know or did not answer that question (~18%). Almost 35% of respondents indicated that an aspect of their degree program had made them change their mind about their chosen career path (they were not asked the nature of the change or which experience was important in that change of mind). About 60% felt they were part of a community in the Department of Biological Sciences (the survey pre-dated BUGS). The UGCC presented the findings of this early survey to Department Council. Council used the information as early formative feedback on the BSc programs that had been launched 3 years previously. A follow-up discussion at Council identified the information that was required in various templates toward a future review of the undergraduate programs. Looking back in 2016, it was useful to have this early discussion of a program review, prior to strategic planning and well before the start date of the current review process, since issues (for example related to enrollment, laboratory teaching, student preparation, endowment funding, and program capacity) could be raised and discussed, and we could make changes to improve the programs, independent of the pressure to compile and analyze data in preparing a self-evaluation report.

The Department also conducted a more recent survey of current and former students from the Biological Sciences programs, with input collected from December 2015 to January 2016. Individual faculty were asked to contact their former and current students and provide them a link to the survey on SurveyMonkey, and the BSGSA circulated the request for respondents on their Facebook page. Responses were considered at a Department retreat, separated by student program (BSc General, BSc Majors, BSc Honours, MSc and PhD) and also overall, as summarized below. The full dataset was graphed for respondents from each program (by use of filters on the *SurveyMonkey* website) and also for “overall respondents”. Written comments and some suggestions for improving the program were also available from the survey, and were reviewed and discussed at the same retreat. The graphical and text responses to the 2015-16 survey, therefore include sections for “overall respondents” and for respondents by program. Input from 96 respondents was compiled in late January 2016; 11 further responses came after that date. Findings of the 2015-16 survey are given in Appendix 7, along with the results of the 2012 survey of the upper-level undergraduate students.

For the BSc General, the 8 respondents were positive about their interactions with faculty. It was suggested that they would like to be exposed to a Biologist from outside the Department. This was taken to mean that many had not taken a course in which this happens, as this type of guest lecturer is more often in the upper-level 3000/4000 courses in the Department.

For the 16 BSc Majors respondents, comments recommended changing the current situation of 'bottleneck', or oversubscribed courses at the 2000 level, particularly Invertebrates (BIOL 2200) and Chordates (BIOL 2210). It was thought this would improve time to completion for students. The comments also suggested that these students would like to gain more skills in hypothesis testing and report writing (note that Majors students do not take BIOL 3100). Responses included comment that their interactions with professors were "awesome". In question 8, respondents indicated they would recommend friends enrol in the program and that they enjoyed and spoke highly of the program and the professors. The respondents did express concerns about Science students not finding employment in their chosen field. About half of the respondents were currently in the program, and all but 3 respondents are still students of some nature.

Respondents for the Honours program formed ~40% of all respondents to the survey. This group had real enthusiasm for the program, but there was a comment that the program did not meet the hope to be prepared for employment. There were some concerns about the skills gained by this group of respondents in relation to their value for an employer. Some respondents indicated specifically that they would like more opportunity for field experiences, although financial costs of those field-course experiences were noted as a hindrance. This group of respondents indicated they used the skills and knowledge gained in the program 2-3 times per week, and that they had a "totally wicked" experience in the program. There was a mix between enthusiastic comments and recommendation to add skill development that would be attractive to employers. Discussion by the Department considered this a useful commentary on us not making effort to overtly identify the skills that students acquire during an Honours (or Majors) program. However, we also discussed the idea that a university degree, *per se*, does not necessarily mean that someone will gain employment in the specific area of their education.

For the Master's program, there were 33 respondents; more than half of these were still registered in the Master's program. There were many respondents in the area of ecology, and few in the areas of genetics and evolution. Respondents indicated that they were using the knowledge and skills gained in the program (question 5). In question 7, respondents indicated the jobs aspect was important, that they were gaining employable skills, and would like to meet with potential employers. The Department discussed that these respondents at the Master's level might not distinguish whether the program is for training or for education (or both). Responses to question 8 were mostly positive, and there was a suggestion that student roles in mentoring (graduate students mentoring undergraduate students, for example) be formalized (for CV purposes). It was noted that about 30% of respondents plan further training, and 30% plan to seek employment. Many are working off campus; while this may be seen as detrimental to student success (taking time from academic work or research), it may also be considered a positive factor, as students will ultimately need to find employment after graduating with a Master's degree. Reliable interpretation of the responses about work would require a differential focus (not possible from the limited number of questions in the survey tool, or from our ability to cross-reference two or more responses). The discussion by the Department about this survey included the context of the time-to-completion for the Master's program, which is currently 28-32 months. This time interval, *per se*, is considered acceptable from the Department's perspective, since the work of a Master's thesis project is a 'package' and the nature of biology in laboratory or fieldwork experiences, involves replicates that take time. [The same is true for PhD-level research projects, although the PhD is not "a bigger MSc"; the two are distinctly different programs, each with its own set of expectations.] However, we do not downplay the impact of time-to-completion goals (e.g., at the Faculty of Graduate Studies and NSERC) on funding for graduate students. The real concern is that a student's eligibility for external scholarships (e.g., from Tri-Council awards) and supplemental funding from the institution (e.g., from

University of Manitoba Graduate Fellowships) essentially ends after 24 months in the Master's program (48 months in the PhD program). The relatively short period of eligibility cannot always accommodate the need for sufficient field seasons or repeat lab experiments to test the validity of results; this situation makes it difficult to support MSc students adequately after the 2-year period of eligibility, when the full stipend amount would have to come from a supervisor's research funding. A major consequence is that students begin taking on part-time work (in addition to TA positions) once they exceed 2 years in the Master's program, and that this delays their time-to-completion even more. We recognize these are systemic issues across the institution (and beyond), but feel it is important to note that the need to fit a graduate student's eligibility for scholarship funding in with the urgency for a rapid time-to-completion puts pressure on the amount and period of research funding available to supervisors. This is an ongoing challenge.

For PhD-program respondents, 40% of the 13 respondents were currently in the program; 23% of the respondents had also completed a BSc and/or MSc at the University of Manitoba. Respondents noted they were in a range of sub-disciplines, and some indicated multiple disciplines. Students therefore, categorized themselves in many fields, which was contrary to the individual comments made by discipline. There were no responses from individuals who had completed the integrative theme of the BSc Major program. Almost half (46%) of the respondents for the PhD program had gained research experience by employment on campus, and others had experience outside the traditional PhD program. The very large majority of respondents were using the skills they had acquired in the program (58% strongly using them and 32% somewhat using them), in their current employment. There was a suggestion to formalize mentoring of more junior students by PhD students, with training and recognition. These might be something to consider in a co-curricular record for graduate students, although currently the information is not collected by the Department.

The Department discussed the overall survey in detail, and determined that the idea to provide more field experience at the second-year level was an excellent suggestion. This led to a discussion of how to do that, including moving BIOL 2300 to the Fall term, to include field trips and even on-campus field work exercises. This would conflict with the Agriculture offering of BIOL 2300 in the Fall, although we should be able to reconcile that, since that offering is still a course in the Department that we have allowed Agriculture to run so our students can benefit from the possibility it offers for flexible enrollment. The Department considered it was very useful to plan for an increase the number of students taking field-based courses; the number of field-based courses had been pared down after the loss of the Delta Marsh Field Station (due to flooding) and the change in pattern of expertise with faculty renewal. However, one of the strengths of the Department's programs is that more than 75% of courses already "marry" field and lab-based experiences with the lecture instruction. We might also consider developing other courses such as one specifically on the natural history of Manitoba. The ecology theme was tasked with discussing these ideas, and revisiting if and how field-based courses could and should be added to the program, remembering that the time for instruction and the availability of instructors are important considerations. Subsequent to that discussion, a sample-survey of program offerings across Canada was conducted and is under discussion by the ecology theme group (see below, under the section on the BSc Major program).

Employment for graduates of the programs

There are many career options for students who complete programs in Biological Sciences, whether BSc General, BSc Majors, BSc Honours, MSc and/or PhD. These include careers (listed alphabetically) in:

- Academia – e.g., Professor or Instructor roles

- Academic administration
- Administrative services in post-secondary institutions - e.g., research services, student advisor, institutional analysis, research compliance, budgets/grants, bookstore, grant-writing facilitator
- Advertising and communications – e.g., for a professional body, business, research directorate
- Advocacy and the politics of science and/or science education,
- Agriculture – industry, biotechnology, sales, marketing, aquaculture, horticulture, landscaping, greenhouse technician, pest control/entomology, farming (animals or plants)
- Analyst/modeller in government agencies, business, NGOs, etc. especially with field/lab experience
- Animal trainer, animal-behaviour therapist, animal technician, pet groomer
- Business sales and services, business development,
- Consulting – e.g., environmental, conservation, remediation, grant-writing, technical writing, etc.
- Curator of collections
- Editorial services, publishing, copywriting
- Emergency measures organizations, emergency responder, cleanup and environmental services
- Entrepreneurship, self-employment (e.g., marine aquarium systems)
- Equipment repair technician
- Field biologist
- Film/movie consultant on science, education, specific areas of science and experience with biology
- Food safety technician or consultant
- Forestry, wood harvester, forestry consultant or in the forestry business
- Genetic counselling
- Governmental agencies – e.g., Parks Canada, Manitoba Conservation, Department of Fisheries and Oceans, Statistics Canada, City of Winnipeg, Canadian Food Inspection Agency, Agriculture Canada (also international agencies)
- Graduate school, advanced training in research
- Health and safety technician, critical-incident investigator
- Health professions – e.g., medicine, dentistry, pharmacy, nursing, physiotherapy, occupational therapy, physician assistant, pathology assistant, public health inspection, athletic therapy
- Human resources officer, dispute resolution
- Isotope-handling techniques or specialist, including radioisotope safety, isotope regulatory functions
- Journalism, media, film production
- Laboratory technician
- Law – e.g., related to intellectual property, environment, business development and litigation
- Library sciences, records management
- Management
- NGOs – e.g., Nature Conservancy, Living Prairie Museum, Ducks Unlimited, Experimental Lakes Area
- Patent protection – e.g., patent agent, technology transfer services, protection of intellectual property
- Policy analyst – e.g., government, NGO, industry, business, post-secondary education
- Politics
- Project management – e.g., lab design and construction, administration

- Proof reader
- Psychology – counselling, research, social services
- Public education – e.g., writing, speaking, interpreting scientific analyses/results, media, science interpreter, teaching, patient communications/advocacy, patient liaison (e.g., in a hospital)
- Public relations – e.g., zoo, museums, collections, business, ecotourism
- Research scientist, taxonomist, research associate, research-development officer
- Research administration in funding agencies, post-secondary institutions, office of the MB minister of education, school divisions, regional health authorities, professional bodies (health, science, conservation, governments, funding agencies, NGOs, etc.)
- Workplace safety and health – e.g., technician, manager
- Sales in scientific supplies and equipment (e.g., Fisher, pharmaceutical, Zeiss, Sigma)
- Student advisor – e.g., at post-secondary institution
- Teacher – e.g., of science in public or private school system
- Taxonomy and systematics – e.g., in museums, archives
- Technical consultant on fieldwork or lab-bench techniques (any discipline), trouble shooting
- Tourism and ecotourism, tour guide, expedition consultant, planner, communications
- Veterinarian, veterinary technician, animal technician, groomer
- Volunteer/charitable organizations, community building
- Workplace safety and health – e.g., technician, manager, director, communications officer, liaison with regulatory agencies (worker's compensation)
- Zookeeper

Previous graduates of programs from the Department (and the founding Departments) have found successful careers from among the many options and opportunities in the above list, particularly in fields related to research, industry, academia, business, consulting, health professions, and a wide variety of government and non-governmental agencies. For example, previous graduates are: professors at Canadian and international institutions; Canada and other Research Chairs; technicians, research administrators, or researchers in science-related fields in post-secondary institutions; self-employed in biology-related start-up companies; consultants in pursuits related to science or public education or advocacy; work in conservation, greenhouses, animal care facilities, or museums; work in industry (e.g., Manitoba Hydro, Fisher Scientific), government and non-governmental agencies and organizations, or health professions (physician assistant, pathology assistant); or are taking further advanced training for careers (post-doctoral fellows, health-research fellows).

UNDERGRADUATE BSc PROGRAMS – general overview

University-1

University-1 is a program unique to the University of Manitoba. It was launched in 1997 with the aim to be highly supportive of students entering their first year of university studies. It is the administrative home for most new undergraduate students, from the time they first register at the university through until they complete their first 24-30 CH. It is termed the 'gateway' to university studies, and is currently led by the Executive Director of the Student Academic Success unit. University-1 incorporates a large student-advising service. University-1 is one of the entrance options at the University of Manitoba for incoming students who have never attended post-secondary studies (either direct entry from high school or entry as a mature student) or for those with fewer than 24 CHs of post-secondary study (students who have attended another university or college but have not completed a full year of study elsewhere). Regardless of whether a student is admitted to University 1 or directly to another Faculty, first-year students will take the same 1000-level courses for their intended degree program. University-1 is not an extra year or a general or remedial year; it is described as a starting point for students at the University of Manitoba and considered the first year of a degree.

Although the Faculty of Science delivers the science courses that are taken by University-1 students, the ability to track student progress from high school into the Faculty of Science, and then into Biological Sciences programs specifically, is somewhat limited by the formal separation of the administration and institutional data collection related to programming in first-year vs. subsequent years. This can sometimes blur our ability to get concrete evidence for changes in demand or student preparation, to interpret trends in enrollment and entry to the Majors program, explain VWs, etc., and/or to make changes in light of real-time data. It is also possible for students to receive academic advice from University-1 advisors for more than a year before they make a connection with the Faculty of Science advisors or meet with someone in the Department of Biological Sciences for specific discussion of their academic interests and schedules, course options and learning opportunities in the Department and Faculty.

After completing at least 24 CH of University-1 courses, students can transition formally to the Faculty of Science and register in a BSc program. At that time, our contact and interactions with them as part of the Department's programming is more direct, timely, and responsive, and is well coordinated with the Faculty of Science. The Department is not involved directly in the evaluation of University-1, although it coordinates investigation, reporting, and discipline related to allegations of academic dishonesty.

Undergraduate Curriculum Committee - UGCC

The purpose of the Undergraduate Curriculum Committee (UGCC) is to support the Department's undergraduate program by coordinating on behalf of the Departmental Council, the curriculum (content and program of courses) of undergraduate studies in our Department's programs. This process is designed to guide the department in revising and developing a strong program of courses and theme areas available for undergraduate study. The guiding principles of the UGCC are that members will act with fair and impartial judgment, and that decisions on reviews and recommendations will be reached in a timely manner.

The UGCC is composed of a Chair (voting), who is the Associate Head (Undergraduate) and is also expected to have had successful teaching and curriculum experience, and comprehensive knowledge of undergraduate programs in the biological sciences, five members of the academic staff (faculty) elected by and from the Department of Biological Sciences Council, one undergraduate student representative designated from undergraduate students in the Biological Sciences, and the Department Head, *ex officio* (voting). In addition, one member of administrative staff in the Department is assigned by the Head to support the work of the committee, including recording and filing minutes. This requires that the staff member attend all the UGCC meetings. The election of members from Council is by simple majority of the Biological Sciences academic staff (including Adjunct Professors) attending the meeting of Department Council. Appointment on the UGCC is typically be for three years, and renewable. If an elected member becomes unavailable, the position is normally be filled by election at the next meeting of Council.

Meetings of the UGCC are typically held 2-3 times per year, or as required. Additional meetings may be called at the request of the Chair or the Head, depending on issues or requirements that may arise outside the usual schedule. A meeting schedule is developed by the Chair of the UGCC in coordination with the member of administrative staff who support the committee. Votes may be held by email to expedite processing minor matters (e.g., course revisions). Minutes of the meetings will be confidential to the committee.

The UGCC is responsible for considering aspects related to student admission to, and success in the Majors, Honours and Co-op programs, the evolution of our programs, and the need for review of the programs, and for making recommendations to for change, as required. Committee members serve as a resource to Department Council, undergraduate students and academic staff, regarding the design and integration of undergraduate programs. They also conduct the evaluation of Biological Sciences undergraduate programs at appropriate intervals, and provide feedback and assistance to academic faculty regarding inquiries and proposals for new courses, refinements of course content, changes in course offerings related to new program directions (integration of courses, deletions, additions), and pre-requisite courses. Members of the committee also review and discuss the overall design of the Department's undergraduate program, including core course requirements for degree programs in Biological Sciences, themes and sub-core courses required to meet requirements for the theme specializations. From time to time, members recommend changes in the undergraduate curriculum to Council (e.g., new courses, new themes, pre-requisites, advising, time tabling, etc.) through the chair. They also coordinate with the website manager, to maintain the currency and accuracy of information posted on the undergraduate programs. Members also meet as necessary, with members of the other undergraduate committees such as, the Honours Thesis Committee to coordinate oversight of the Honours thesis, and make recommendations to revise Honours thesis requirements. Finally, the committee members together have responsibility to serve as a nucleus committee in organizing external reviews of the undergraduate programs.

The Chair of the UGCC has additional responsibilities to do the following or designate another member of UGCC to: represent the Department at the Faculty of Science Committee on Courses and Programs (COCAP), and report back to the UGCC on COCAP decisions and deliberations as appropriate, and also represent the Department as required at other committees; provide an annual written report to Departmental Council in summary of matters considered by the UGCC; coordinate with Chairs of the other undergraduate committees, in drafting an agenda for a joint meeting of any of the undergraduate committees, as required; and to work with the Department Head in coordinating the assignment of teaching responsibilities in course offerings of the Department of Biological Sciences.

The Terms of Reference for UGCC have been revised once since the programs launched, specifically to include 5 members elected from Council; this allows one member from each theme group to serve on UGCC. An undergraduate student representative rarely attends meetings of the UGCC.

Evaluation of programs

Formal evaluations

The ongoing maintenance of, and changes to, the programs is the result of the interactions between the faculty members who maintain/update their courses and the UGCC who review proposed changes from faculty members. Faculty members are continually updating their teaching methods and using the services of the Centre for Advanced Teaching and Learning (CATL) for peer-assessment and advice on teaching, and for workshops on topics of particular interest or need. Members of the UGCC evaluate the proposed course changes as well as their relevance to the entire program. The UGCC examines the program and will also make recommendations to both the faculty member and the Department Council on the proposed changes. After approval by Department Council, proposed course and program changes go to the Faculty of Science Committee on Course and Program Changes (COCAP), then to Faculty of Science Executive Committee, Faculty of Science Council, the Senate Committee on Curriculum and Course Changes (SCCCC), and to Senate for final approval. The Faculty-level committees scrutinize the proposed changes with respect to their potential impact on programs in other departments. The SCCC scrutinizes the changes with respect to other programs among Faculties across the University of Manitoba. Within the Department of Biological Sciences, entire programs are not formally evaluated, although each theme group has reviewed at least twice, whether there are sufficient core and recommended courses to make the theme-based specializations meaningful and consistent within the Department.

The level of academic and technical skills that can be provided by course offerings within the Department of Biological Sciences is enhanced by the ability to apply for and often obtain significant upgrades, replacements, and/or new technologies and equipment for teaching. Proposals are made yearly to maintain essential pieces of equipment and to update or purchase new equipment for leading-edge technologies through the Faculty of Science Endowment Fund. This Fund, to which Faculty of Science students make annual voluntary contributions (on a per-CH basis) is administered and disbursed through a committee at the Faculty of Science formed by a majority of students; it ensures that all departments within Science have funding for instruction using safe and modern equipment, and even state-of-the-art infrastructure for teaching in laboratories. The Department of Biological Sciences has received thousands of dollars each year for teaching equipment to promote valuable learning

Endowment Funding 2008-2015

	Proposed by Biological Sciences	Awarded to Biological Sciences	Lab Fees for equipment
2008-09	\$265,413.70	\$69,134.77	
2009-10	\$136,150.50	\$68,507.89	
2010-11	\$123,090.04	\$80,826.53	
2011-12	\$132,382.11	\$89,895.00	
2012-13	\$195,735.40	\$119,446.87	\$71,520.61
2013-14	\$196,516.95	\$155,708.70	
2014-15	\$276,689.13	\$174,868.41	

experiences for students in our programs (as tabulated below).

In addition, it should be noted that the Department was also able to capture opportunities to upgrade the spaces used for teaching laboratories in Biological Sciences Building through the federally-funded Knowledge Infrastructure Program (awarded in 2009, completed in 2010; BSB110, 223, 211, 305, 409), ongoing upgrades and renovations to the Buller Building (Buller 314, 211A, 211B, 212A, 212B, 215, 216), and the Duff Roblin Building (post-fire restoration or modest redesign of teaching labs in W324, W332, W346, W418). Restoration of a core physiology suite with 4 new controlled-environment rooms (W442A, W442B, W442C, W442, W446A, W446B) is scheduled for completion in Winter term in 2016, and will be available for Honours, CO-OP, and other research or project undergraduate students. The microscopy suite (Buller 517) was also developed as a core facility and is utilized by Honours project students registered in BIOL 4100, some special topics students (BIOL 4890), some of the students in our CO-OP work terms, and undergraduate summer-research students and research assistants as well as graduate students and faculty (see later section in this report, for review of infrastructure).

Informal feedback as secondary evaluations

Informal feedback serves as secondary evaluation to the Department on its programs and courses, and includes the following observations:

- growing interest in BIOL 3100, the “Honours-preparation” course
- increasing enrollment and completion of research projects in BIOL 4100
- high engagement of BUGS – biology undergraduate students – in social and social-academic events
- strong inventory of skills from teaching labs
- undergraduate student successes in competing for USRAs from NSERC, Faculty of Science (many in the Department’s programs)
- number of graduate students who complete an Honours degree in the Department
- number of students taking Special Topics courses
- support staff enjoyment of working hard in toward support of undergraduate programs, including a huge level of student interaction
- engagement and commitment of faculty on the Undergraduate Curriculum Committee (UGCC)

Sample Program Listing, BSc Programs – Table 1

The time to completion varies across programs for many reasons. Generally students take from 3-4 years to complete a 3-year BSc General, and from 4-6 years to complete a BSc in the Majors and Honours programs. However, these timelines can be much longer, although some students do complete a 3-year BSc General or a 4-year BSc Majors or Honours degree in 3 or 4 years, respectively. It is worth noting that the 3- or 4-year degree designations relate to historical course loads by students, from times when students did not typically hold part-time employment during the regular-session terms, and did not VW as frequently (if at all) from courses. As well, the definition of “full-time student” is not 9 CH per term (for purposes of being eligible for a Canada Student Loan), whereas it was previously 15 CH per term. Thus, the use of terms such as 3-year or 4-year programs is somewhat semantic, and can be confusing in relation to tracking student progression against any normative expectation for the particular time-to-completion in a degree program.

YEAR 1	YEAR 2	YEAR 3	YEAR 4
BSc Honours			
<u>Required Courses</u>	<u>Required Courses</u>	<u>Required Courses</u>	<u>Required Courses</u>

BIOL 1020/BIOL 1030 CHEM 1300/CHEM 1310 STAT 1000 3cr hours of math, physics or statistics and 6cr hrs from Arts with a "W" course.	BIOL 2300, BIOL 2500, BIOL 2520. Choose one course from each of: Group A: BIOL 2200, BIOL 2210 Group B: BIOL 2240, BIOL 2242, BIOL 2260 One additional course from either Group A or Group B Either both of CHEM 2770 and CHEM 2780; or all three of CHEM 2210, CHEM 2360, and CHEM 2370 (theme courses)	BIOL 3100, BIOL 3300 BIOL 2540 (theme course) Choose one of the following: BIOL 3450, BIOL 3470, BIOL 3472 30 credit hours of 3000/4000 level Biological Sciences courses	BIOL 4100 (6)
<u>Electives</u>	<u>Electives</u>	<u>Electives</u>	<u>N.A.</u>
TOTAL HRS. 24	TOTAL HRS.	TOTAL HRS.	TOTAL HRS.
BSc Major			
<u>Required Courses</u> BIOL 1020/BIOL 1030 CHEM 1300/CHEM 1310 STAT 1000 3cr hours of math, physics or statistics and 6cr hrs from Arts with a "W" course.	<u>Required Courses</u> BIOL 2300, BIOL 2500, BIOL 2520 Choose one course from each of: Group A: BIOL 2200, BIOL 2210 Group B: BIOL 2240, BIOL 2242, BIOL 2260 One additional course from either Group A or Group B Either both of CHEM 2770 and CHEM 2780; or all three of CHEM 2210, CHEM 2360, and CHEM 2370 (theme courses)	<u>Required Courses</u> BIOL 3300 BIOL 2540 (theme course) Choose one of the following: BIOL 3450, BIOL 3470, BIOL 3472 30 credit hours of 3000 or 4000 level Biology courses ⁴ (courses from outside Biology may be approved by the theme advisor). Elective CHs required to make a total 120 CH for the program.	<u>Required Courses</u>
<u>Electives</u>	<u>Electives</u>	<u>Electives</u>	<u>Electives</u>
TOTAL HRS.	TOTAL HRS.	TOTAL HRS.	TOTAL HRS.
BSc General			
<u>Required Courses</u>	<u>Required Courses</u>	<u>Required Courses</u>	<u>Required Courses</u>
<u>Electives</u>	<u>Electives</u>	<u>Electives</u>	<u>Electives</u>
TOTAL HRS.	TOTAL HRS.	TOTAL HRS.	TOTAL HRS.

BSc HONOURS – Program structure

As a general overview of the Honours program, students enrol in first year through University-1 (with appropriate pre-requisites and qualifications from high school) or by direct entry to the Faculty of Science (again with appropriate pre-requisites and qualifications from high school and at least an 85% average, as defined under the direct-entry program). Students then would complete BIOL 1020 and 1030 (and other courses). Depending on their GPA, the students can proceed to the 200-level courses (core and elective) before taking upper-level courses including BIOL 3100, which is the course that prepares them for the Honours Thesis Course (BIOL 4100) in their final year.

Completion of the Honours Thesis Course at the fourth-year level is coordinated by the Honours Thesis Committee, as provided by the Terms of Reference for that committee, working under the mandate provided by Department Council and in conjunction with the Undergraduate Curriculum Committee. The Terms have been revised twice to expand the membership of the committee (in order to distribute workload) and to change the structure of the advisory committee that is formed to guide the progress of each student registered in the Honours Thesis course, BIOL 4100.

Honours Thesis Committee - HTC

The mission of the Honours Thesis Committee is to organize and administer all aspects of the Honour's thesis course (BIOL 4100). This committee is designed to support the success of students enrolled and graduating with an Honours degree from the Department of Biological Sciences, and to maintain the standards of the Honours thesis course.

The guiding principles of the committee are that members will act with fair and impartial judgment, decisions on reviews and recommendations will be reached in a timely manner, and information regarding undergraduate student files will be maintained in strict confidence.

The Honours Thesis Committee is composed of a Chair who is expected to have experience and comprehensive knowledge of undergraduate Honours and Honours Co-op programs, three additional members of the academic staff (faculty) of the Department of Biological Sciences who have experience conducting and supervising research at the undergraduate level, and the Department Head, *ex officio*. One member of administrative staff in the department will be assigned by the Head to support the work of the committee, including providing student information. The committee membership may be enlarged as appropriate to enrollment in the thesis course.

Membership is on a rotating to provide continuity from year to year, with appointments typically lasting for four (4) years. The Chair will also rotate annually, with the most experienced committee member becoming Chair in the final year of their 4-year term. Each year, a single member will be elected by simple majority of the Biological Sciences academic staff to replace the 'retiring' committee member. Appointments are typically for 3 years, renewable once. To ensure that each of the major theme groups (e.g., Cell/Molecular/Development, Ecology, Evolution/Biodiversity, and Physiology) is represented, the HTC may recommend specific members of the Department for nomination to Council. If an elected member becomes unavailable (e.g., research/study leave), the position will normally be filled by election at the next meeting of Department Council or as designated by the Head.

Meetings are typically held as required by the course syllabus and for planning; meetings may also be called at the request of the Chair or the Head, depending on issues which may arise from time to time.

The committee is responsible for considering aspects related to the Honours thesis course, including student recruitment, course delivery and organization, research-thesis proposals, student supervision at research, thesis writing and examination, and overall student progress. The committee will also oversee the need for program review related to the Honours degree program, and recommend changes to Department Council.

Committee members are responsible for meeting with 3rd-year Honours and Majors students in January of each year to discuss the requirements of the course, and coordinate information and recruitment sessions and provide information to interested students on the requirements and expectations associated with the Honours program in the Department. This meeting will typically be organized and presented by the incoming Chair for the next academic year. They are to be proactive by informing faculty and students about their roles and responsibilities for successful completion of this course. Members are to coordinate with the supervisor and student on the thesis proposal and progress report(s) according to the syllabus, and in selecting an additional member for the advisory committee from among members of Department Council, to serve during the proposal and progress meeting, and as an examiner on the final thesis oral presentation and defence.

Members of the HTC also organize and advertise the final symposium for thesis presentations, determine the final grade for each student enrolled in the thesis course, based on the course syllabus. It will be the Chair's responsibility to submit these final grades (via Aurora), communicate with the Undergraduate Curriculum Committee, as necessary, regarding suggested modifications to the thesis course, and assist the member of administrative staff assigned to support the Honours thesis course, by providing information as requested.

Additional responsibilities of the Chair of the committee (or designate) include: coordinating the membership of the advisory and examining committees for each registered student, and, via consultation with the student and supervisor, helping to organize the time and location for proposal and progress report meetings. The Chair also is to provide a brief oral report to Departmental Council as required, regarding matters related to the Honours thesis course as requested from Council members, and report annually in writing to Department Council about the student enrollment, progress, completions, and difficulties from the previous year and provide some projections for similar items for the upcoming year. The Chair also liaises with the department Head in coordinating teaching responsibilities in the course required for completion of the Honours program, coordinates with the Chair of the UGCC in determining the need for a joint meeting, as required regarding important issues, and liaises with the Chair of the Graduate Studies Committee in directing Honours students to finding appropriate information about opportunities and requirements for graduate study in the Department of Biological Sciences.

Biological Sciences Core Courses

First Year

For entry into BIOL 1020, students must have the following pre-requisites: High school Biology (40S or equivalent) and any Mathematics (40S or equivalent) and one of Chemistry or Physics (40S or equivalent); or [BIOL 1000](#). Students who complete [BIOL 1000](#) as the prerequisite for [BIOL 1020](#) will not be allowed to use both [BIOL 1000](#) and [BIOL 1020](#) towards their degree program as the 2 courses may not both be held for credit.

- BIOL 1020 Biology I - Principles and Themes
- BIOL 1030 Biology II - Biological Diversity, Function and Interactions

Admission requirements to the BSc Honours program

Students may be admitted to an Honours program in two ways. Firstly, the student must have completed at least 24 CHs, a minimum Degree GPA (DGPA) of 3.00, and a minimum grade of “B” or better in BIOL 1030. Alternatively, students may be admitted to the Honours program by the Second Year Entry Route if they were not eligible in the first way. In the Second Year Entry Route the student must take 18 CH applicable to the desired program over consecutive Fall and Winter terms with a minimum of 9 CH in each term. The student must achieve at least a B average over those 18 CH and have an overall DGPA of 3.00.

In addition, students are strongly urged to complete the additional 1000-level core courses CHEM 1300, CHEM 1310, STAT 1000 and 3CH of Mathematics (e.g., MATH 1200, MATH 1300 or MATH 1500), Physics (e.g., PHYS 1020 or PHYS 1050) or Statistics, and 6 CH from the Faculty of Arts (including a “W” course) in their first year. Students must declare their program and one of five themes when they are admitted to the Honours program. Further core courses may be required for a particular theme area of specialization.

Students are strongly encouraged to enter the Honours program at the beginning of their second year. If students select the Honours Co-op option they must complete at least 60 CH (2 years) in the Honours program first. Specific courses must be taken before students begin their first employment term. These courses include BIOL 1020, BIOL 1030, CHEM 1300, CHEM 1310, STAT 1000, 3 CHs of specified Mathematics or Physics, BIOL 2300 Principles of Ecology, BIOL 2500 Genetics 1, BIOL 2520 Cell Biology and BIOL 3100 Skills in Biological Sciences. Students must also complete 9 CHs from program core courses as follows: one course selected from Group A (BIOL 2200, BIOL 2210), plus one course from Group B (BIOL 2240, BIOL 2242, BIOL 2260), plus one additional course from either Group A or Group B. The grade and course requirements to enter the BSc Honours Co-op program are the same as those for the BSc Honours program.

Core requirements – second and third year

Honours students in the Department of Biological Sciences must complete the following core courses:

- BIOL 2300 Principles of Ecology
- BIOL 2500 Genetics I
- BIOL 2520 Cell Biology

Students must also take one course from Group A (below) and one course from Group B, and a further course from either Group A or Group B.

Group A

- BIOL 2200 The Invertebrates
- BIOL 2210 The Chordates

Group B

- BIOL 2240 The Non-Flowering Plants
- BIOL 2242 The Flowering Plants
- BIOL 2260 Biology of Fungi and Lichens

To fulfill the core requirements students must also complete

- BIOL 3300 Evolutionary Biology
- and one of:
- BIOL 3450 Plant Physiology

- BIOL 3470 Environmental Physiology of Animals I
- BIOL 3472 Environmental Physiology of Animals II

Program Chart – BSc Honours program (sample theme)

UNIVERSITY 1	YEAR 2	YEAR 3	YEAR 4
HONOURS: Cell, Molecular and Developmental Biology Theme (incl. Co-op) 120 CHS (Courses listed in chart below and electives)			
BIOL 1020 , BIOL 1030 CHEM 1300 , CHEM 1310 STAT 1000	BIOL 2300 , BIOL 2500 , BIOL 2520 Choose one course from each of: Group A: BIOL 2200 , BIOL 2210 Group B: BIOL 2240 , BIOL 2242 , BIOL 2260 One additional course from either Group A or Group B Either both of CHEM 2770 and CHEM 2780 ; or all three of CHEM 2210 , CHEM 2360 , and CHEM 2370 (theme courses)	BIOL 3100 , BIOL 3300 BIOL 2540 (theme course) Choose one of the following: BIOL 3450 , BIOL 3470 , BIOL 3472	BIOL 4100 (6)
In University 1 or Year 2 the following must be completed: 3 credit hours of Mathematics or Physics chosen from: MATH 1200 , MATH 1300 ¹ , MATH 1500 ¹ , PHYS 1020 or PHYS 1050 6 credit hours from the Faculty of Arts, including a required “W” course		Work Terms (if Co-op Selected): BIOL 3980 , BIOL 3990	Work Terms (if Co-op Selected): BIOL 4980 , BIOL 4990 (if necessary)
30 Hours	30 Hours	30 Hours	30 Hours

Course requirements – required and elective, by Theme

As indicated above, the five themes all require BIOL 1020, BIOL 1030, CHEM 1300, CHEM 1310, and STAT 1000, in addition to 3 CH of Math or Physics, 6 CH of Arts courses including a “W” course (courses designated by the Faculty of Arts to have a significant Writing component), and 12 CH of electives.

In the Cell, Molecular and Developmental Biology Theme students are required to take BIOL 2300, BIOL 2500, BIOL 2520, one course from each of Group A: BIOL 2200, BIOL 2210, one from group B: BIOL 2240, BIOL 2242, BIOL 2260, one additional course from either Group A or Group B, and either both of CHEM 2770 and CHEM 2780; or all three of CHEM 2210, CHEM 2360, and CHEM 2370 (theme courses). In the third year students must take BIOL 3100, BIOL 3300, BIOL 35424 (theme course), and one of the following BIOL 3400 (the former BIOL 3450), BIOL 3470, or BIOL 3472. Students are required to take BIOL 4100 in the fourth year. In addition to these courses in the third and fourth years, students must take 30 CHs of 3000- or 4000-level Biology courses (courses from outside Biology may be approved by the theme advisor) and enough elective CHs required to total 120 CHs for the program.

In the Ecology and Environmental Biology Theme students are required to take STAT 2000 (theme course) in the first year. In the second year students are required to take BIOL 2300, BIOL 2500, BIOL 2520, and one course from each of Group A: BIOL 2200, BIOL 2210, one from group B: BIOL 2240, BIOL 2242, BIOL 2260, one additional course from either Group A or Group B. In the third year students must take BIOL 3100, BIOL 3300, BIOL 3310, BIOL 3312, BIOL 3314 (theme courses) and one of the following BIOL 3400 (the former BIOL 3450), BIOL 3470, or BIOL 3472. Students are required to take BIOL 4100 in the fourth year. In addition to these courses in the third and fourth years, students must take 21 CHs of 3000- or 4000-level Biology courses (courses from outside Biology may be approved by the theme advisor) and 15 CHs of approved electives, and either both of CHEM 2770 and CHEM 2780; or all three of CHEM 2210, CHEM 2360, and CHEM 2370 (theme courses).

In the Environmental and Integrative Physiology Theme students are required to take BIOL 2300, BIOL 2500, BIOL 2520, one course from each of Group A: BIOL 2200, BIOL 2210, one from group B: BIOL 2240, BIOL 2242, BIOL 2260, and one additional course from either Group A or Group B. In the third year, students must take BIOL 3100, BIOL 3300, one of the following BIOL 3400 (the former BIOL 3450), BIOL 3470, BIOL 3472, and two of BIOL 3470, BIOL 3472, BIOL 3400 (the former BIOL 3450) (if not already taken), or BIOL 3452 (theme courses). Students are required to take BIOL 4100 in the fourth year. In addition to these courses in the third and fourth years, students must take 24 CHs of 3000- or 4000-level Biology courses (courses from outside Biology may be approved by the theme advisor), and enough elective CHs required to total 120 CHs for the program.

In the Evolution and Biodiversity Theme students are required to take BIOL 2300, BIOL 2500, BIOL 2520, one course from each of Group A: BIOL 2200, BIOL 2210, one from group B: BIOL 2240, BIOL 2242, BIOL 2260, and one additional course from either Group A or Group B. In the third year students must take BIOL 3100, BIOL 3300, and one of BIOL 3400 (the former BIOL 3450), BIOL 3470, BIOL 3472. Students are required to take BIOL 4100 in the fourth year. In addition to these courses in the third and fourth years, students must take 3 CHs chosen from the Evolutionary Processes List (A): BIOL 3360 Animal Behaviour, BIOL 4300 Evolution and Adaptation, BIOL 4362 (Behavioural Ecology and Cognitive Ethology), 3 CHs chosen from the Biodiversity course List (B): BIOL 3200 Advanced Invertebrate Biology, BIOL 3242 Vascular Flora of Manitoba, BIOL 3250 Lichens and Bryophytes, BIOL 3270 Introductory Parasitology, BIOL 3340 Biology of Primitive Fungi and Allies, BIOL 4212 Systematics and Biogeography of Fishes, BIOL 4214 Biology of Amphibians and Reptiles, BIOL 4216 Biology of Birds, or BIOL 4218 (Biology of Mammals), 24 CHs of 3000- or 4000-level Biology courses (courses from outside Biology may be approved by the theme advisor), and 15 CHs of approved electives.

In the Integrative Biology Theme students are required to take BIOL 2300, BIOL 2500, BIOL 2520, required theme courses BIOL 2200, BIOL 2210, BIOL 2240, BIOL 2242; MBIO 1010; CHEM 2770 and CHEM 2780 or CHEM 2210, CHEM 2360, CHEM 2370. In the third year students must take BIOL 3100, BIOL 3300; and one of BIOL 3400 (the former BIOL 3450), BIOL 3470, BIOL 3472. Students are required to take BIOL 4100 in the fourth year. In addition to these courses in the third and fourth years, students must take 24 CHs of 3000- or 4000-level Biological Sciences courses, 6 CHs of 3000 or 4000 level Microbiology courses, and enough elective CHs required to total 120 CHs for the program.

We also offer an Honours program in Genetics (with a Co-op option) administered through a multi-faculty interdisciplinary committee, to be reviewed in 2017-18.

Note that Program Charts for all the BSc Honours, Majors and General programs are included in a package for ease of reference, as Appendix 8. Course outlines including that for the Honour Thesis Course BIOL 4100, are provided in Appendix 12.

The evaluation of student progress in the Honours program requires that students maintain a minimum GPA of 3.00, that they complete a minimum of 9 CH each Fall and Winter term, and do not accumulate more than 15 CH of F grades after entering the Honours program. To graduate with the BSc Honours degree, a student must have a minimum GPA of 3.00 and obtain a minimum grade of "C" on the courses that make up the 120 CH of the degree. Students in the Co-op program must also meet these requirements in addition to successfully completing all work-term courses. The procedures for their evaluation involve course evaluation through grades, and meetings with the theme chairs or Associate Head to review their progress and complete and sign the program approval forms. The Student Information System (AURORA Student) will not permit any student to register in courses unless a

program approval form has been completed and processed through the Faculty of Science office. This procedure ensures that all students in these programs meet with a theme chair for evaluation. Throughout the program students are encouraged to visit the academic advisors in the Faculty of Science office who provide a worksheet for the student and clearly outline the remaining courses they need for their degree. Prior to the student graduating with an Honours degree, a graduation check is done by the academic advisors in the Faculty of Science office to ensure the student is aware of the courses remaining.

Thesis procedures and regulations in the Honours Thesis Course

Extensive guidelines are provided for students to perform an Honours thesis project (BIOL 4100, 6 CH) and write the thesis (see course outline in Appendix 12). To summarize, students must meet with an advisory committee (advisor, external advisor, and one Honours Thesis Committee (HTC) member) in May (summer projects) or September (Fall projects) to present and discuss their research proposal. Having an HTC member on the advisory committee for each Honours student is designed to ensure a standard process, level of mentorship, conduct of research, and evaluation of student performance. As well, the external member of the committee is there from the start of the course, similar to a Master's advisory committee, to serve as a secondary advisor, and so the final thesis can follow from the feedback provided at the earlier meetings of the same committee. The student and advisory committee meet again in January for a progress report, and in April for the final oral presentation and defence of the thesis at the annual Honours Symposium event in the Department. The experimental part of the project may be carried out during the fall term of the fourth (or fifth) year or during the preceding summer.

The Honours Thesis research proposal should be written before the research begins and should be no more than 5 to 10 double-spaced, typed pages in length (excluding figures and tables); specific points to be covered are included in the course outline and on the course webpage.

(http://umanitoba.ca/science/biological_sciences/honours/) Specific guidelines are also provided for writing the progress report, for writing the thesis, and for the oral presentations. Extensive guidelines are also provided for supervisors and HTC members. The student's mark is based on the research proposal, including oral presentation (10%), the progress report, including oral presentation (15%), the conduct of the research (15%), the written thesis (50%), and the oral thesis presentation (5%). The conduct of the research itself, is evaluated by the advisor only; all other marks are based on the evaluation of all committee members. Sample listings of the Honours Thesis Symposia are included in Appendix 9.

Specialty and novel or innovative features

One of the special features of the Biological Sciences Honours program is in the extent of student training in research. Students are first prepared rigorously for the Honours program by taking the BIOL 3100 and trained in scientific writing as they learn to describe the controversies and existing gaps in scientific knowledge and to evaluate in the scientific literature and presentations. Students are also trained in BIOL 3100 in presenting data and ideas in oral presentations and in the development of a poster presentation which is showcased at a BIOL 3100 open-house event that encourages faculty, staff and students to hear about future Honours projects. The in-depth student experience with a particular faculty member as a mentor/advisor in BIOL 3100 allows both to evaluate whether there is a sufficient level or manner of interest, capability, capacity and interpersonal interaction to sustain both through the ups and downs of completing the BIOL 4100 Honours project together the following year. Students are under no obligation to stay in the Honours program after completing BIOL 3100, nor do they have to stay with same advisor for BIOL 4100. As well, advisors from BIOL 3100 are not obligated accept the students they have mentored/advised in BIOL 3100 students for an Honours project (in BIOL 4100). So

far this hasn't been a problem; most students completing BIOL 4100 do work with the mentor/advisor they had for BIOL 3100, although some students have done successful Honours projects with a different advisor.

The novelty and the rigour of the BIOL 4100 course and Honours program include the iterative evaluation of student progress from writing the research proposal, to the mid-term committee meeting for the progress report, and finally the presentation of the thesis work, itself. This process provides a nurturing environment for feedback that helps to build the student's confidence in their progress. The stepwise process also helps both student and advisor keep on track, and helps the student in particular, manage their time for the thesis project and thesis writing. It also helps the student leave enough time for the advisor to review a draft of the thesis and provide feedback at least some time before the final thesis is due to go to the examining committee. As indicated above, the advisory committee evaluates and guides the student, and meets at least three times over the course of the project (proposal, midterm progress report, and final thesis defence) about how to write about and communicate findings. This iterative process also feeds forward, in building skills for job interviews, where the ability to communicate and think on your feet, is returned by being able to compete for jobs in high-pressure situations. The committee may consist of members from the Department of Biological Sciences but also provides opportunity for collaboration with other campuses or institutions.

The thesis program in Biological Sciences is popular and continues to grow, given the diversity in research interests within the Department. Research theme areas are represented well and include training abroad and beyond campus including experimental and field sites in Africa, Churchill, Newfoundland and the Atlantic coast, the Experimental Lakes Area and the high Arctic. Students are also provided unique opportunities to work with researchers interested in a huge range of topics that foster the development of topic-specific and general skills, and scientific inquiry and interest in areas including parasitology, respirometry, stable-isotope analysis for diet-ecology applications to management and conservation, GIS applications, RNA sequencing, bioinformatics and computational biology, avian bio-logging, wetland ecology, and small and large mammal biology, etc. Students are encouraged to use open access software for quantitative analysis of datasets, and to learn R and modelling for data interpretation. Beyond this diversity in field work, the major research infrastructure available for student use in strong research-training programs in cell, developmental and molecular biology, genomics/genetics, microscopy and image analysis including laser microdissection, genetics and physiology of a range of plants and animals all provide students with the tools and instruments necessary to carry out cutting-edge experiments in the lab.

Students truly take ownership in their projects doing novel research, and are encouraged to publish their work and findings in leading internationally recognized peer-reviewed journals, in addition to publishing species accounts through open access databases around the globe. The discoveries made through the Honours research projects, drive innovation and have the potential for applications for translational research opportunities. Essentially, the access by Honour students to infrastructure and training brings similar opportunities to the more extensive programs that can be developed at a graduate level, although on a shorter time scale. It is clear from discussions at the Honours thesis symposium and beyond, that students are proud of their achievements give strong presentations, and typically do an excellent job of defending their ideas. It is also clear that faculty and thesis examiners are proud of the Honours students, and try to find ways to attract them (and fund them) for graduate studies.

Strengths

Students in the Biological Sciences BSc Honours program are prepared early for the program and are provided with a diversity in upper level course offerings that complement and support an Honours degree. Two courses in particular, BIOL 3100 and BIOL 4100 form the strong framework of the program. Students interested in the Honours program must register for BIOL 3100 (Skills in Biological Sciences). This course provides training in communication and problem solving skills through comprehensive writing and oral assignments, and practice finding and referencing information.

Students are also provided with upper-level courses that provide hands-on experience in both lab (e.g. BIOL 4544 Advanced Developmental and Cellular Biology; BIOL 4554, Molecular Methods – DNA; BIOL 4556 Molecular Methods - RNA) and field disciplines (e.g. BIOL 4216, Biology of Birds; BIOL 4218, Biology of Mammals; BIOL 4210, Biology of Fishes; BIOL 4260, Introductory Parasitology; BIOL 4362, Behavioural Ecology and Cognitive Ethology; and other fieldwork travel courses in Churchill, South Africa, Costa Rica). In addition, courses are also offered for those interested in quantitative biology and biological collections. Research faculty and Adjunct professors can serve as supervisors of Honours project students, and bring awareness of exciting opportunities for research projects on a global scale.

The Department of Biological Sciences offers state-of-the-art infrastructure to carry out cutting edge experiments, including the use of molecular biology, physiology, and ecology labs, imaging facilities, plant- and animal-rearing facilities, and high-end computational stations for the analysis of large-scale data sets.

The Honours program is a major strength of our whole department, and is recognized and celebrated as a point of pride by everyone. The evaluation process of students enrolled in the Honours program is considered to be the biggest strength of the program, in part due to its rigour. Student evaluation spans a two-year period, starting in BIOL 3100 that culminates in an oral defence of their thesis work in BIOL 4100. The delivery of BIOL 3100 is directed specifically so students can determine whether they really wish to undertake an Honours research project. A thesis committee is struck at the beginning of the Honours project, and consists of at least one member of the Honours Thesis Committee. (The composition of the Honours Thesis Committee has undergone revisions since 2009, to accommodate increased enrollment in the program, and distribute the workload of committee members, who are expected to review the proposal, progress report, and thesis, and serve as an examiner for the thesis defence.) The thesis committee provides feedback and guidance to the student by consensus and joint evaluations throughout the project (including examination of the thesis). Feedback throughout the program aims to help guide the student and their progress, in addition to addressing challenges in the process of scientific writing and in their interpretation of their data. During the evaluation process, the committee helps the student define clear goals and timelines, and that guide the student's path to success. During the final oral examination/defence, an external reviewer also provides feedback to the student. Overall, the thesis is graded by at least 3 faculty members, and is not overly-weighted by a supervisor's grade. Thesis examiners have come from the Department, University, industry, government (e.g., Department of Fisheries and Oceans), the Adjunct professors in the Department, and other members of the scientific community in Manitoba and beyond. This broadens the expertise available to students, and helps them build their own network.

Students enrolled in the Honours program are provided with professional opportunities in public outreach, interactions with municipal, provincial and federal governments, and engagement with industry and non-governmental organizations (e.g., at Experimental Lakes Area) to satisfy their research-thesis requirements. As well, the Honours students in a given year, often become a cohort (e.g., with the support of events coordinated by the Honours Thesis Committee and interactions within the Biological

Sciences Undergraduate Students group). A cohort will benefit from the support of peers while progressing synchronously through the stages of proposal writing and presentation; progress-report writing and presentation; and thesis submission, presentation, and defence.

Given the high quality of research and performance by students in the Undergraduate Honours program, students are encouraged to attend conferences. They often are able present their work at regional, national and international meetings. Travel support from the Department and the Faculty of Science is provided to help offset conference-travel costs. Honours students are also provided opportunity to publish their work in internationally recognized peer-reviewed journals, and be part of the writing, review, and revision processes. Please see the section on Major undergraduate student awards, Honours, and publications, over the past 5-years, below.

The Biological Sciences Honours students are highly 'marketable' and can easily find employment. They often enter the graduate program at the University of Manitoba or another post-secondary institution. Their Honours research training often serves as a recruitment and retention strategy for members of the Department of Biological Sciences, and brings the best and brightest students to (or back to) the Department. The Department also has a strong desire to recruit into the Honours program. Many Honours theses are considered as equivalent to a "mini-Master's thesis", and there is no doubt that students who complete the Honours program are much better prepared for the Master's program than those who do not have this level and extent of experience with research, a supervisor, and a thesis. This is demonstrated by the strong preparation and performance of the first-year MSc students in BIOL 7100, and indeed brings challenges to the continual improvement of that graduate-level course.

Weaknesses or challenges

Despite the strong historic successes and accomplishments of students and professors contributing to the Honours program, there are some weaknesses or challenges.

The primary challenge of the program is the time commitment required of students (and faculty) to ensure that students succeed in the Honours thesis course (BIOL 4100 – Honours Thesis). There is a six (6) hour minimum commitment per week that typically starts in the Winter or Summer Session, prior to the Fall-term start of classes. This begins when students are writing their thesis-project proposal. The Honours Thesis Committee is considering whether to increase the credit-hour allocation to the course, since it is so onerous. Many students spend far more than six hours per week in the development, design and execution of the experiments over the course of their final year, in addition to the extensive writing process of a real thesis. The end result, however, is seen as an exceptional accomplishment for most students.

Students also need to manage their time between commitments to the Honours thesis and balance that with their other course work. The students who prepare best for the Honours program often plan to have a lighter course load (although the minimum load is 9 CH per semester) in the final (Winter) term of the program, to avoid having the pressure of having too many deadlines.

Some students begin the Honours thesis project course in May, and others in September. Although there is pressure to become productive rapidly if a student opts for the Fall start, by the time of the progress report in January, the cohort shows fairly uniform progression. The trend is for many, if not most Honours students to take an extra year (i.e., 5 years rather than 4) to complete the BSc Honours degree, given the demands of managing Honours thesis work with the work and commitments from other upper-level courses, and any part-time work outside the university environment. The ability of

faculty to effectively guide and mentor their Honours students through interpretation of data and thesis preparation is higher when students have only three 3-CH courses to complete in that final term. However, some students do complete the Honours program in 4 years with excellent results.

The time commitment required of students to complete their Honours project plus other coursework can attenuate formation of a strong cohort, depending on the particular group of students and the supervisors involved in a given year. The Honours Thesis Committee is now holding promotional events (pizza discussions) to help students interact as a group, and have them discuss in general what each other is doing, and how they are coping with the workload while learning first-hand about research.

Although a clearly rigorous evaluation is a strength of the program, to some extent it could be considered a challenge, in that students may choose an alternative Honours pathway or the Co-op Majors pathway, for their BSc. To some extent, this may limit the enrollment of students in our Honours program. Two other Honours programs, in Microbiology and in Genetics, also attract students, and some faculty in our Department supervise students in those programs as well. The Department discussed whether this brings other issues about competition, or dilution of contributions to our Honours program by our researchers. We understand that some researchers opt not to contribute to our program, even if approached. Since we do help students who are registered in an Honours program from another department, we should be ensuring that students are held to the same standards as for our own program. The Honours Genetics program is not really in competition with a Biological Sciences Honours, as it is a different and independent program with different core requirements. Both Genetics Honours and Biotechnology Honours students go through the Honours program course in Microbiology. One or two of our faculty members currently supervises an Honours student from the University of Winnipeg, and Department members also supervise Honours students in Psychology program at the University of Manitoba. We discussed that it is always a good thing to have students find options that suit them, and that the movement of students across departments helps build our collegiality with other departments.

It may not be understood by our students, that they can seek an advisor for their Honours program from a researcher in another department or Faculty. This is not common, but students have been very successful in completing excellent Honours thesis under such circumstance.

Some students have trouble finding an advisor for their Honours program, particularly if they determine from their BIOL 3100 experience that they wish to find an alternate supervisor for BIOL 4100 that is not the researcher who mentored them in BIOL 3100. Advisors may not have the capacity to take on multiple Honours students, even after mentoring the 3rd-year students through the excellent assignments in BIOL 3100 to write a literature review, design a hypothesis and experimental plan, and finally develop and present a research proposal using a poster. There is a significant commitment of time and resources required of faculty who supervise an Honours project. There is also competition for summer research placements by undergraduate students, and not all those students may want or have the capability to do well at an Honours thesis project. However, the students do not have a significant problem finding a suitable supervisor for an Honours project. We note that students recognize on their own, that they may not be prepared to undertake an Honours project. This happens at the level of BIOL 3100. For example, 2 of 25 students this past year (2015) dropped BIOL 3100 as they weren't ready, or were unable to find a mentor for the rigours of that course. Mentors were sensitive to the students' capabilities in early discussions in BIOL 3100, and did not over-encourage weaker students or those who had unrealistic expectations of their ability to handle a heavy workload.

It is possible that only the best students should be able to do an Honours BSc program. Currently there is a relatively low entrance requirement to the program (GPA = 3.0). It is really important that students

consult a student advisor and the Chair of the Undergraduate Curriculum Committee for advice on the Honours program, and that advice to students needs to be realistic. Talking with Co-op program advisors is also critical, since doing the Honours Co-op program, can dramatically add to the student's time-to-completion of the program, overall.

Although the scope and scale of an Honours project can be quite large, it is quite typical for the advisory committee, particularly guided by the member from the Honours Thesis Committee, to help a student and their supervisor recognize that expectations of the research project need to be realistic as well as ambitious. Finding that balance is part of a student evaluating their own progress, mid-way through BIOL 4100. Consistent reference to the guidelines, and stepwise mentoring and evaluation processes are very valuable in helping students and faculty overcome these challenges.

The number of students registered in the Biological Sciences Honours program has increased over the past five years (see Table 4). We don't necessarily want more Honours students if they are not prepared. Currently the avenue into the Honours program is through BIOL 3100, which has an important cap on registration and also lets students know whether they would enjoy and could be successful in an Honours research project. It may be that we could bring more students up to the level of preparation to do the Honours program (e.g., start preparing them at the 2000 level), but this is not realistic, given the need to sustain the core program courses on essentially stable resources. Given the increase in high value placed on student (and faculty) success in the Honours program, those running the Honours Thesis Course would like to see students coming together at events beyond the final thesis presentations to establish a stronger sense of community at the Honours level. This suggestion is part of the ongoing discussion about time commitment and CH allocation to BIOL 4100.

In considering the possible shortcoming that students start at two times (May or September), we discussed that ideally every student should have the opportunity to begin in April. However, we don't necessarily have funding for all of them. Many of the strongest students receive Faculty of Science Summer Research Awards or NSERC USRAs, and a number of those students are aiming at medical school. We will be considering additional ways to fund students in our Honours program specifically, possibly by providing some scholarships for those who don't make the cut-off on a USRA if they are in the Honours program. This may help more students begin BIOL 4100 in May. The award of an NSERC-USRA to an undergraduate student requires an advisor to have an NSERC grant, and this excludes some faculty as being supervisors if they only have bridge funding to get back on track with their research or have funding from non-NSERC agencies. Occasionally, this restriction has effectively penalized researchers who could most use the help of an excellent undergraduate student with scholarship funding, to build their HQP tally, their track record in student supervision, and the extent of achievement and progress in their research program.

Some students have a great deal of difficulty writing a good thesis. We learned from interactions with the Biological Sciences Librarian that writing tutors can work with individual thesis advisors to sort out their involvement in the course assignment, and then provide students direct feedback on thesis drafts. This assistance is not for marks, so there is less pressure on students. To take advantage of this assistance, students need to give extra time to getting feedback toward improving their final document when they take advantage of this one-on-one service. There is apparently un-tapped capacity in the writing-tutor service, which is funded by the Academic Learning Centre, so we should let students know they can take early and more frequent advantage of the help that is available with thesis writing.

To address these weaknesses or challenges, the Department's self-evaluation process has provided the following suggestions for consideration as way to further strengthen the Honours program. The Honours

Thesis Committee is discussing the options and opportunities, prior to making any recommendations to the Undergraduate Curriculum Committee for course or program changes.

1. Give students course credit for the work conducted in the summer term leading up to the official Fall registration in the Honours course. This may be a problem when a student is being paid (a stipend, or salary) for working on a research project during that period, as they would be getting paid and getting course credit for the same work/research. Alternatively, students in the Honours program could theoretically be given more CHs for a project course if they started on their project full time in May, than if they start in the Fall when they are taking other courses, since both complete the project course in April of the following year. However, most students don't want more CH in the Honours program, and the tally of CH for BIOL 4100 do not count toward the 30 CH of Biological Sciences courses that are required. Honours (and Majors) students finish their degree with 120 CH; in that tally, Majors students take 6 CH of electives, while Honours students get 6 CH from taking the BIOL 4100 course.
2. Provide students with detailed program advice on an ongoing basis, using frequent reference to the course syllabus.
3. Honours thesis committees should be structured to enhance and support the student and their needs; this includes the recent addition of the 'external' member of the examining committee (not directly supervising the student or serving on the Honours Thesis Committee) right from the outset of the Honours course for each student.
4. Ensure that Honours students have a project that balances realistic goals and strong research, plus a back-up plan if experiments should fail. While the research conducted by an Honours student is not necessarily going to be published, it contributes to the research program of the advisor, and should be original work. Expectations for the research project should also be balanced with course work and extracurricular activities. Notably, many Honours thesis projects are published or contribute to publications.
5. Encourage that feedback on the program from students (past and present) be collected on a regular basis.

Transferability of course credits from post-secondary institutions

The transferability of course credits is examined on a course by course basis. Some course equivalencies have already been established and others are examined by the Associate Head and/or a course instructor. A database of previous decisions is maintained by the Chair of the UGCC so the Department can ensure consistency in future decisions about transferring credit for a given course from a given institution.

BSc MAJOR – Program Structure

Objectives of the BSc Major program

The four-year BSc Major program is designed for students planning a professional career in an area or application of the Biological Sciences, but who may not be considering graduate training. It will provide intensive training in all areas of Biology comparable to that of the Honours program, but with less demanding performance requirements (i.e., without needing to do an original research project). Additionally, students may complete the requirements of a Majors degree on a part-time basis if they wish.

Areas of speciality and any novel/innovative features of the BSc Major program

We offer a variety of organismal and process-oriented courses, as well as areas of specialization. Students in the BSc Major program can follow one or more of five themes, and this specialization is recorded on their transcript:

- Ecology and Environmental Biology
- Integrative Biology
- Cell, Molecular, and Developmental Biology
- Environmental and Integrative Physiology
- Evolution and Biodiversity

We also contribute to the management and course offerings of a Majors program in Genetics (with a Co-op option) administered through a multi-faculty interdisciplinary committee, to be reviewed in 2017-18.

Strengths

We offer one of the most comprehensive and wide-ranging undergraduate biology programs in Canada. This includes the provision of hands-on laboratory learning for all first-year students enrolled in BIOL 1020 and 1030, the two year-1 requirements for entry to the Majors program. In addition to general second-year introductory courses in genetics, cell biology and organismal biology, we provide the opportunity for upper-level students to take specialty courses in areas such as endocrinology, sensory and motor physiology, comparative animal energetics, specialized organismal-group biology (such as the biology of vascular flora of Manitoba, birds, mammals, fungi, algae, and lichens), applications of population ecology in fish management, and molecular biology of prokaryotes and eukaryotes (course outlines are in Appendix 12).

The first and second years of our BSc Major program are designed to lay a solid foundation for progression of knowledge through more advanced courses in third and fourth year. The two first-year Majors courses have labs (BIOL 1020 and BIOL 1030) which are a strength, given the wide range of background in biology and in the proficiencies of our intake students. The lecture portions of these courses are taught by video-format lectures by full-time Instructors, ensuring the consistency of instruction and evaluation across 12 lecture slots. The video format also frees up time for the Instructor to engage students in small-group and one-to-one interactions in the lab setting, that otherwise would not be possible with a heavy schedule of lectures.

Indeed, it is one of the unique features of the BIOL 1020/1030 courses that the lecture material is presented by DVD. This format has evolved over many decades, from initial offering by the Biology Teaching Unit which adopted use of VHS tapes for lectures. This was adopted to optimize use of instructor contact hours for laboratory teaching, provide opportunity for students to catch up on lectures they may have missed, and review lecture material in preparing for examinations. Students in these 2 courses have been the major users of the Science and Technology Library where the videos, and then DVDs were housed and played on library equipment available by short-term loan from the reference desk. The use of video lectures is in the process of transitioning to Streaming Video, although currently still supported by availability of the DVDs through the Library. This will likely end in Fall 2016. The current process for access by streaming, requires those logging into the site to be registered as current students in the course, and that they access the lectures from a secure location on campus (as of Winter 2016).

The use of video lectures in BIOL 1020/1030 was highlighted in the “Report on Blended and Online Learning” (chaired by Dr. Jeff Taylor, Dean, Faculty of Arts) as having taken the lead within the

institution to provide blended-learning opportunity to students. The instructors in these 2 courses take the production of high-quality video lectures very seriously, and work closely with the staff in the AudioVisual studio (and also in IST and the Centre for Advancement of Teaching and Learning) to ensure the lectures have high-resolution illustrations and are accessible on commonly used formats (laptops, iPads). Instructors also aim to minimize copyright infringement of the material that is used in lectures, by agreement with the textbook publisher. The instructors have refined their pedagogical approach to delivering lectures through taping, and they each closely review the editing of taped lectures to ensure there is a smooth transition between topics, illustrations, slides, voiceover, and the presentation of textual material on PowerPoint or overheads, as each lecture is developed for a final video.

The use of video lectures in these two courses, with their very large enrollment, allows the Department the necessary resources to provide hands-on laboratory learning with instructors present in the laboratories. This requires very full days over 6 weeks for each instructor, when they are attending all the numerous laboratory sections (5 concurrent sections in many time slots). Each lab section also has a TA available to help students.

Despite having honed the approach to video lecturing and dovetailed it with the use of “Mastering Biology” in the Pearson website (paired with quizzes each week, to keep students ‘on track’ as the course progresses), there are critics of the course offering by video lecture. In particular, many students indicate that they would much prefer in-person lectures, and they are sometimes quite vocal about their preference. However, the Dean’s office continues to be very supportive of the use of this blended-learning approach in first-year biology laboratories with a new guideline as recently as late March, 2016. In part, this is because it is cost-effective, since 4 full-time Instructors can deliver lectures to very large-enrollment courses, with videos scheduled for delivery in linked classrooms throughout campus. Faculty in all departments in the Faculty of Science are now encouraged to consider revising their teaching materials and format to try and then adopt versions of blended and online teaching in other courses. Faculty are also encouraged to explore the use of ‘flipped classrooms’ where students would discuss topics during class time, and receive the lecture material only online. The instructors of the BIOL 1020/1030 courses have worked through the many details of streaming-video lectures with the staff in Information Systems and Technology, AudioVisual Services (Classroom Technology), the Centre for Advancement of Teaching and Learning, and the Library (e.g., securing the video files across different servers that house them). However, the Department of Biological Sciences holds a strong consensus view that we can only sustain the learning outcomes of these foundational courses by retaining the students’ opportunity for hands-on experiences through laboratory teaching. Pressure to cut laboratories in first-year Biological Sciences courses would significantly undermine the effective learning in these 2 courses, and make new introductory lab courses necessary in second year, to prepare students for the upper-level laboratory courses and for research opportunities in this Department and others.

At this time, fewer than half of the Biology Departments in Canada have been able to sustain their offering of laboratory teaching in first-year biology (due to ongoing budget cuts). This situation is despite the strong recognition (e.g., at the Canadian Council of University Biology Chairs) that such laboratory-learning experience is pivotal to truly learning biology. Some departments (e.g., Lakehead University) are trying to bring back laboratory teaching in first-year biology, with little success because of budget implications. To date, the Department has been able to sustain the costs of running the labs (including 2 technical staff positions for lab and specimen preparation, course-supply costs, and lab-preparation space) and the ongoing work of developing successful proposals to the Endowment Fund in the Faculty of Science. The Endowment Fund has been very generous in supporting equipment upgrades and replacements. The funding has addressed needs in the short term (e.g., with advances in digital imaging

and computer technology, to provide high-resolution demonstration microscopes equipped with digital cameras that project to high-resolution screens in each laboratory) or on longer-term cycles (e.g., replacement of student microscopes and hotplates on a 15-year cycle), as needed. The Department is always very grateful for the amazing support of our educational programs through the contributions of past and current student to the Endowment Fund.

Notably, much of our first-year (labs and lectures) and second-year teaching (especially in labs) is delivered by full-time Instructors who are not research faculty, although most have PhDs and often postdoctoral experience. This has helped the Department limit (and in some years prevent) the need to recruit and hire Sessional Instructors. It also helps the Department bring consistency to the course offerings, maintain standards of delivery and grading within the program, and maintain the opportunity for undergraduate students at all levels to learn from full-time academic staff.

University wide, students are evaluated by letter grades on a scale up to 4.5 (A+). The table below presents the average percentage to letter-grade equivalence, although there is some deviation by individual course instructors assigning grades in a given course offering.

Letter grade	% score
A+	90-100
A	80-89
B+	74-79
B	68-73
C+	62-67
C	56-61
D	50-55
F	0-49

Students in the Majors program generally perform quite well. On average, they have a good GPA upon graduation (Fig. 4). Based on a review of the grade distributions, “A” is the most commonly received grade across all courses (Figs. 7-13). While we are always concerned that there is pressure by students to get an A, we try to prevent upward grade creep. However, the frequency of As may be partly an artifact of how numerical grades are categorized: it is important to note that there is a large range for an “A” grade. Many instructors have identified that an “A-minus” grade would be useful since a score in the low 80s is very different from one in the high 80s; both are now given an A. We are interested in knowing if our grade distributions are in line with those in other biology programs in Canada.

Students also perform well in our required courses, and this enables their entry into third- and fourth-year courses. Students demonstrate a good progression of knowledge from second, to third and fourth year in the program, but faculty in the Department are not sure if we pay enough attention to the progression of students’ development of skills at the different levels. The skills inventory compiled in 2012, is just now revised (see below), and we will be providing this to students so they can track their acquisition of skills, and be able to use the inventory as they apply for jobs or other programs.

Our faculty members are engaged in innovative pedagogy in the face of resource constraints. For example, some instructors allow students to complete drafts of assignments with an iterative process of TA feedback and peer evaluation. Others have used *PeerWise*, in which students create, complete and evaluate multiple-choice questions (MCQs); one class generated 600 multiple choice questions in an assignment that was worth 5% of their final grade in the course, and the questions were often very insightful as to the topics important for evaluating student learning in the course. Instructors are increasingly incorporating assignments into their course curriculum that are realistic exercises for

eventual practical application in a job or in research. In one course students complete an image processing assignment wherein they take a digital micrograph, manipulate the image (e.g., for contrast, scale, cropping, and colour) using image-processing software, document their manipulation and label salient features of their image.

Weaknesses

Student progression

It is our perception that some of our Majors students seem to be unprepared for courses they are taking at the 3000 and 4000 level. This may in part, be due to the absence of 2nd-year pre-requisites for some of the upper-level courses and the fact that students often take courses out of order (e.g., taking 4th-year course in 2nd year or vice versa). This is exhibited in the large number of students listed as part of the “second-year class” (Figure 2). We know that we have a high number of students who voluntarily withdraw (VW) from courses (Figs. 5, 6). This results at least partly, from the relatively liberal University of Manitoba policy on VWs. We are happy that this is soon to change. It is our perception that students VW from courses that they consider difficult or too much work and that they are preferentially taking courses without labs or major assignments in order to ‘manage’ their GPAs. This is borne out by the information presented to Senate in January 2016, from Dr. David Collins, Vice-Provost (Programs and Planning). The University plans Policy changes that should help avoid the real problem with VWs, as there is currently a large change in enrollment numbers before vs. after the posted “VW date”. This is part of the challenge of managing enrollment, as the perceived demand differs from the actual demand. For example, serious students who have not previously taken one of the so-called “bottleneck courses”) may not get into a course needed for their program because less serious students register and then drop the course. This prevents progression, and can be very detrimental for scheduling courses in a program. The timing of the new Fall term break (to be implemented in October 2016) may affect how the demand for some of our courses is managed, as mid-term dates may move, and the number (or nature) of labs and assignments in some courses may need to be changed with the 2 days of the break being placed the week immediately before the Thanksgiving holiday.

The levels of enrollment in our 4000-level courses are relatively low (Figure 2). While we don’t have many required courses at the 4000 level in the Majors (or Honours) program, there is a perception among some students that 4000-level courses are conceptually more difficult and harder to get into than 3000-level courses. This may be due to the fact that there is uneven distribution of the availability of fourth-year courses across terms and that some of the courses are on a 2-year rotation cycle. In fact, the number of every-other-year courses is very small. According to some long-serving members of the Department, there has been no consistent difference in level of difficulty between 3000- and 4000-level courses since the 1990s, either here or in other institutions. While the lack of a distinction is seen as a possible weakness of our program, the situation seems to be part of the progressively longer time-to-completion among undergraduate programs in Canada. The recent proposal to change the VW policy (in discussion at Senate) should alleviate at least some of the delay, since at the institutional level, analysis showed that students who take even one VW in their undergraduate program will statistically take two extra years to complete a 4-year Bachelor’s program. This makes it a challenge to know how to allocate resources year over year, given the uncertainty of student progression. However, it is clear that the volume of VWs affects (and in some cases, even jeopardizes) student progression through their program, adds to the tuition fees for an undergraduate program, and costs the University money and resources in servicing teaching for what can amount to a fairly large number of students who ultimately drop a course.

While the grade distributions in courses at the 3000 and 4000 level show a high level of achievement by students (Figs. 11-13) and we work to ensure that this is real achievement, there is a sense that we are

sometimes re-teaching concepts and skills that should have been developed in second year. This perception may have arisen from an absence of pre-requisites for 3000- and 4000-level courses. The relatively small minimum number of courses required to stay in the Majors program is also considered a possible weakness, as students tend to take only the minimum requirement of courses.

The number of allegations of academic dishonesty, particularly plagiarism, is increasing, and this has required increasing resources to manage and investigate through required processes and reporting lines. There are many meetings on these allegations with each undergraduate student (with their Student Advocate), and investigations and findings of academic dishonesty are taken seriously in every Department throughout the Faculty of Science and the University. The institution is taking steps (unfortunately necessary on a regular basis) to have consistent application of policies and consistent procedures for reporting, investigating, and giving penalties across all units and programs. This is an ongoing challenge at the University, as it is across Canada and internationally. Faculty emphasize in every course and course syllabus, the need for students to respect to work by others in any format, such as through in-class in discussions and specific directions on how to attribute original work by others within written assignments at every level of the program. Many faculty utilize an Honesty Declaration form in their course outline, and require students to submit a signed declaration with each assignment, to emphasize that it is every student's responsibility to maintain the integrity of academic work. Faculty also instruct students to protect their own work and not copy other work in examinations. The challenge also relates to the significant amount of time and effort that are required by faculty and support staff (and the Student Advocates who represent and support students during such investigations), for processing the many aspects of the academic dishonesty policy and procedures. The Dean's office and Associate Dean (Undergraduate) are advocating for more timely and concise procedures that can help everyone handle the number of allegations, meetings, investigations, and correspondence, and appeals of decisions. We will continue to process the allegations, and educate one another and new faculty recruited to the department about the importance of attending to policy and procedures on this issue, and have discussed at Department Council that the range of penalties for infractions needs to be developed in balance with the impact on students, programs, and workload. The chair of our Undergraduate Curriculum Committee works closely with the Associate Deans (Undergraduate) on this issue (and many others relevant to the undergraduate programs).

Skills development

We would like to have better progression in the students' development of skills in biology, and are considering how best to integrate skill development across the programs. For example, we have asked ourselves whether students are receiving adequate training in writing (especially lab reports and journal-style papers), numeracy, and problem solving. While there are some theme-specific courses that students can take to develop these skills, some students select courses from across the broad offerings at the University, and may fall short in the development of their particular skillset, due to their choices. Instructors in the Department have tried very hard to incorporate a broad range of skills into a course like BIOL 3300, which is the only upper-level course that is required by all Majors and Honours students. The instructors for BIOL 3300 emphasize skills such as critical thinking, writing, problem solving, numeracy, computer literacy, and leading and participating in small peer group discussions. The Department supports that course design by providing significant hours for TAs and Grader Markers. Similarly, the instructor for BIOL 3100 emphasizes library literature searching, critical thinking, presentation skills, writing, and research design. The whole Department actively supports that emphasis by serving as advisors and mentors (with considerable implication for workload) on the student assignments (literature review, presentation, and research-proposal poster) for every student taking that course. These (and other) courses are rigorous and challenging to students, and considered

valuable aspects of the educational program and research training opportunities in the Department. In general, instructors revise what is done in each course (relative to content, to complement and reinforce the skills students gain but there may be a need for more directed skills development program. For instance, Developmental Biology was previously listed as a 2000-level course but recently was moved to the 3000-level so students could prepare by taking Cell Biology and Genetics courses beforehand. This is considered similar to the progression of knowledge from 2nd to 3rd year, and also will enable the course instructor to review some topics only in brief, and add new topics from the current research literature on organism development.

In the process of reviewing and evaluating our programs, Dr. Joy Stacey led the development of the second iteration of a skills inventory in our course offerings (see Appendix 10). While it is currently apparent that students are able to increase their knowledge base through our course offerings, students themselves, lack an understanding of the skills they acquire as they proceed through the program. In addition to general technical skills, the inventory includes some discipline-specific skills that students receive in taking their program of courses (e.g., molecular biology and other wet-lab skills, field-based skills related to ecology, use of taxonomic keys, use of GPS, photo-microscopy, etc.). By using this new skills inventory with students, we aim to help them understand that they are receiving skills training at an early stage, and reiterate that they can track their own acquisition of skills. Then we will be better able to determine if particular skills are being acquired too late in the programs and do something to address specific deficiencies.

It is our sense that many skills are not being taught until the 3rd or 4th year and that additional training, especially in numeracy and writing, is required during the first and second year. Such a skills inventory should theoretically become part of the syllabus for every course (even though many students do not read those documents). However, we need to emphasize with students, that employers want to hire BSc graduates with the skill to learn on their own; the skill of self-directed learning is the critical skill we need to help students acquire, since they will be able to accrue many more skills than could be provided from a dossier of technical skills acquired during a BSc program. Nonetheless, the skills inventory will be a useful asset for illustrating selected aims and outcomes of courses in our program.

Therefore, the Department is very strongly committed to helping students develop the skills they need *to develop skills themselves*, through education and self-directed learning, rather than providing “training programs” that are directed strictly toward students gaining employment upon graduation. We value the opportunity to provide training toward employable skillsets, but we value what we do as educators, as well. We recognize that we need to communicate the distinction between education and training, to our students, while we encourage them to become independent thinkers who achieve considerable independence from their professors before they graduate. Students may see a BSc credential as an investment, and view the outcome of a diploma as the benefit, but the diploma alone is not what will open doors for them. Rather, their ability to apply the knowledge and skills they have learned, and to know they have the skill, values and attitude to learn new skills, will bring opportunity for high-level, rewarding careers and employment. We are aiming to provide a liberal education rather than a ticket to a list of job opportunities. The Department feels strongly that an undergraduate education is not, or should not be, thought of solely as job training, although pressure from parents and government funders, may push the employment aspect of post-secondary education. We want students to be successful and happy in careers, because they can continue learning. We’re by no means unique in considering these topics for discussion; the President’s “Visionary Conversations” event (February 24, 2016) had as its theme the important question: “Has Manitoba put the right value on post-secondary education?” We will continue to address the weaknesses of our programs on the basis of a philosophy that places very high value on a broad education with emphasis on the biological sciences.

In addition, we are concerned that our students are not developing the general numeracy and writing/literacy skills from the courses that they are mandated to take outside the Department (“M” (maths) and “W” (writing) courses). The real impact for the renewed attention to skill development will only be realized if we start in first year (if we know who will declare Science as their home Faculty). Such attention would almost certainly impact the quality of skills shown by students in the Majors and Honours program. Logistics a significant barrier, as the first-year cohort is so large. There is some writing now required in BIOL 1020 and BIOL 1030 labs (within the allotted TA time), but this is limited, since the process of reviewing and giving feedback on lab reports is very labour intensive, and thus cost-prohibitive when budgets are reduced. TA pay is also low at the University of Manitoba compared to most universities in Canada, so it is possible that the TA motivation would not be sufficient to do more work, even if we could afford to pay them for their extra hours. If we were able to commit “TA-ships” to graduate students, who had to work a pre-set number of hours (e.g., 100 hr per term), we might be able to have them serve as TAs for tutorials of 20-30 students, and provide regular feedback, while grading written reports at the first-year level. However, BIOL 1020 is a very large service course, so the feasibility of giving such intensive feedback to every students would need to be determined. One solution might be to pull Majors and Honours students into a separate course at the first-year level (currently not possible with University-1), but this would have significant implications for course/room scheduling, resources, management of time conflicts for each student, and our programming, given that it might be a fairly large cohort at the level of first year.

These are some of the challenges to making improvements that we discuss in regard to the BSc Majors program. Many instructors have expressed an interest and willingness to incorporate more skill-building assignments into their course curricula and have ideas that are congruent with both the Faculty and University Strategic Plans. However, resource limitations (time and money) and teaching support are major roadblocks to implementation, especially with respect to having the capacity to give timely and effective feedback on scientific writing. An increase in TA and Grader-Marker support would enable us to give more feedback on skill-development exercises in more courses. The development of mandatory skills workshops (e.g., at each year-level) may also help to alleviate some of these perceived shortcomings.

Fieldwork courses

The idea of increasing the number of fieldwork courses (or courses that incorporate field work in assignments and/or laboratory exercises), currently in discussion by the Ecology theme group, will also be up against the challenge of finding capacity and sufficient levels of support for financial and human resources, to be implemented. However, we will be considering opportunities to merge some courses, possibly discontinue some others, and develop new courses within the budget, at the same time as we continue to advocate for resources for ongoing improvements to the program.

On the topic of field components in undergraduate-ecology courses at Canadian universities, more than a few respondents to our survey noted the lack of field experiences, although not all the responses came from students taking the Ecology theme. In our Department’s discussions about the survey and programs, it was noted that most other Canadian universities had dropped their field exercises, for reasons of logistics and/or liability and safety. Thinking that it would be useful to know what the situation is across the country, one of our Instructors, Dr. Isobel Waters, compiled a table listing the field components (field exercises during lab periods; a day-long field trip; a weekend field trip; a 1- or 2-wk field course) of Ecology courses at most of the major Canadian universities, under the following categories:

- 2nd-year Ecology courses, analogous to our Principles of Ecology offering (course numbers, not titles),
- 3rd-year Field Ecology courses; these are dedicated courses specifically dealing with field methods,
- Population, Community, or other 3rd-year ecology courses that list a field component in the calendar,
- 4th-year Field ecology courses (specifically designated as field courses), and
- other undergrad courses that list a field component in their calendar entry (see Appendix 11).

Many universities (including ours) likely have a field component to their second year ecology course when it is offered in the summer term. However, the proportion of our Majors students who take the summer offering is small, as is also the percentage of Ecology-theme students who take the Fall term offering of the BIOL 2300 Principles of Ecology that is offered through Agriculture and does have field exercises.

The information in the survey will be very useful as a comparison, in discussing our fieldwork offerings. However, the survey is noted to have the following limitations. There are likely undergrad courses (particularly upper-level, optional courses) that also have a field component, but these are likely to be minor, and the focus was on the lower-level, required courses; different institutions vary in how much detail they provide online regarding the field component; not all Canadian universities were canvassed, and the survey of websites was focused on the medical-doctoral category of university, as well as a few in the mostly-undergraduate category of university. There was no information available about field components in labs in comparable upper-level courses at other Canadian universities, so that information was not included for our own university. As well, the main purpose of the survey was to compare field trip experience and exposure for students both in their entry-level ecology courses, and in courses specifically designated as field ecology courses.

Despite these limitations, there is evidence that the University of Manitoba has a lower content of fieldwork experience in its undergraduate Ecology courses. There is a large range, since certain universities (UBC, and Dalhousie with its “Seaside” program, for example) are blessed with geographic locations that allow them to maximize the variety of their field components. But even setting aside those examples, most major universities invest considerably more resources into field experiences for their undergraduate students than we do at the University of Manitoba.

Those universities that incorporate field exercises into their 2nd year course (Alberta, UBC, McGill, Regina, Saskatchewan, and Toronto) have many more lab sections to make such exercises possible. The table gives examples, where the numbers could be found, showing that there are typically 18-20 lab slots per term, presumably to accommodate lecture slots of 400-500 students. All have lab instructors/coordinators (often more than one), and some universities even have a lab coordinator dedicated solely to the field components of their undergraduate courses. All the universities listed in the survey (with the exception of Regina) also have a dedicated Field Ecology course of 2-week’s duration at the level of third or fourth year.

Two universities that do not incorporate field exercises into their 2nd-year course (Guelph and Queen’s) have dedicated field ecology courses in both their 3rd and 4th year. Queen’s, for example, has no 2nd-year ecology course at all, but has 4 field-based half courses as well as field trips associated with two other required ecology courses, Population and Community. There are 5 other universities that do not have field exercises listed for their basic 2nd-year ecology course:

- Dalhousie has a 3rd-year dedicated 2-wk-long field ecology course, plus approximately 20 field-based courses for students enrolled in their “Seaside” program;
- Memorial is unusual in having no field components listed for any of their 2nd- or 3rd-year courses, but has a total of 8 field-based courses at the upper undergraduate levels;
- Calgary has a field component in their second-year course (the calendar entry is unclear) and a 2-week field ecology course in 4th year;
- Victoria has a number of optional field-based courses at the upper level; UBC, by comparison, has extensive field components for both required and optional courses;
- Western Ontario is the most similar to our Department, in having no field component to its 2nd-year courses, and relying on field modules for its offerings in third and fourth year. It is the only university that offers a dedicated Natural History course (Flora and Vegetation of Ontario).
- University of Winnipeg is included in the survey as our nearest neighbour. Although the calendar entry is not clear, there appear to be some field exercises in their 2nd-year course. At the upper level, they have specialized in Forest Ecology, for which there is a 3-week field course.

Despite this wide variety of types and amounts of field components in undergraduate courses across the country, the University of Manitoba comes out close to, if not at the bottom of the pack. This situation is unfortunate, given our heritage of being one of the first Canadian universities to establish an Ecology program. We identify this as a serious shortcoming of our program. Members of the Ecology theme will be developing a plan to redress this shortcoming. Ecology theme meetings have already started discussing the re-instatement of our former, dedicated 4th-year Field Ecology course, but we strongly contend that incorporating a field component into Principles of Ecology (BIOL 2300, a core and required course in both our BSc Majors and Honours programs) is just as important. It is at this early juncture in an academic career, that a student’s ecological interests can most effectively be engaged, captured and stimulated.

Overall, the perceived weaknesses and challenges to the BSc Majors program relate to student progression into upper-level courses (3000 and 4000), in part due to a huge number of VWs; and the need to provide opportunities for skills development and fieldwork. Addressing each of these challenges will have resource implications for staffing (e.g., lab coordinator and TAs), fiscal and space resources, and scheduling courses with more fieldwork. The Department is strongly committed to overcoming these challenges and the current self-evaluation review process has prompted and renewed our plan to address the deficiencies.

Admission requirements to the BSc Majors program

Entry into BIOL 1020 is the same as for the BSc Honours program; again, BIOL 1020 and 1030 are the two required Biological Sciences courses for the students in first year.

To enter the Biological Sciences four-year Major program a student must have completed a minimum of 24 CHs with a minimum DGPA of 2.00, and obtained a minimum grade of “C+” in BIOL 1030. CHEM 1300, CHEM 1310, STAT 1000; and 3 CHs of Mathematics (e.g.: MATH 1200, MATH 1300 or MATH 1500), Physics (e.g.: PHYS 1020 or PHYS 1050) or Statistics; and six CHs from the Faculty of Arts (which should include a “W” course) are program requirements. Students are strongly urged to complete these courses in their first year.

To continue in the BSc Major program, a student must maintain a minimum DGPA of 2.00.

To graduate with the BSc Major in Biological Sciences, a student must obtain passing grades on all courses, and obtain a minimum GPA of 2.00 on the 120 CHs that contribute to the degree.

Course requirements – required and elective

Majors students in the Department must complete the same core of courses as students in the BSc Honours program. These include:

- BIOL 2300 Principles of Ecology
- BIOL 2500 Genetics I
- BIOL 2520 Cell Biology

Students must also take one course from Group A (below) and one course from Group B, and a further course from either Group A or group B; again, these program requirements are the same as for the BSc Honours program.

Group A

- BIOL 2200 The Invertebrates
- BIOL 2210 The Chordates

Group B

- BIOL 2240 The Non-Flowering Plants
- BIOL 2242 The Flowering Plants
- BIOL 2260 Biology of Fungi and Lichens

To fulfill the core requirements, in their third year, students must also complete

- BIOL 3300 Evolutionary Biology

and one of:

- BIOL 3450 Plant Physiology
- BIOL 3470 Environmental Physiology of Animals I
- BIOL 3472 Environmental Physiology of Animals II

Students are encouraged to select a specific theme area as part of their Biological Sciences program (see above); however, not all students in the BSc Majors program declare a theme area of specialization (see Figure 3). Each theme has a suite of courses that are required for that particular area of specialization.

In addition to the core requirements, the specific courses required for each theme group are provided in the following theme-specific program charts.

Cell, Molecular, and Developmental Biology Theme

Specific courses required for the Cell, Molecular, and Developmental Biology Theme in addition to the core course requirements: [BIOL 2540](#) (3); *Plus a minimum of 6 CHs of Biochemistry:* [CHEM 2770](#) ([MBIO 2770](#)) and [CHEM 2780](#) ([MBIO 2780](#)); or [CHEM 2210](#) and [CHEM 2360](#) ([MBIO 2360](#)) and [CHEM 2370](#) ([MBIO 2370](#)).BIOL 2540 (3); Plus a minimum of 6 CHs of Biochemistry: CHEM 2770 (MBIO 2770) and CHEM 2780 (MBIO 2780); or CHEM 2210 and CHEM 2360 (MBIO 2360) and CHEM 2370 (MBIO 2370).

Program Chart

UNIVERSITY 1	YEAR 2	YEAR 3	YEAR 4
4-YEAR MAJOR: Cell, Molecular and Developmental Biology Theme (incl. Co-op)⁶ 120 CREDIT HOURS (Courses listed in chart below and electives)			
BIOL 1020, BIOL 1030 CHEM 1300, CHEM 1310 STAT 1000	BIOL 2300, BIOL 2500, BIOL 2520 Choose one course from each of: Group A: BIOL 2200, BIOL 2210 Group B: BIOL 2240, BIOL 2242, BIOL 2260 One additional course from either Group A or Group B Either both of CHEM 2770 and CHEM 2780; or all three of CHEM 2210, CHEM 2360, and CHEM 2370 (theme courses)	BIOL 3300 BIOL 2540 (theme course) Choose one of the following: BIOL 3450, BIOL 3470, BIOL 3472 30 credit hours of 3000 or 4000 level Biology courses ⁴ (courses from outside Biology may be approved by the theme advisor). Enough elective credit hours required to total 120 credit hours for the program.	
In University 1 or Year 2 the following must be completed: 3 credit hours of Mathematics or Physics chosen from: MATH 1200, MATH 1300 ¹ , MATH 1500 ¹ , PHYS 1020 or PHYS 1050 6 credit hours from the Faculty of Arts, including a required "W" course		Cooperative Option Requirements (if selected): BIOL 3100 ⁶ , BIOL 3980, BIOL 3990	Cooperative Option Requirements (if selected): BIOL 4980, BIOL 4990 (if necessary)
30 Hours	30 Hours	30 Hours	30 Hours

Ecology and Environmental Biology

Specific courses required for the Ecology and Environmental Biology Theme in addition to the core course requirements: [BIOL 3310](#) (3); [BIOL 3312](#) (3); [BIOL 3314](#) (3); [STAT 2000](#) (3).

Program Chart

UNIVERSITY 1	YEAR 2	YEAR 3	YEAR 4
4-YEAR MAJOR: Ecology and Environmental Biology Theme (incl. Co-op)⁶ 120 CREDIT HOURS (Courses listed in chart below and electives)			
BIOL 1020, BIOL 1030 CHEM 1300, CHEM 1310 STAT 1000, STAT 2000 (theme course)	BIOL 2300, BIOL 2500, BIOL 2520 Choose one course from each of: Group A: BIOL 2200, BIOL 2210 Group B: BIOL 2240, BIOL 2242, BIOL 2260 One additional course from either Group A or Group B	BIOL 3300 BIOL 3310, BIOL 3312, BIOL 3314 (theme courses). Choose one of the following: BIOL 3450, BIOL 3470, BIOL 3472 21 credit hours of 3000 or 4000 level Biology courses ⁴ (courses from outside Biology may be approved by the theme advisor). Enough elective credit hours required to total 120 credit hours for the program.	
In University 1 or Year 2 the following must be completed: 3 credit hours of Mathematics or Physics chosen from: MATH 1200, MATH 1300 ¹ , MATH 1500 ¹ , PHYS 1020 or PHYS 1050 6 credit hours from the Faculty of Arts, including a required "W" course	Cooperative Option Requirements (if selected): BIOL 3100 ⁶ , BIOL 3980, BIOL 3990	Cooperative Option Requirements (if selected): BIOL 4980, BIOL 4990 (if necessary)	
30 Hours	30 Hours	30 Hours	30 Hour

Evolution and Biodiversity

There is currently a discussion in the theme group for Evolution and Biodiversity, and at the Department level, about augmenting the list of core course requirements for List A (under evolutionary processes). This is particularly timely, given the growth in expertise with recent faculty recruitment, and plans for new special topics courses and full courses.

Specific course required for the Evolution and Biodiversity Theme in addition to the core course requirements:

List A: One of the following: [BIOL 3360](#), BIOL 4240, BIOL 4242, [BIOL 4362](#)

List B: One of the following: [BIOL 3200](#), [BIOL 3242](#), [BIOL 3250](#), [BIOL 3270](#), [BIOL 4212](#), [BIOL 4214](#), [BIOL 4216](#), [BIOL 4218](#).

Program Chart

4-YEAR MAJOR: Evolution and Biodiversity Theme (incl. Co-op)⁶ 120 CREDIT HOURS (Courses listed in chart below and electives)			
BIOL 1020, BIOL 1030 CHEM 1300, CHEM 1310 STAT 1000	BIOL 2300, BIOL 2500, BIOL 2520 Choose one course from each of: Group A: BIOL 2200, BIOL 2210 Group B: BIOL 2240, BIOL 2242, BIOL 2260 Plus one additional course from either Group A or Group B	BIOL 3300 Choose one of the following: BIOL 3450, BIOL 3470, BIOL 3472 3 credit hours chosen from the Evolutionary Processes List (A) above. 3 credit hours chosen from the Biodiversity course List (B) above. 30 credit hours of 3000 or 4000 level Biology courses ⁴ (courses from outside Biology may be approved by the theme advisor). Enough elective credit hours required to total 120 credit hours for the program.	
In University 1 or Year 2 the following must be completed: 3 credit hours of Mathematics or Physics chosen from: MATH 1200, MATH 1300 ¹ , MATH 1500 ¹ , PHYS 1020 or PHYS 1050 6 credit hours from the Faculty of Arts, including a required "W" course	Cooperative Option Requirements (if selected): BIOL 3100 ⁶ , BIOL 3980, BIOL 3990	Cooperative Option Requirements (if selected): BIOL 4980, BIOL 4990 (if necessary)	
30 Hours	30 Hours	30 Hours	30 Hours

Environmental and Integrative Physiology

Specific courses required for the Environmental and Integrative Physiology Theme in addition to the core course requirements: 6 CHs of Biochemistry [CHEM 2770](#) ([MBIO 2770](#)) and [CHEM 2780](#) ([MBIO 2780](#)); or [CHEM 2210](#) and [CHEM 2360](#) ([MBIO 2360](#)) and [CHEM 2370](#) ([MBIO 2370](#)); Plus: two of the following courses (one of which is already required in the four-year Biological Sciences Degree programs): [BIOL 3470](#) (3), [BIOL 3472](#) (3) [BIOL 3450](#) (3), [BIOL 3452](#) (3).

Program Chart

4-YEAR MAJOR: Environmental and Integrative Physiology Theme (incl. Co-op)⁶ 120 CREDIT HOURS (Courses listed in chart below and electives)			
BIOL 1020 , BIOL 1030 CHEM 1300 , CHEM 1310 STAT 1000	BIOL 2300 , BIOL 2500 , BIOL 2520 Choose one course from each of: Group A: BIOL 2200 , BIOL 2210 Group B: BIOL 2240 , BIOL 2242, BIOL 2260 Plus one additional course from either Group A or Group B. Either both of CHEM 2770 and CHEM 2780 ; or all three of CHEM 2210 , CHEM 2360 , and CHEM 2370 (theme courses).	BIOL 3300 Choose one of the following: BIOL 3450 , BIOL 3470 , BIOL 3472 Choose two of: BIOL 3470 , BIOL 3472 , BIOL 3450 (if not already taken), or BIOL 3452 (theme courses). 24 credit hours of 3000 or 4000 level Biology courses ⁴ (courses from outside Biology may be approved by the theme advisor). Enough elective credit hours required to total 120 credit hours for the program.	
In University 1 or Year 2 the following must be completed: 3 credit hours of Mathematics or Physics chosen from: MATH 1200 , MATH 1300 ¹ , MATH 1500 ¹ , PHYS 1020 or PHYS 1050 6 credit hours from the Faculty of Arts, including a required "W" course		Cooperative Option Requirements (if selected): BIOL 3100 ⁶ , BIOL 3980 , BIOL 3990	Cooperative Option Requirements (if selected): BIOL 4980 , BIOL 4990 (if necessary)
30 Hours	30 Hours	30 Hours	30 Hours

Integrative Biology

Specific courses required for the Integrative Biology Theme in addition to the core course requirements: All five of the following (three of which are already designated as core courses in the four-year Biological Sciences Degree programs): [BIOL 2200](#) (3), [BIOL 2210](#) (3), [BIOL 2240](#) (3), [BIOL 2242](#) (3), [MBIO 1010](#) 3); One of the following (one of which is already required in the four-year Biological Sciences Degree programs): [BIOL 3450](#) (3), [BIOL 3470](#); Plus: 18 CHs in Biological Sciences (3000/4000 level courses) and 12 CHs in Microbiology (3000/4000 level courses).

Note: a maximum of 15 CHs of Biological Sciences and Microbiology courses at the 2000 level are permitted in the Integrative Theme for use toward the 3000/4000 level requirements of the degree.

Program Chart

4-YEAR MAJOR: Integrative Biology Theme (incl. Co-op)⁶ 120 CREDIT HOURS (Courses listed in chart below and electives)			
BIOL 1020, BIOL 1030 CHEM 1300, CHEM 1310 STAT 1000	BIOL 2300, BIOL 2500, BIOL 2520 Required Theme course: BIOL 2200, BIOL 2210, BIOL 2240, BIOL 2242 MBIO 1010	BIOL 3300 Choose one of the following: BIOL 3450, BIOL 3470, BIOL 3472 18 credit hours of 3000 or 4000 ³ level Biology courses ⁴ 12 credit hours of 3000 or 4000 ³ level Microbiology courses (theme courses). Enough elective credit hours required to total 120 credit hours for the program.	
In University 1 or Year 2 the following must be completed: 3 credit hours of Mathematics or Physics chosen from: MATH 1200, MATH 1300 ¹ , MATH 1500 ¹ , PHYS 1020 or PHYS 1050 6 credit hours from the Faculty of Arts, including a required "W" course	Cooperative Option Requirements (if selected): BIOL 3100 ⁶ , BIOL 3980, BIOL 3990	Cooperative Option Requirements (if selected): BIOL 4980, BIOL 4990 (if necessary)	
30 Hours	30 Hours	30 Hours	30 Hours

Evaluation procedures for the BSc Majors program

Professors evaluate course success through student feedback (e.g., verbal and written comments, SEEQ evaluations) and by monitoring grades on assignments and exams.

When necessary, changes are made to course content and/or course prerequisites. Suggested changes to course prerequisites and program requirements are proposed by faculty, discussed by the Undergraduate Curriculum Committee and proceed by recommendation through the Department Council, Committee on Courses and Programs (COCAP), Faculty of Science Council, Senate Committee on Curriculum and Course Changes (SCCC), and Senate. Several examples of these procedures are listed below.

Individual course content or prerequisite changes

Instructors decided that the systems-level approach to vertebrate anatomy that was traditionally used in Biology 2210 labs was detrimental to student progress in the course. The labs were revised to approach the material using a phylogenetic sequence to harmonize the content of labs with that in the course lectures.

Instructors found that students lacked an adequate plant background for BIOL 3242 Vascular Flora of Manitoba. BIOL 2240 or BIOL 2242 were added as a prerequisite. In addition, students were not starting their plant-collection assignment prior to the start of the Fall term, despite the information presented in the course calendar. As a result, the instructor sent each student a copy of the assignment as they enrolled during early August and encouraged the student to complete their collection over the summer, when plants are in flower and specimens are easy to obtain. In addition, students are strongly discouraged from registering for this course after classes O recommendation to Department Council, then in serial recommendations to the Faculty of Science Committee on Courses and Programs (COCAP), Faculty of Science Council, the Senate Committee on Curriculum and Course Changes, and to Senate.

Thesis, practicum or comprehensive procedures and regulations

The four-year BSc Major program in Biological Sciences does not have a thesis, practicum or comprehensive option.

Transferability of course credits from post-secondary institutions

We evaluate the transferability of courses from other post-secondary institutions when students transfer into our program. There is broad transferability from other U15 institutions in particular, as the sample [equivalency chart](https://aurora.umanitoba.ca/banprod/ksstransequiv.p_trans_eq_main) illustrates below (https://aurora.umanitoba.ca/banprod/ksstransequiv.p_trans_eq_main).

University of British Columbia		University of Manitoba Equivalent		Comments
Course	Credit Hrs.	Course	Credit Hrs.	
AGRO 418 Intensive Fish Production	3	BIOL 4XXX Transfer 4000 Lvl	3	Last assessed Summer 2014
APBI 311 Animal Physiology	3	BIOL 2XXX Transfer 2000 Lvl	3	Last assessed Fall 2012
APBI 312 Animal Physiology II	3	BIOL 2XXX Transfer 2000 Lvl	3	Last assessed Fall 2012
APBI 418 Intensive Fish Production	3	BIOL 4XXX Transfer 4000 Lvl	3	Last assessed Summer 2014
APBI 419 Fish Diseases	3	BIOL 4XXX Transfer 4000 Lvl	3	Last assessed Summer 2014
BIOL 112 Unicellular Life	3	BIOL 1XXX Transfer 1000 Lvl	3	Last assessed Fall 2014 BIOL 112 & 121 W BIOL 140 ARE EQUAL TO BIOL 1020 & 1030
BIOL 112/121/140 Unicellular Life/Ecology W Lab	6	BIOL 1020 Bioprinciples	3	Last assessed Fall 2014
BIOL 112/121/140 Unicellular Life/Ecology W Lab	6	BIOL 1030 Biodiversity	3	Last assessed Fall 2014
BIOL 117 Evolution & Ecology	3	BIOL 1XXX Transfer 1000 Lvl	3	Last assessed Fall 2011
BIOL 121 Ecology, Genetics, Evolution	3	BIOL 1XXX Transfer 1000 Lvl	3	Last assessed Fall 2014 BIOL 112 & 121 W BIOL 140 ARE EQUAL TO BIOL 1020 & 1030
BIOL 200 Cell Bio I: Structural Basis	3	BIOL 2520 Cell Biology	3	Last assessed Fall 2015
BIOL 210 Vascular Plants	3	BIOL 2XXX Transfer 2000 Lvl	3	Last assessed Fall 2011
BIOL 230 Fundamentals of Ecology	3	BIOL 2300 Principles of Ecology	3	Last assessed Fall 2013
BIOL 234 Fundamentals of Genetics	3	BIOL 2500 Genetics 1	3	Last assessed Fall 2013
BIOL 303 Pop Bio	3	BIOL 3310 Fndtn Population Ecology	3	Last assessed Fall 2011
BIOL 304 Fundamentals of Ecology	3	BIOL 2300 Principles of Ecology	3	Last assessed Fall 2012
BIOL 335 Molecular Genetics	3	BIOL 3XXX Transfer 3000 Lvl	3	Last assessed Winter 2013
BIOL 361 Intro To Physiology	3	BIOL 2410 Human Physiology 1	3	Last assessed Fall 2011
EESC 301 Limnology	3	BIOL 3370 Limnology	3	Last assessed Fall 2011 NO CREDIT IN ENVR.
EOSC 315 The Ocean Ecosystem	3	BIOL 1XXX Transfer 1000 Lvl	3	Last assessed Fall 2013
HGSE 353 Rainforest Ecol & Mgmt	3	BIOL 3XXX Transfer 3000 Lvl	3	Last assessed Winter 2015
HGSE 355 App Ecol Coastal Tere Eco	3	BIOL 3XXX Transfer 3000 Lvl	3	Last assessed Winter 2015
HGSE 356 Biophy Dyn of Mar-Ter Inter	3	BIOL 3XXX Transfer 3000 Lvl	3	Last assessed Winter 2015
HGSE 357 Ecol & Mgmt Island Wildlife	3	BIOL 3XXX Transfer 3000 Lvl	3	Last assessed Winter 2015
HGSE 358 Conservation Ecology	3	BIOL 3XXX Transfer 3000 Lvl	3	Last assessed Winter 2015
HGSE 359 Ecosystem Bases Mgmt Sem	3	BIOL 3XXX Transfer 3000 Lvl	3	Last assessed Winter 2015
HMKN 190 Functional Anat & Appl Phys I	3	BIOL 1XXX Transfer 1000 Lvl	3	Last assessed Fall 2012

RELEASE: 8.5.3

Enrollment and VW rates, by course, theme, or programs year – Figures 1-6

These graphs were extracted from data tabulated by the Office of Institutional Analysis, as made available during this program review, to illustrate some of the information discussed in the report.

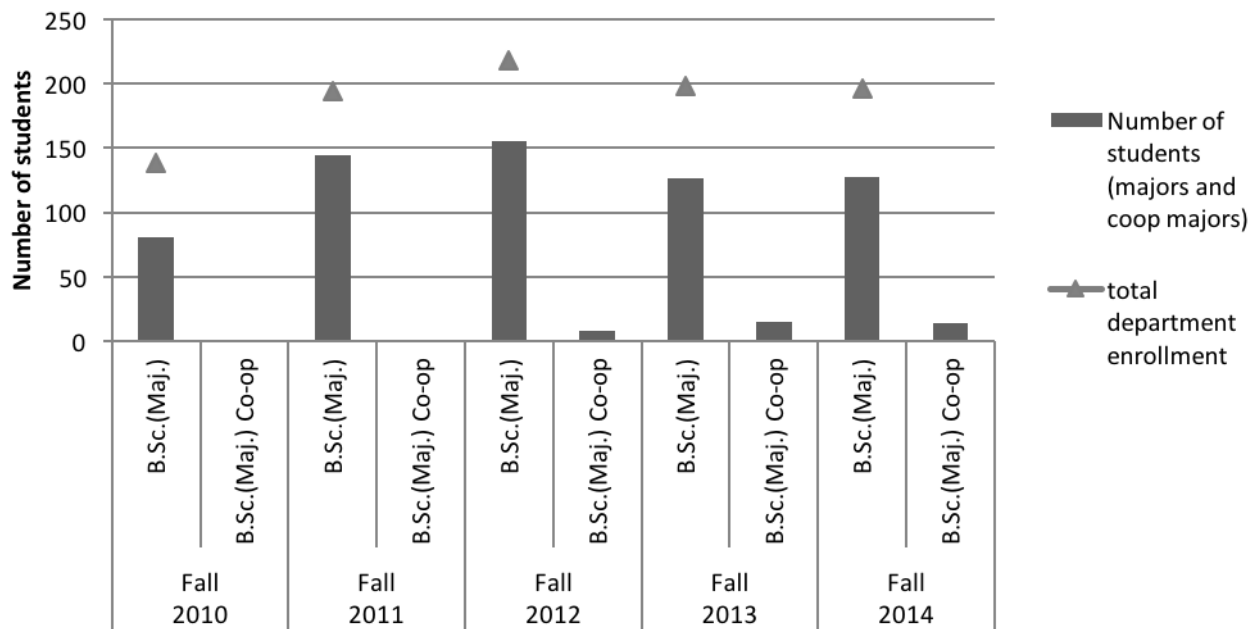


Figure 1: Enrollment in BSc Majors and Coop by year compared to total Department enrollment (which includes BSc Honours students).

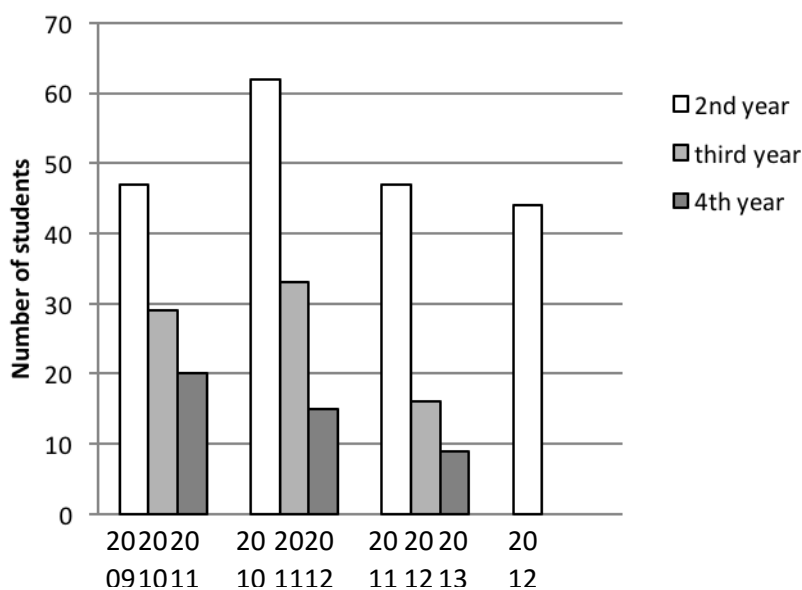


Figure 2: The total number of BSc Majors and BSc Honours students registered, per year-class from 2009-2012.

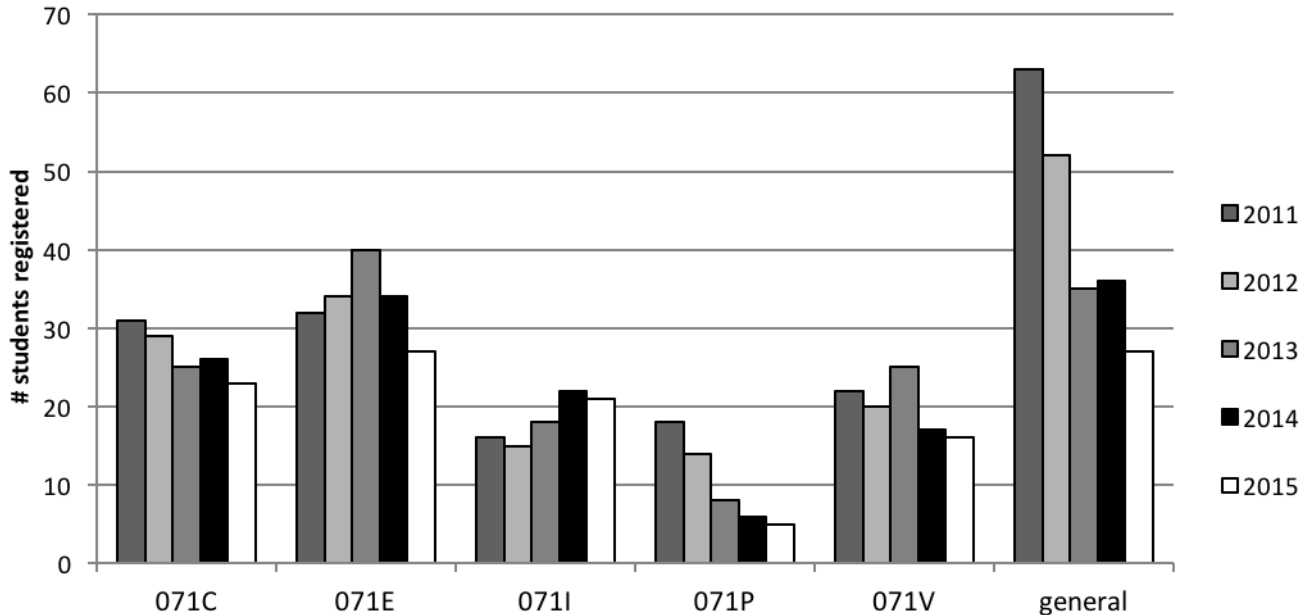


Figure 3: The number of students registered in each theme concentration and in the non-specialized of “general Majors BSc” in 2011-2015. (071C=Cell and molecular; 071E=Ecology; 071I=Integrative; 071P=Physiology; 071V=Evolution)

In reviewing Figure 3, it appears that there is a declining number of students that do not declare any theme group for a specialization during their BSc Majors program. However, it is not known whether these students are in the process of entering the Honours program in Biological Sciences or whether they elect to go to another program, such as Genetics or Microbiology.

The Department would like to see that both the Majors and the Honours programs are strong (in 2015-16, there were 41 Honours students and 39 Majors student enrolled in the third or fourth year of their program).

Students declare their ‘home Faculty’ only when they leave University-1, and can stay in the 3-year BSc General program for more than 3 years. Since those students may then declare a Major and make a late transition to that program, it is challenging to know if the apparent pattern in Figure 3 is meaningful. Students seem to add a year to their program quite often, even to complete a BSc Major degree, and the same thing happens from some students who decide to start an Honours program in their fifth year on campus.

The number of Majors students in the Physiology theme seems low compared to the other themes. However, there is a very strong number of BSc Honours students in Physiology theme.

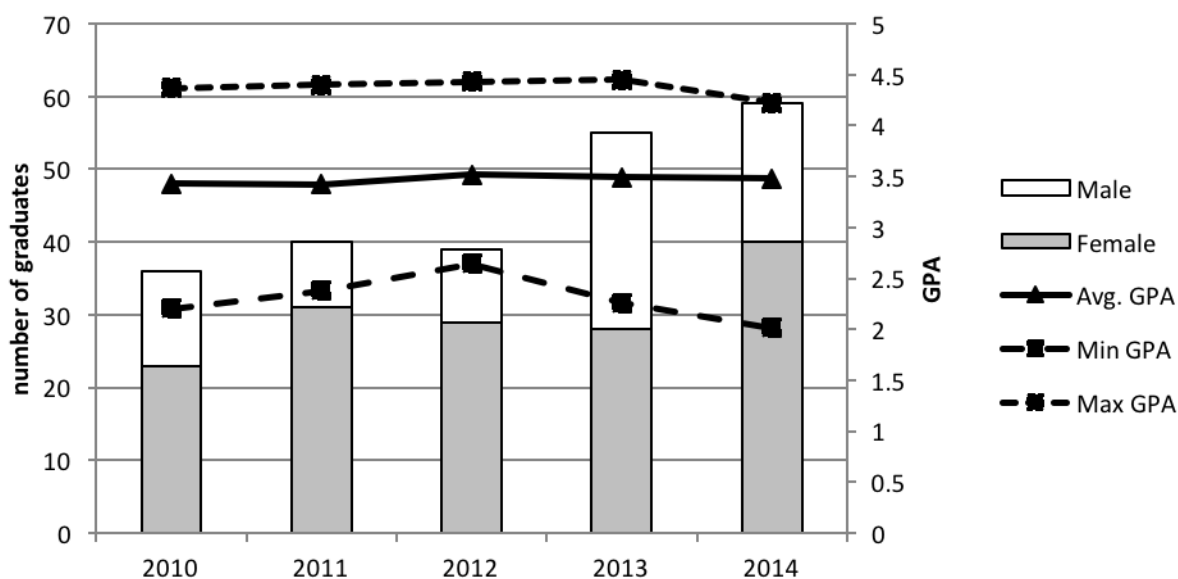


Figure 4. Total number of BSc graduates from the Department from 2010-2014 (left axis) and the average, minimum and maximum GPA of those graduates (right axis). Data include the “legacy degrees” and all current degree offerings.

One of the main issues that students encounter in completing their program is their sequencing of courses through the Majors program. For instance, many students may not take a full course load (defined as 9 CH per term, while the program designation of a ‘2nd-year course load’ is typically 15 CH per term). The Department (and also the University of Manitoba) have found students will take a Voluntary Withdrawal (VW) to avoid getting a low mark. From a recent study by one of the instructors in a third-year course (BIOL 3300), we know that students are using the VW system to manage their GPA (e.g., so it is high for entry to a professional program, for instance). The perception that it is difficult to get into 4th-year courses (which would be a major weakness of the programming) may arise from students being unable to take the pre-requisites for 3000- and 4000-level courses, and so they take the minimum number of courses required to stay in a Major (or Honours) program. This essentially hinders their progression and allows the VW practice to continue.

The University is revising the VW policy (along with changes to bring in Limited Access to courses that are dropped by VW, and the Authorized Withdrawal policy), to try and mitigate the huge challenges to students trying to schedule a program, that accrue from so many VWs (~18,000/yr, campus-wide). Students currently can VW a course for a very long time, up to and including only 3 weeks before the end of classes in a term. Thus, considerable resources are still been devoted to students that ultimately VW a course, and these students therefore deprive others of the opportunity to take the course. It's also a concern when so many students routinely "bail" from a course in which they are not doing well, as it seems to encourage a "quitter" mentality (bailing when the going gets tough), which is not a useful attitude for career success. The Department knows quite clearly that students VW in courses they consider to be hard work or too much work, and prefer to take courses with no labs or major assignments to “manage” GPAs. Having graduation-GPAs quite high could be a strength or a weakness. Instructors in the Department all try to avoid grade inflation. We do not know whether whether different courses apply different standards for assigning marks, or whether other universities use/set

similar standards. However, after years of teaching, we would like to think that most faculty members have a good sense of what constitutes an “A” grade, and sufficient experience of other institutions to know general standards. However, we recognize that students are under pressure to have a high GPA so they are competitive in applying to other programs, for scholarships (e.g., for graduate school), and in the job market.

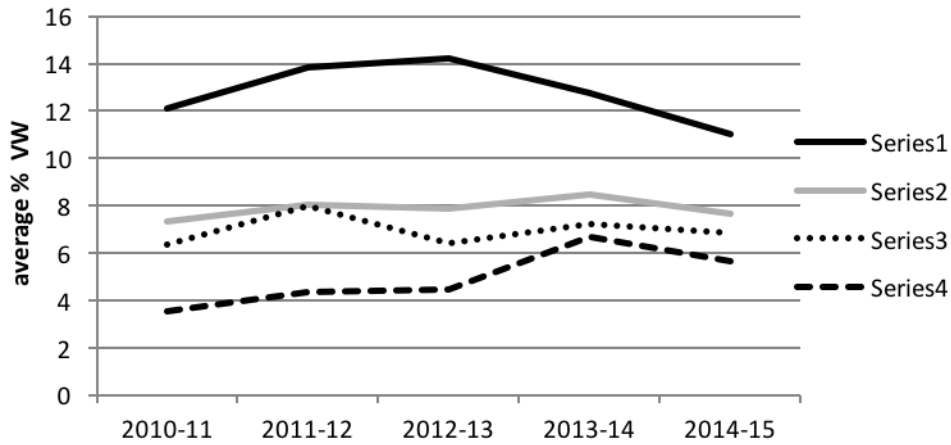
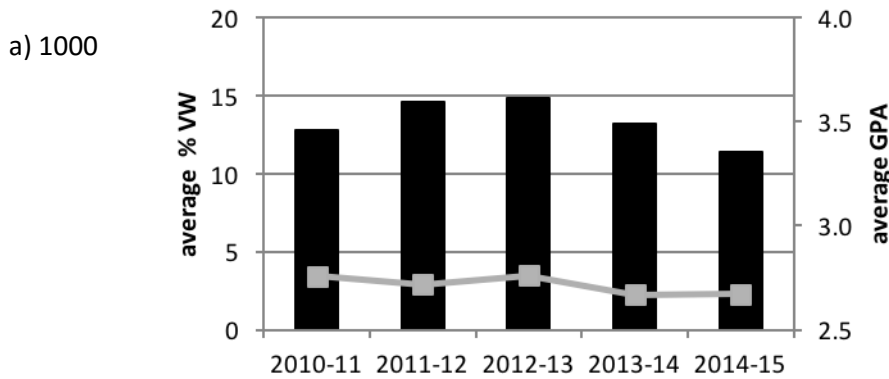


Figure 5: Average rate of Voluntary Withdrawals (VWs) in first-year through fourth-year courses (Series 1 to 4) from 2010-2014.

Figure 6: Graphs (a to d, below) show the average %VW rate (bars, left axis) and average GPA (line, right axis) in 1000-2000 level courses, for each year from 2010-2014.



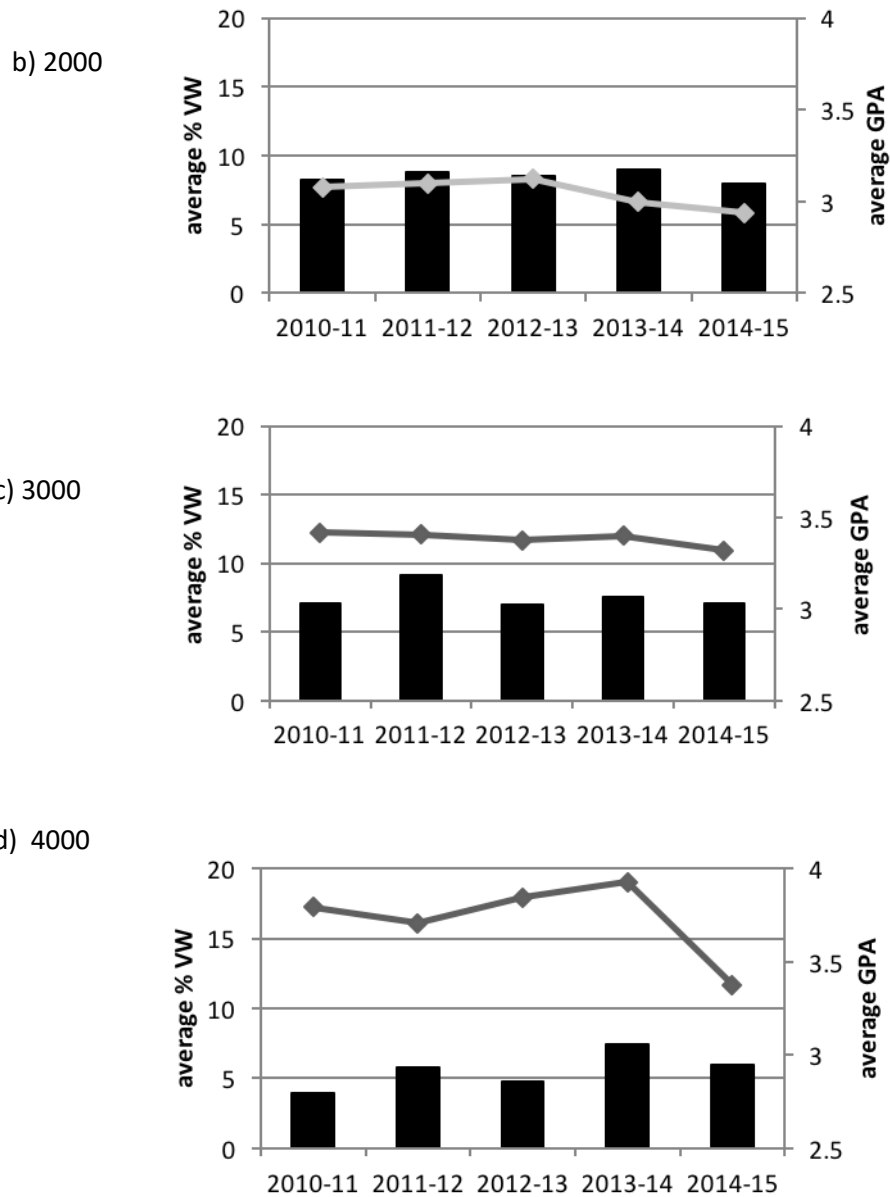


Figure 6: Graphs (a to d, above) show the average %VW rate (bars, left axis) and average GPA (line, right axis) in 1000-2000 level courses, for each year from 2010-2014.

Grade distributions by course, course level, or year – Figures 7-13

These graphs were extracted from data tabulated by the Office of Institutional Analysis, as made available during this program review, to illustrate information discussed in the report.

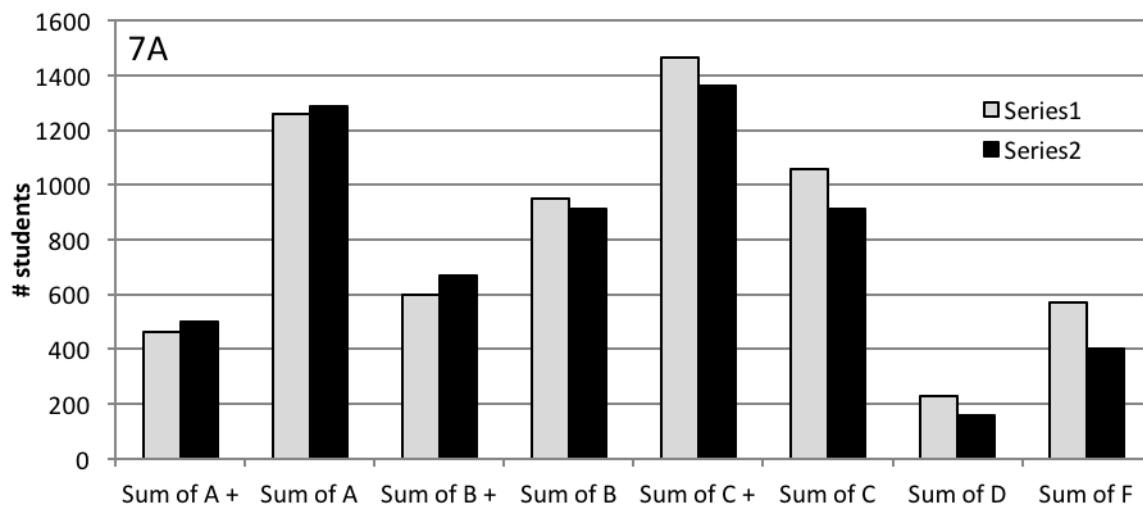
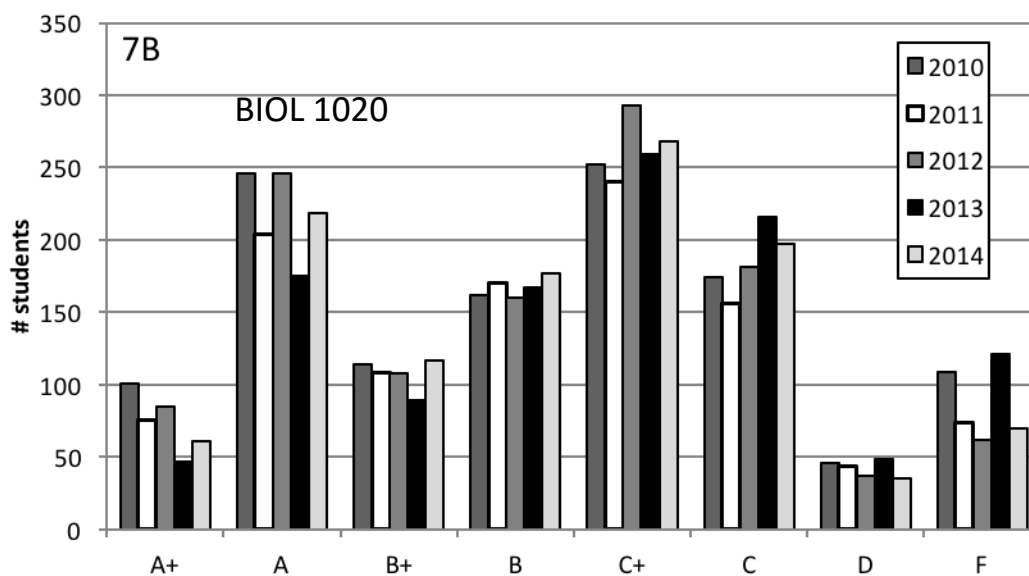


Figure 7: Figure 7A (above) shows the overall distribution of letter grades for BIOL 1020 (Series 1) and BIOL 1030 (Series 2) awarded from 2010-2014. Figure 7B (below) shows the letter-grade distribution for BIOL 1020, separated by year.



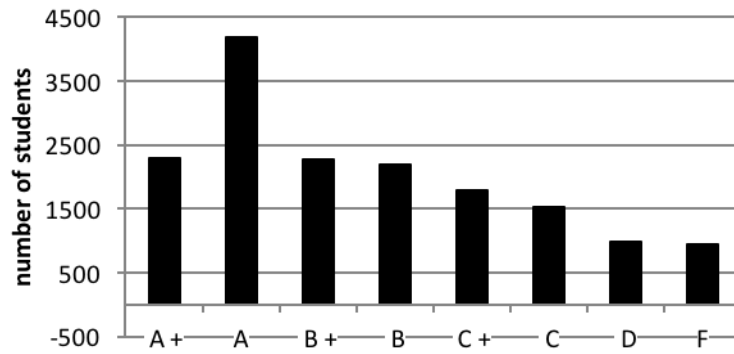


Figure 8: All grades awarded in second year courses 2010-2015

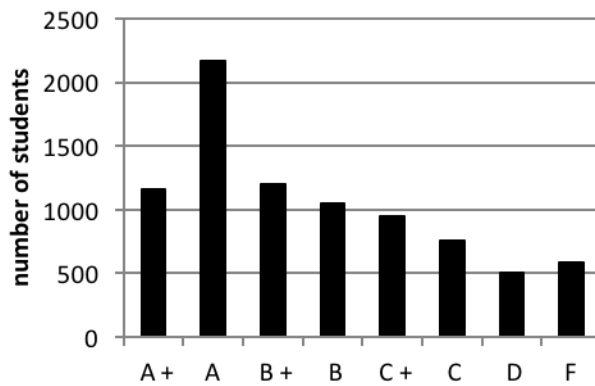
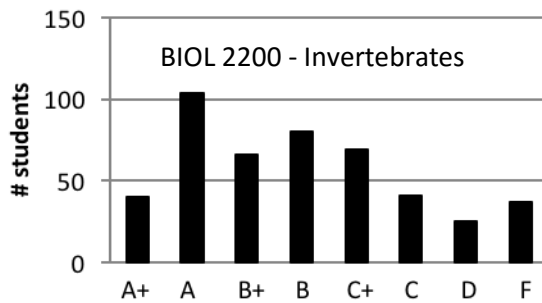
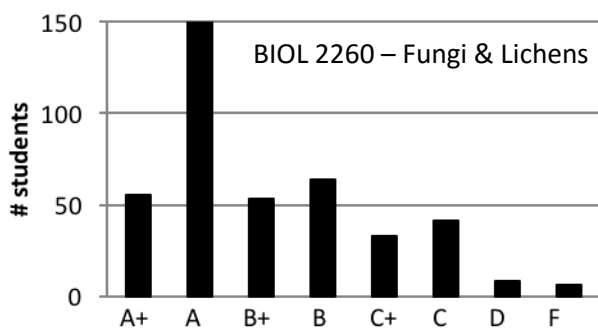
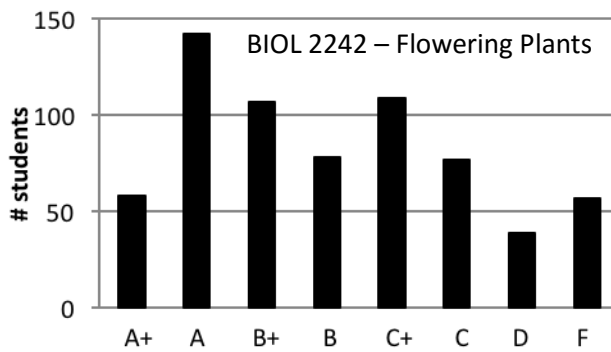
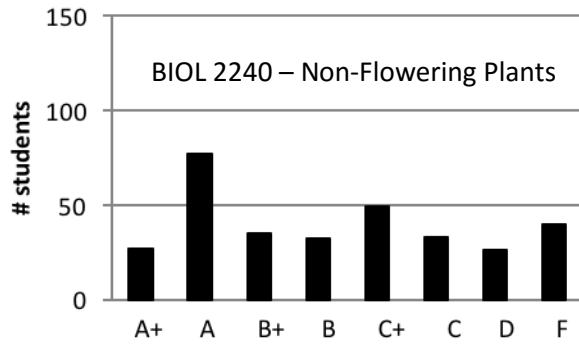
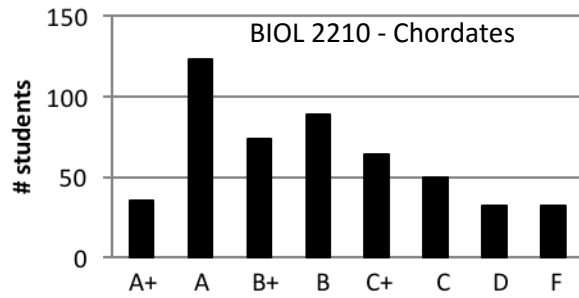


Figure 9: All grades awarded in Core Courses in second year, 2010-2015 (BIOL 2200, 2210, 2240, 2242, 2260, 2300, 2500, 2520).

Figure 10 (below and next 2 pages): Grade distributions in specific 2000-level courses from 2010-2015.





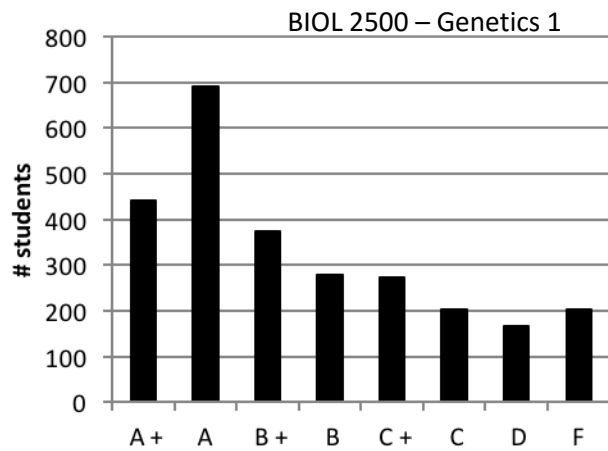
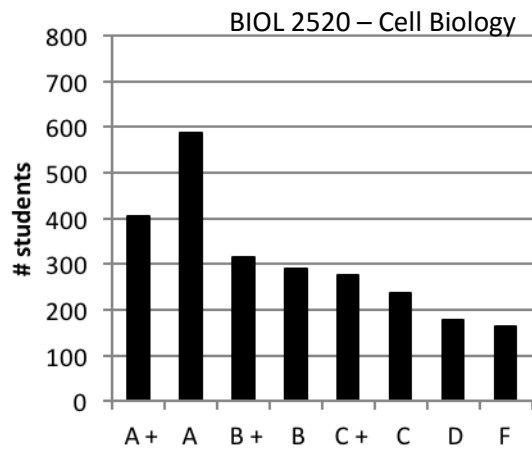
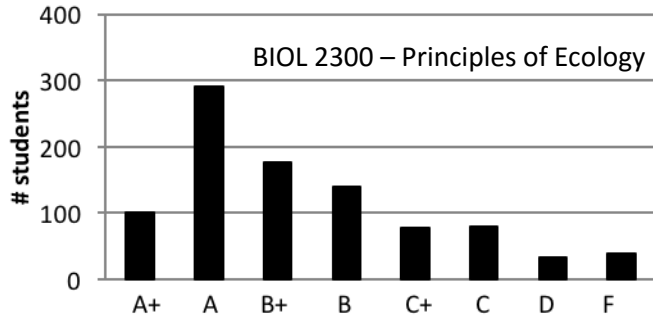


Figure 10: Grade distributions (above, and previous 2 pages) in specific 2000-level courses from 2010-2015.

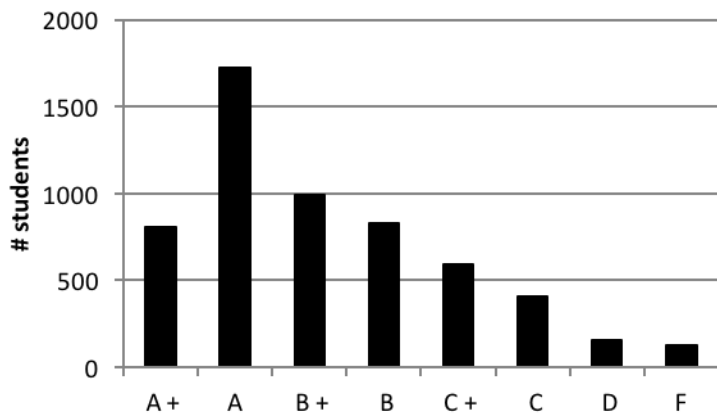


Figure 11: All grades awarded in third year courses 2010-2015

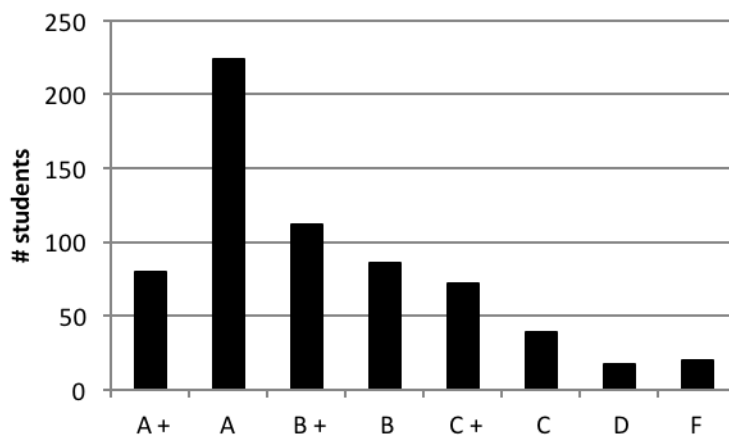


Figure 12. All grades awarded in BIOL 3100, 3300, 3400, 3470, 3472 in 2010-2015

■

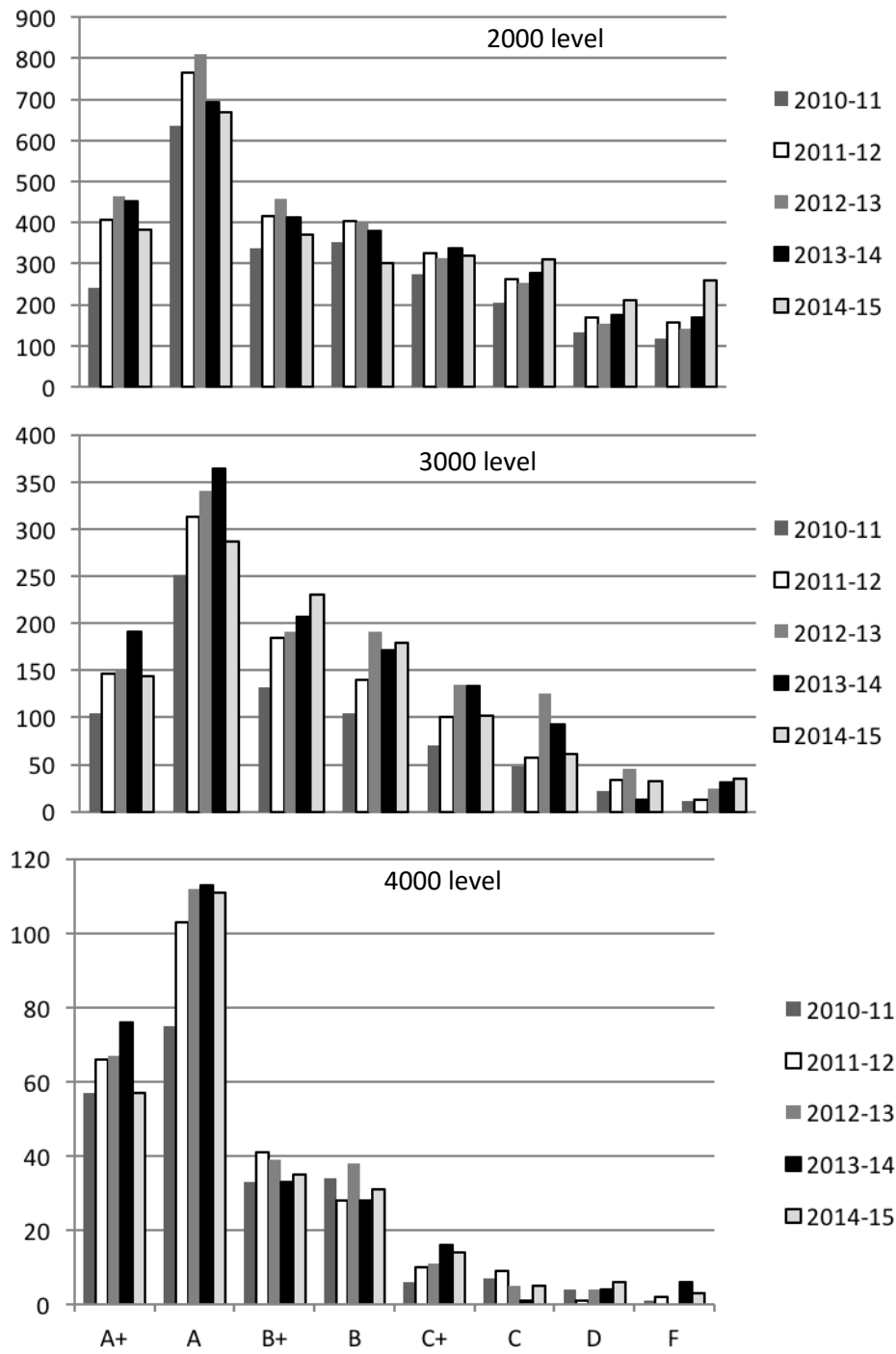


Figure 13. Graphs above show very minor year-to-year variation in letter grades awarded in 2000-, 3000-, and 4000-level courses.

BSc GENERAL – Program Structure

Objectives of the BSc General program

The BSc General degree is designed to provide diversified training in science while allowing students with a diverse range of background and preparation to express their interest in one or more areas of study in Science, by distributing the CH-requirement across departments.

The objective is to provide a well-rounded, general knowledge of science that prepares students for the job market or for a transition to a professional school, an external college or training program, or a 4-year degree program. The 3-year BSc General program allows students to be multidisciplinary because of the requirement for two areas of focus in the BSc General degree. Alternatively, they can complete the program with more strength (a “focus” or an Option) in Biological Sciences. The 3-year program provides students with a foundation of knowledge and a basic set of skills.

This program is administered directly by the Faculty of Science, and has about 3000 students registered. Students can elect to take a very general BSc degree, which is Option A (including a CH requirement spread across the departments in the Faculty of Science and a modest focus in the Life Sciences), or focus more on Biological Sciences courses, which is Option B. Of the 3000 registered students, about 50-60 students are registered in a “Life Sciences - Option A.” The Department notes that the Biological Sciences focus (Option B) is not really identified prominently as a program *per se*, and is not commonly taken (only 3 students graduated last year with a Biological Sciences focus, “Option B”).

Areas of speciality or novelty of the BSc General program

The novelty of this program is its flexibility in offering Option A and Option B (with a stronger Biological Sciences focus), although very few do Option B.

Strengths

The program allows students to rapidly achieve the qualifications needed for entry to a professional program that requires a Bachelor’s degree and a minimum of 6 CH of Biochemistry plus 18 CH of arts/humanities, such as required for application to medical school at the University of Manitoba. There is therefore, considerable demand for the program.

Option B of the program (with a Biological Sciences focus) allows students to complete the degree with appropriate minimum courses required for entry to medical school. The ability to apply to medical school after a 3-year degree (rather than completing a 4-year degree) provides a fast-track into the professional school at the University of Manitoba.

The 3-year program also lets students enter the work force rapidly with a degree after only 3 years of post-secondary education, or to switch to another career sooner than if they took a 4-year degree. Some students have completed this program and entered other programs at the University of Manitoba or at an external technical school, such as Red River College.

The 3-year BSc General program gives students opportunity to transition into the University of Manitoba from another institution or to change their career aspirations after a few years of experience on campus (learning what they enjoy or where they excel), to switch to a 4-year program in the sciences without losing credits obtained by having taken a more diverse, 3-year BSc General program.

Since Option A has a very broad focus, if students cannot get into their desired program at the end of third year, they can continue into a 4-year BSc Majors program in Biological Sciences.

Weaknesses or challenges

The BSc General program graduates students with a degree that is not differentiated by its credential name, “Bachelor’s degree,” from a 4-year BSc Majors degree. This may be confusing for some students, and for some employers who expect a particular level of skills and academic knowledge that is typically achieved in a 4-year, BSc Majors program. For many years, the BSc General degree was the “default” program in which students registered on the online system (Aurora Student) at the time they first enrolled in University-1 at the University of Manitoba. Only recently is there more overt guidance online (and by academic advisors) toward a 4-year BSc program as the default recommended to students.

The opportunity to transition from a 3-year to a 4-year degree program is not well explained for students in the Academic Calendar. A more structured listing of courses and a footnote indicating that STAT 1000 is a co-requisite or a prerequisite for one of the required courses in the Majors program in Biological Sciences (BIOL 2300) would be useful. This would help students make the transition to the Majors program without losing a year. As well, it would be helpful to identify the pathways into different 4-year-degree options (e.g., theme requirements) to better inform students planning a possible transition.

We have not articulated very well, the skills that students will acquire in this BSc General degree, as distinguished from the 4-year BSc Major degree. It would be useful for students to know they can acquire more skills, and more useful skills by the end of their third year if they take courses at the 3000 level, rather than confining their course load to the list of second-year courses that they typically take.

The students registered in the BSc General vary widely in their academic preparation and performance, since the cohort includes excellent students with high-level career aspirations and high-level academic preparation and also students who are weaker academically or much less-prepared for post-secondary education. The latter group may still be finding out if they like university or not, and in some cases may be the first in their family to attend university. In that sense, the program is “catch-all” which brings some advantage and also challenges. For instance, many students enrol in the BSc General program quite deliberately as they have their eyes fixed firmly on the goal of entering a professional program such as medicine. The advantage to these strong students is that the program can be a “fast track” to medical school, if their application is successful. However, some of those strong students often do not have an effective “plan B” to implement if they are not accepted to medical school. This brings a challenging disadvantage to even the strong students, as the 3 years of the BSc General program give them less exposure to science at an advanced level (they are required to take only 6 CH of courses at the 3000 or 4000 level), and typically get the advantage of advanced courses in biological sciences topics than would occur in a BSc Major (4-year) program. Faculty would prefer students take a 4-year BSc program; information on the BSc General program that students glean from the calendar and discussions with advisors, does not effectively guide them into other options or “non-professional” opportunities in the case (quite common) they are not successful in their often repeated attempts to enter medical school.

As well, the many thousands of students in the program all require advice, which comes largely from advisors at University-1, at least in their first year when planning decisions are being made. This leads to students in the BSc General program having only a vague idea of what the degree entails and offers, as they don’t feel a part of the Department and don’t find the support of an academic “home.” Therefore, the opportunity to take a rapid BSc General program can be considered a strength for the institution, while getting advice on courses and programming may not be timely enough. Students really do need timely advice to help them make a smooth transition into a 4-year BSc program without having to catch-

up on the pre-requisites needed for courses in a 4-year Majors program, or even to complete the 3-year degree within 3-4 years.

We note that any changes in the BSc General program (e.g., adding a more advanced course as a requirement so students understand, for example, the principles of evolution, or any other course as an additional requirement) would to some extent, be driven by the admission requirements in other programs (e.g., medicine), which may change from time to time.

Admission requirements to the BSc General program

The BSc General program with a focus in Biological Sciences became effective in September 2009 after the merging of the Departments of Botany and Zoology and the Biology teaching unit. It does not have a program code and therefore is not considered a separate degree by the Student Information System (AURORA Student). However, it is considered a “program” for the purpose of this report. Other programs for a BSc Major in each theme in Biological Sciences, are associated with program codes in AURORA.

The requirements for admission and progression through the BSc General (Option A or B) are similar to those for the broader BSc General program in Science except the selection of courses is somewhat more prescribed so students will follow a path through Biological Sciences rather than through Science.

Program Chart

GENERAL DEGREE (90 credit hours)	
BIOL 1020 , BIOL 1030	<p>OPTION A: 18 credit hours of 2000, 3000, and (or) 4000 level Biological Sciences courses (subject to the Faculty requirement that of the 36 credit hours in the two advanced level Science areas, at least 6 credit hours must be at the 3000/4000 level);</p> <p>Or</p> <p>OPTION B: Students may choose all 36 credit hours of advanced level courses from the Department of Biological Sciences as long as courses are selected following the provisions outlined below: Each of BIOL 2300, BIOL 2500, BIOL 2520; one of BIOL 2200 or BIOL 2210; one of BIOL 2240, BIOL 2242 or BIOL 2260; plus 21 additional credit hours from the Biological Sciences including at least 6 credit hours at the 3000 or 4000 level⁵.</p>
MINOR	
BIOL 1020 and BIOL 1030	12 credit hours from 2000, 3000, and/or 4000 level Biology courses.

NOTES:

- [MATH 1510](#), [MATH 1520](#), or [MATH 1690](#) may be taken in place of [MATH 1500](#); [MATH 1310](#) may be taken in place of [MATH 1300](#).
- IMPORTANT: The programs need not be completed in the manner prescribed in the chart above. The charts indicate one possible arrangement of the 120 credit hours that make up the degree and are meant to be a guide around which students can plan their programs with a view to satisfying the prerequisites of the required courses. These 120 credit hours are a combination of the courses outlined in the charts above and elective courses chosen by the student in consultation with the program advisors.
- For the Integrative Biology Theme only, a maximum of 15 credit hours of 2000 level Microbiology and Biological Sciences courses may be used towards the 30 hours of 3000/4000 level requirements.
- Courses from other departments or faculties may be acceptable for use towards the 30 credit hours of 3000/4000 level Biological Sciences courses required in the Honours and Major Degree programs. Please consult with the Department for permission to use alternate courses.

5. Students should confirm the new regulations of the BSc General Degree with a Faculty of Science Student Advisor if they wish to choose 36 hours of advanced level study from the Department of Biological Sciences.
6. [BIOL 3100](#) is a required course in the Biological Sciences Major Co-op programs. (The number 6 in brackets indicates a 6 credit hour course.)

To be admitted to this program students must meet the requirements as outlined in the 2015 – 2016 Academic Calendar (pages 630-631 and 634-635). To summarize, students may be admitted through a Direct Entry route or by transiting from University 1. Admission through the Direct Entry route requires that students have a Manitoba high school graduation with five credits at the grade 12 level, a minimum of 85% average (with no less than 60% in each course) over English, Pre-calculus or applied Mathematics, and one of Biology, Chemistry, Computer Science, or Physics (at appropriate levels). Admission by transiting from University 1 requires that students have completed a minimum of 24 CH of courses, a minimum cumulative grade point average (GPA) of 2.00, and have not exceeded 36 CH of F grades. Students may also enter the BSc General program by transferring from another institution or as second-degree students with the same academic requirements as for those transiting from University 1. Mature students may also be admitted to the BSc General program. It may be useful to consider whether we could publicize this as a better opportunity for mature students who may be interested in expanding their general knowledge of science.

The Program Chart shows progression for students registering in courses for this program includes BIOL 1020, BIOL 1030, BIOL 2300, BIOL 2500, and BIOL 2520, and STAT1000 (if a student takes Principles of Ecology, BIOL 2300, which is not required for Option A).

Course requirements – required and elective

The Biological Sciences General 3-year degree is comprised of a broad selection of courses from the Department with 36 CHs of advanced level courses and a total of 90 CHs (equivalent to 30 courses) to be taken over three years. The two introductory Biology courses (BIOL 1020 and BIOL 1030) are required in the first year and serve as prerequisites for program level courses in the Department. After successfully completing these two courses, students may choose from two options A and B (page 648, Academic Calendar). Option A requires “18 CH of 2000, 3000, and/or 4000 level Biological Science courses (subject to the Faculty requirement that of the 36 CHs in the two chosen advanced level Science areas, at least 6 CHs must be at the 3000/4000 level).” For option A, at least 18 CH of advanced level courses must also be taken from another department. Option B requires “36 CHs from the Biological Sciences provided they select the following courses: each of BIOL 2300, BIOL 2500, BIOL 2520; one of BIOL 2200 or BIOL 2210; one of BIOL 2240, BIOL 2242, or BIOL 2260; plus 21 additional CHs (2000 level or higher) from the Department of Biological Sciences, including at least a minimum of 6 CHs at the 3000 or 4000 level”. A worksheet for guidance is provided below, and at the website (http://umanitoba.ca/faculties/science/resources/2013_FALL_TERM_BIOL_Gen_degree_focus.pdf).

Option A is more flexible than option B and provides a path for the completion of a three-year program should students have their goals set on a very general credential. Option B provides a more structured path for students who have their goals set on application to a professional school but will also satisfy a general credential. This option provides the prerequisite courses needed for application to professional schools but the selection of courses will also allow the students to complete a four-year degree in 4 years if they choose to transfer to a four-year program in the Department midway through their path in the BSc General program. After completing these core courses and 36 CH from either option, students may choose elective courses from within the Biological Sciences or from other departments. Both

Options (A and B) give students the opportunity to transfer to the Major or Honours programs offered by the Department.

Evaluation procedures for the BSc General program

Evaluation procedures for admission to the Biological Sciences General 3-year degree resides with AURORA where the prerequisite, the grade, the number of F grades accumulated, the GPA, and other academic requirements are automatically tracked. If students do not meet the requirements, AURORA will not permit their admission to any Faculty or to a specific course or program. If student grades fall below that required or other requirements are not met, AURORA will send a message to the student that they cannot register and must check with their Faculty office. The admission, continuation and graduation requirements of the programs are also tracked by the Faculty of Science office.

Evaluation requirements for the General degree are mainly based on number of F grades accumulated. Students with more than 36 CH of F grades will be placed on academic suspension for one year. After one year the student may choose from two further options, either to continue with no possibility of further "F" grades (in which case any further "F" grades result in academic suspension for 2 years) or to start afresh, with their previous work not counting toward degree requirements. Students may appeal to transfer up to 30 CHs of coursework previously completed with a grade of "C" or better. (In either case this does not mean that the previous coursework will be removed from the student history or transcript.) This requirement is the same for all programs in the Faculty of Science. In order to graduate with a BSc General degree a student must have an average GPA of 2.00 on the 90 CH that comprise the degree. The residence requirements for the BSc General program require that the student take at least 48 CHs at the University of Manitoba or at least the final 30 CHs at the University of Manitoba.

Thesis, practicum or comprehensive procedures and regulations

The BSc General program does not have a thesis, practicum or comprehensive option.

Transferability of course credits from post-secondary institutions

Transferability of course credits is examined on a course by course basis by the Associate Head (Undergraduate, and Chair of UGCC), often in consultation with course instructor, to determine whether the course can be a direct equivalent of an existing course or if unallocated credit will be given at the University of Manitoba, based on the course outlines provided by the student making the request for transfer credit. Requests are considered on an on-going basis and are usually determined within a few days of receipt. Requests are made by students through the Admissions Office at the University of Manitoba and are sent to the Faculty of Science office, and then to the Department. After a decision on each course, the course-credit transfer form is completed and signed by the Associate Head, and returned to the Faculty of Science office.

Current ideas for program change

The Department is considering the following ideas as a result of our discussions during this self-evaluation process, and will welcome suggestions and further discussion during the review:

1. making the progression and sequence of course requirements more overt, with a flow chart online, and in 2000-level courses to highlight program progression, so students can more effectively plan how to make a transition (with recommendations for course completion),

2. taking out Option A, which is very diffuse (36 CHs of BIOL), as it is more of a dis-service than a service toward students. Only one other Department, Chemistry, has a focus, and it is more proscribed (and more students complete it) than the Biological Sciences focus, Option B,
3. putting the BSc General program on our website, so students can find information about it, even though the program is administered by Faculty of Science,
4. considering whether to add a course such as an introduction to evolution to the requirements for the Biological Sciences focus, as evolution underpins biology,
5. developing a “skill tracker” for this program, so students at least can develop a basic list of the skills they acquire/learn in lab-based and field-based courses; this would help students market themselves (e.g., if they don’t want or can’t get into a professional program), and
6. changing the program (e.g., adding any course requirements) if/when admission requirements change for other programs (e.g., medicine).

B.Sc. General – 3 Year Degree Biological Sciences - Faculty of Science

NAME _____ **STUDENT NUMBER** _____

As of 2009	COURSE	HRS	GRD	CK	FAILURES (36 credit hours maximum)		
INTRODUCTORY SCIENCE COURSES 24 Credit Hours as listed	BIOL 1020						
	BIOL 1030						
ADVANCED LEVEL BIOLOGY COURSES 36 Credit Hours of 2000 / 3000 level BIOL with at least 6 hrs from the 3000- 4000 level	2300						
	2500						
	2520						
	2200 or 2210						
	2240 or 2242 or 2260						
OTHER FACULTY COURSES Min. 12 Cr. Hrs. of 6 cr must be Arts					COMMENTS:		
ELECTIVE COURSES 18 credit hours					DATE	INITS	COMMENTS
	90 Hours						

In the event of a discrepancy between this worksheet and the General Calendar, the General Calendar shall prevail.

UNDERGRADUATE STUDENT BODY

Total enrollment in our undergraduate Majors and Honours programs is relatively stable, with an increase in Co-op enrollment in the last few years (see Figures 1 and 2 above). With our current allocation of resources, we probably cannot accept a larger enrollment and don't necessarily think we should. A large proportion of student enrollment in our second-year courses, perhaps owing to students taking less than a 15-CH course load and being in second-year courses in their third and fourth years of university, and/or a result of student indecision in selecting a Major.

Enrollment in the Physiology theme specialization in the BSc Major is lowest while enrollment in the non-specialized "general BSc Major" (confusing designation) is highest although showing a decrease from 2011 to 2015 (see Figure 3, above). This may arise from increased awareness of the value of specializing in a particular theme, or the rise of the cohort of students who enter directly into Science (with high school average > 85%). Interestingly, although enrollment is relatively stable, the number of students who graduate from Biological Sciences undergraduate programs increased from 2010 to 2014. Several cohort years have more female than male students in the enrollment roster (see Figure 4, above). This appears to account for the higher number of graduates in those years. It is not known if these changes are congruent with the male-to-female ratio at University-1 or at the time of entry to the Faculty of Science.

The average GPA of graduating students has been stable and fairly high from 2010 to 2014, presumably owing to consistency in course expectations, the delivery of courses primarily by full-time faculty, well-developed course syllabi, a strong teaching cohort in the Department, and consistent evaluation from year to year.

Undergraduate Student Body and Enrollment Trends – Table 2

Table 2: Undergraduate Student Body and Enrollment Trends

(Control click on the above hyperlink to view table 2)

Enrollment Trends in Undergraduate Programs

See Table 2 above and Table 3 and 4 below.

There was a jump in overall enrollment between 2010 and 2011, and numbers have subsequently stabilized. In 2010, students were relatively evenly distributed among years. More recently there has been a marked increase in students classified as 3rd and 4th year, whereas numbers in second year have remained more stable. This could reflect either a delay in completion of programs or a relative decrease in recruitment. Information on time-to-completion and overall numbers in Faculty of Science and first-year programs as a whole would help to distinguish between these possibilities.

Co-op students comprise about 10% of declared Biological Sciences students (BSc Majors, Honours, and General programs); slightly more than 10% of all Honours students are registered in the Co-op option, although this latter group is small in absolute numbers. There was a jump in Co-op enrollment in 2012, followed by a more gradual rise. Co-op enrollment is likely influenced by the availability of positions. The number of Co-op positions available in federal government agencies including laboratories, decreased about 15% in the last 3-4 years, according to the Co-op program director in the Faculty of Science. However, the placement rate for students from Faculty of Science is 90-95% (100% placement for students to work in co-op fieldwork positions).

The Co-op experience is valuable in that it gives students practical work experience and develops workplace contacts by direct exposure in the work force. It also helps them see the relevance of their course material. A potential drawback of the Co-op and especially Honours Co-op programs is that students will have their graduation delayed by at least a year. This delay may be further increased by part-time work, which is a reality for most students, based on anecdotal information, and feedback from our survey of students (see section on Student Success, above). Co-op students may have less than the usual level of financial need during undergraduate study, as they have 3 work terms in which they earn a salary. However, they also have an extra year before graduating, with respective tuition and service fees to pay, so their overall financial situation is not clear.

Approximately 25% of all Majors students enroll in the Honours program and approximately 2/3 of these students complete the Honours thesis course and graduate with a BSc Honours. The level of enrollment in our Honours program indicates that many of our top students are interested in participating in research.

As presented earlier in this report, the Honours program is a major strength of our Department, and a source of pride, particularly given the achievements of our Honours students in conference presentations, success in receiving scholarships and awards, and publications in the peer-reviewed literature. The Honours Thesis course is very rigorous in having a structure similar to a “mini-Master’s” program; it therefore, allows students to determine whether research is something that appeals to them before they commit to entering graduate school. Success in the program makes these students very competitive for post-graduate scholarships and very attractive to potential graduate supervisors at U of M and elsewhere. Presumably, our Honours graduates are better prepared than the average student graduating with a BSc degree, to directly enter a PhD program or transition into one from a Master’s program. There are many strengths of our Honours program and it confers a range of excellent opportunities and achievements on our graduates for real engagement in research and discovery. This is far more of an opportunity than simply letting students “try out research”, and we are very pleased to provide considerable resources to preparing students for the Honours program (e.g., through BIOL 3100, advice, research opportunities, scholarships, and mentorship) and then supporting their progression through the Honours Thesis Course (BIOL 4100) with thesis completion, presentation, and defence.

Undergraduate Programs in Biological Sciences, Progression & Majors – Table 3

[Table 3: Undergraduate Programs in Biological Sciences, Program Progression and Major Declaration for the past 5 years.](#)

(Control click on the above hyperlink to view table 3)

Table 4 below (and Figure 4 above), summarizes the graduate count from undergraduate programs in the Department of Biological Sciences (and those from previous Departments of Zoology and Botany up until 2012).

Major trends in the graduate count include a large increase in the total number of BSc graduates from 36 to 59 (a 64% increase), and a corresponding increase in declared Majors since 2010. This is considered due to the launch of new undergraduate programs in 2009, although that first year was immediately following the Duff Roblin fire, which very likely affected the ability of the Department to recruit Majors and Honours students for a Fall-2009 start date (given the huge disruption from March to September that year).

While programs in Botany and Zoology were previously successful, perhaps the integrated programs in Biological Sciences provided a larger and more diverse critical mass. The renewed attention brought to the design of new undergraduate programs in Biological Sciences may have made the programs more attractive to students. There were also 4 or 5 new faculty recruited at the rank of Assistant Professor, just prior to and following the merger into Biological Science. Those individuals added new levels of research funding and augmented the number of attractive opportunities for undergraduate research training in their programs in the Department. That, too, may have helped boost the number of graduates from the program over the years.

The female-to-male ratio of graduating students increased to 2:1 in 2014. In addition, the number of indigenous students graduating increased from 1 in 2011 to 6 in 2014. Finally, students graduating from Biological Sciences undergraduate programs tend to have a strong average GPA of 3.38, and a GPA of 3.86 for those graduating with an Honours distinction. Although we don't have data on the median GPA for each cohort, the average GPAs presumably mean that more than half of the Majors and Honours students were eligible for entry, and attractive for as potential recruits to a graduate program.

Undergraduate Programs, Graduation Count for past 5 years – Table 4

		Total Number of Grads	Student Demographics*			Graduation GPA				
			Female	Male	Self-Declared Indigenous	Avg. GPA	Min GPA	Max GPA		
2010	B.Sc.(Maj.)	1	0	1	1	XX	XX	XX		
	B.Sc.(Maj.) Co-op	0	0	0		XX	XX	XX		
	B.Sc.(Hons.)	1	0	1		3.53	2.98	4.00		
	B.Sc.(Hons.) Co-op	0	0	0		XX	XX	XX		
	B.Sc.(Maj.) - Biology	7	6	1		XX	XX	XX		
	B.Sc.(Maj.) - Botany	2	0	2		XX	XX	XX		
	B.Sc.(Hons.) - Botany	1	0	1		3.20	2.29	4.07		
	B.Sc.(Maj.) Co-op - Ecology	1	1	0		3.75	3.28	4.37		
	B.Sc.(Hons.) - Ecology	1	1	0		1	3.43	2.20	4.37	
	B.Sc.(Maj.) - Zoology	8	6	2			3.33	2.38	4.36	
	B.Sc.(Maj.) Co-op - Zoology	6	3	3			4.06	3.76	4.37	
	B.Sc.(Hons.) - Zoology	7	5	2			3.71	2.77	4.40	
	B.Sc.(Hons.) Co-op - Zool.	1	1	0			XX	XX	XX	
Total	36	23	13	4	3.42		2.38	4.40		
2011	B.Sc.(Maj.)	18	13	5	4		3.39	2.64	4.05	
	B.Sc.(Maj.) Co-op	0	0	0			3.95	3.42	4.43	
	B.Sc.(Hons.)	3	3	0			XX	XX	XX	
	B.Sc.(Hons.) Co-op	0	0	0			3.31	2.76	3.64	
	B.Sc.(Maj.) - Biology	6	5	1			2	3.52	2.64	4.43
	B.Sc.(Maj.) - Botany	2	1	1				3.38	2.26	4.45
	B.Sc.(Maj.) - Zoology	6	5	1				3.83	3.32	4.23
	B.Sc.(Maj.) Co-op - Zoology	1	1	0		3.49		2.26	4.45	
	B.Sc.(Hons.) - Zoology	4	3	1		3.35		2.01	4.18	
Total	40	31	9	4	3.48	2.01		4.22		
2012	B.Sc.(Maj.)	23	17	6	2	3.35		2.01	4.18	
	B.Sc.(Maj.) Co-op	2	2	0		3.86		3.48	4.22	
	B.Sc.(Hons.)	8	4	4		6		3.48	2.01	4.22
	B.Sc.(Hons.) Co-op	1	1	0						
	B.Sc.(Hons.) - Ecology	1	1	0						
	B.Sc.(Maj.) - Zoology	2	2	0						
	B.Sc.(Maj.) Co-op - Zoology	2	2	0						
Total	39	29	10	2						
2013	B.Sc.(Maj.)**	38	20	18	4		3.49			
	B.Sc.(Maj.) Co-op	4	2	2						
	B.Sc.(Hons.)	12	6	6						
	B.Sc.(Hons.) Co-op	1	0	1						
Total	55	28	27	4						
2014	B.Sc.(Maj.)	41	26	15	6	3.48	2.01	4.22		
	B.Sc.(Maj.) Co-op	3	3	0						
	B.Sc.(Hons.)	13	9	4						
	B.Sc.(Hons.) Co-op	2	2	0						
	Total	59	40	19					6	

*Given the possibility of change in status during a program, international student counts are not provided at time of graduation.

** Graduation counts include students graduating with a double major.

XX GPA's for counts of 2 or less have been redacted to protect the privacy of the individuals but have been included in the total weighted averages.

- Sources: 1. Undergraduate Degrees, Diplomas, Certificates Conferred by Faculty/School, Degree, Program/Major and Gender http://umanitoba.ca/admin/oia/program_reviews/2064.html
 2. Self-declared Indigenous Graduation Counts, Biological Sciences OIA, September 30, 2015
 3. Graduation GPA's, Majors in Biological Sciences OIA, September 30, 2015

Major undergraduate student awards, Honours, and publications in the past 5 years

The Department is fortunate in attracting a strong body of undergraduate students interested in research experiences, as shown by the high proportion of students who succeed in garnering very competitive summer research awards from NSERC (23%), the Faculty of Science (15%), the Vice-President Research (5%), and major awards from other sources (7%).

For undergraduate students (25 respondent faculty out of 32 possible; tally of 354 undergraduate students):

- 23% - percentage of undergraduate students receiving an NSERC-USRA
- 5% - percentage of undergraduate students receiving a Vice-President (Research) Research Award
- 15% - percentage of undergraduate students receiving a Faculty of Science USRA
- 7% - percentage of undergraduate students receiving another major award

- 20% - percentage of undergraduate students over the past 5 years with 1 publication
- 36% - percentage of undergraduate students over the past 5 years with ≥ 1 conference presentation
- 8% - percentage of undergraduate students over the past 5 years with more than 1 publication

The Department is particularly proud of the success of those undergraduate students who do research in our programs. This is especially demonstrated by the high proportion of the undergraduates we advise or supervise, who become authors on our publications (28%) and who are able to present their work at national and international conferences (36%). It was interesting to compile these data, as we had not previously tracked this type of information at the level of the Department, as it typically resides (with no less “place of pride”) in the CV (or CCV) of individual faculty of the Department. These publications and conference presentations are from undergraduate student contributions to research during summer experiences and/or Honours thesis projects.

Undergraduate Course Offerings – Table 5

Detailed course outlines for courses offered in the past 5 years are provided in Appendix 12.

Many courses were taken off the list of course offerings during our planning of the Biological Sciences programs (2008-2009) to reduce duplication. Others have been modified since 2009, as faculty made revisions in their teaching by redirecting the emphasis or changing pre-requisites in a course, or theme groups reshaped the core courses for a specialization. Still other changes were made as the Department captured the enjoyable addition of expertise during the ongoing renewal of faculty.

The 2 main courses that have not been offered in the last 5 years are:

- Human Reproductive Physiology, BIOL 2440
- Biology of Amphibians and Reptiles, BIOL 4214

These 2 courses were kept active, since we know there is ongoing interest in the subject areas, and it because it is easier to revise a course than to introduce a new course. There is still interest in reproductive physiology, which recently was strongly renewed with the proposal for another midwifery program (the basis of the original course proposal in 2004-05). Currently we have a Sessional Instructor

developing the course, on funds from the Faculty of Nursing (pending approval of the midwifery program by the Province). As well, the Department wished to retain the course on Amphibians and Reptiles following retirement of a senior faculty member with herpetology expertise, as the topic area is important to biology. Only our recent recruitment has provided new opportunity to consider changing teaching assignments, so as to allow our current faculty the time to teach the course.

[Table 5: Undergraduate Course Offerings](#)

(Control click on the above hyperlink to view table 5)

Note that Table 5 should be viewed in the context of the physical capacity of lecture theatres and teaching-lab spaces (see a sample of reports that can be generated on section enrollment vs. caps, in Appendix 13).

First-year courses

- Enrollment trends are healthy; a few courses increased in enrollment, notably BIOL 1410, in part due to our adding more lecture sections (starting in 2009) and our move into BSB (in 2012) which opened up teaching laboratories that were configured so 2 labs could be run concurrently.
- Sudden jumps or declines in enrollment can be explained by the addition or removal of sections, and offerings in more than one term to allow flexible scheduling options for students
- The level of attrition between BIOL 1020 and 1030 is stable, at around 25%. Some programs only require BIOL 1020 or students only need 3 CH of Science courses.
- The level of attrition between BIOL 1410 and 1412 is stable, at around 28%.
- The average rate of Voluntary Withdrawals from 1000-level courses has decreased in the past 5 years. This may be explained, at least in part, from the change of pre-requisites to register in BIOL 1020 (requiring a high school mathematics course), the use of “Mastering Biology” online tutorials in BIOL 1020 and 1030 (to help students stay on track with course content each week), and the implementation of a second (early) mid-term examination in BIOL 1410 (to give students early feedback on their performance, in time to allow a change in approach to learning).
- Demand for 1410 seems to have increased the most of any course we offered in the Department
- Distance-education offerings are stable or increasing marginally, although the Department recently started offering BIOL 2410/2420 (Human Physiology 1 and 2) by distance.
- A distance offering of BIOL 1410 and 1412 is under development.

Second-year courses

- Regular-session offerings appear very healthy in regard to enrollment.
- The average rate of Voluntary Withdrawals from 2000-level courses was stable over the past 5 years.
- Demand for summer sections tends to be increasing, even with concurrently offered distance/online and lecture/face-to-face formats for BIOL 2410 and 2420 in summer 2015.
- There is a good, even level of demand for all the organismal courses.

Third-year courses

- BIOL 3100 (Skills in Biological Sciences), the ‘Honours preparatory course’ shows increasing enrollment.
- There is an extraordinarily high enrollment in BIOL 3290 (Medicinal and Hallucinogenic Plants) compared to other third-year courses. This is partly due to the course being a popular topic.

However, the course also has modest pre-requisites, does not have a lab or any written assignments, and is examined by multiple-choice exams. These features make the course accessible to students outside Biological Sciences; it is capable of accommodating an even larger enrollment in that format (or possibly by distance offering, in the future). The course was also recently added to the list of Summer Session course offerings by the Department through Extended Education. In 2014, the course made the list as one of the "coolest classes in Canada" http://www.huffingtonpost.ca/2014/09/03/coolest-classes-canada_n_5755176.html

- There are healthy levels of enrollment in third-year courses, although enrollment is much more variable for than second-year courses.
- The rate of voluntary withdrawals from 3000-level courses is stable in the past 5 years.
- There is good variation in subject matter available for students interested in various biology topics.
- Enrollment in third-year ecology courses is increasing (re: BIOL 3310, 3312, 3314, and 3318)

Fourth-year courses

- The schedule of course availability is somewhat more variable compared to 2000- or 3000- level courses; a few courses alternate every second year, and others are not offered when faculty are on research-study leave.
- Special Topics courses all have low enrollment but the number of options in this course is increasing (often 5 or more sections of BIOL 4890 in each of the Fall and Winter terms). These courses allow students a chance to gain research experience and/or education on methods and approaches to specific areas of or interest in research.
- Need to discriminate between BIOL 4800 (Special Topics in Field Biology) and BIOL 4890 (Special Topics in Biology), one with a specific focus on field biology, whereas BIOL 4890 may include lab-based research or be purely based on literature reviews and synthesis, critical assessment of papers, etc. (i.e., research, but not necessarily hands-on).
- Both BIOL 4800 and BIOL 4890 courses give students a taste of research methods and approaches. Special topics courses have a strong research element.

The percentage of course drops via VW or AW declines steadily with the advance of program year; this likely reflects the progressive increase in the underlying maturity, GPA, and motivation of students. The drop rate is higher, however, when considered across all levels for Distance Education offerings than for courses offered in-person on campus. Presumably this reflects a greater commitment of students on campus, and the better opportunity for one-on-one interactions, face-to-face with a course instructor.

Undergraduate Grade Distributions, Summary – Table 6

[Table 6: Undergraduate Grade Distributions, Summary](#)

(Control click on the above hyperlink to view table 6)

Undergraduate Grade Distribution, Multi-Section Courses – Table 7

[Table 7: Undergraduate Grade Distribution, Multi Section Courses](#)

(Control click on the above hyperlink to view table 7 multiple tabs on excel sheet)

In reviewing Tables 6 and 7, the Department made the following observations on grade distributions (see also, Figures 7-13, above).

Grade distributions for introductory courses (1000 level) tend to be bimodal, with modes evident around grades of both “C” and “A”. This is likely attributable to the extensive variation among individual students in their background preparedness, maturity, and motivation. However, the modes at C and A may also suggest that A represents a typical well-prepared student and C represents a typical less-well-prepared student. The “A” grade is also such a broad category, so the distribution around it may be partly artefactual. Distributions shift toward higher grades as program year advances, which can be attributed not only to changes in maturity of students, but the filtering of weaker students from the program in their initial years, as many at the lower end of the grade distributions find other directions in life. There is no major disparity in grade distribution among sections that could be reliably attributed to any feature such as teaching effectiveness or instructor, given that enrollment into sections proceeds from the ‘favoured’ time slots toward less favoured/avoided slots (e.g., Monday am and Friday pm, 8:30 am and 4:30 pm).

That said, as is evident in Figure 13, there is a similar distribution of grades among years, and no apparent evidence of grade inflation over the 5-year period surveyed. There appears to be a compression of student grades into the A in senior courses, however, that again could reflect changes in maturity and attrition of weaker students. It may also indicate that instructors can devote more time to students in the smaller senior-level classes, where the weaknesses of individuals can more readily be identified, and assistance offered where necessary. However, again, A covers a big numerical range (80-89), roughly equivalent to B and B+ together (68-73 and 74-79) or C and C+ together (68-73 and 74-79). So, if we combine the B and B+ grades and C and C+ grades, the distribution of grades is not so “A-heavy”. Another contributing factor could be the higher prevalence of lab and workshop components that complement lecture material, with direct interaction with faculty members enriching the student learning experience.

The early attrition rate for students progressing from first-year to second year, for example, is expected to be fairly high, in part as admission standards to University of Manitoba into University 1 are fairly low compared, for instance, to Queen’s or University of Toronto (minimum entry grade to Science of 90%, and 75-88% respectively, according to Maclean’s rankings 2016 compared to no posted (available) minimum grade for entry to Science at the University of Manitoba, due to University-1 entry except for direct entry to Science at 85%)

For the period of 2010-2015, the number of CHs offered at the senior level (3000 and 4000) has increased, as the Department has grown and individual faculty offer advanced courses in their own area of specialization. This apparent trend should serve as a caution that some plateau must be reached so as not to overburden faculty with teaching at the expense of research. That said, the breadth of course offerings reflects the breadth of the biological sciences itself. This diversity is a strength in that it allows the Department to flexibly adapt to a changing societal landscape, seizing on opportunities to contribute, while maintaining a solid foundation that can be applied across sub-disciplines. As well, the student cohort in biological sciences has diverse interests (e.g., from ecology and fieldwork to cell, molecular and developmental biology). However, the range and types of expertise and interests by recent faculty recruits to the Department, the cross-cutting themes of research (for example, metabolism and ecosystem dynamics, parasitology, molecular-genetic approaches to pest control and fungal infection, developmental genetics), and the focus on genotype-phenotype interactions by the Industrial Research Chair in the Department, Dr. Gary Anderson, we anticipate that some of the traditional distinctions will be bridged as molecular biology and bioinformatics are integrated further through field-based sampling approaches to research.

There has also been a gradual but progressive increase over the 5 years, in student engagement in doing Co-op work terms (see also Table 3), which at its root may reflect the growing awareness of students that job-related skills obtained over the course of their degree will increase the likelihood of obtaining employment upon graduation. This may also reflect student need to obtain employment over the course of their degree program to meet their financial needs.

GRADUATE PROGRAMS – general overview

The graduate programs, the MSc of Biological Sciences and the PhD, are both governed by the Faculty of Graduate Studies for the administration of policy and procedures, and appeal procedures. The Supplemental Regulations of the Department are additional guidelines for program administration and expectations. The Graduate Studies Committee (GSC) of the Department acts on the authority of Department Council to oversee the admission and progress of students through the program, and to identify deficiencies and recommend improvements to the program. The GSC reports to Department Council according to its Terms of Reference (below). The Adjunct Professor Committee (Terms of Reference are also below) also contributes to the graduate program and the work, decisions, and recommendations of the GSC, and also reports directly to Department Council.

Graduate Studies Committee - GSC

The purpose of the Graduate Studies Committee is to support the Department's graduate program by coordinating on behalf of the Departmental Council, the entire program of graduate studies in the department, from student selection to graduation. This process is designed to facilitate the success of students enrolled and graduating from the department, and to maintain the standards of the programs of academic coursework and research conducted by graduate students.

The guiding principles of the committee are that members will act with fair and impartial judgment, decisions on reviews and recommendations will be reached in a timely manner, and information regarding applications and graduate student files will be maintained in strict confidence.

The GSC is composed of a Chair (voting only in the case of a tied vote), designated by the Head, who would be expected to have an active research program; four members of the academic staff (faculty) of the Department of Biological Sciences, elected by simple majority of the Biological Sciences academic staff, including Adjunct Professors attending Department Council; a member of the Adjunct Professors committee (typically the Chair); one graduate student representative or designate (selected or elected by the Biological Sciences Graduate Students Association); and the Department Head, *ex officio* (voting). One member of administrative staff in the department will be assigned by the head to support the business of the committee including record keeping, room booking, meeting minutes, student information, and will attend all meetings. At the meeting of Department Council where elections are held, activities of nominees will be discussed in relation to expected commitment by a member of the Graduate Studies Committee.

To facilitate communication between the Committee on Adjunct Professors (which supports the graduate studies program) and the Graduate Studies Committee, the minutes of GSC meetings can be made available to the Committee on Adjunct Professors for review in relevant cases.

The Chair of the committee will receive teaching relief in recognition of the responsibility, importance and workload associated with the role.

The graduate student member of the committee may be requested or request to be absent from discussion of graduate-student matters a sensitive or personal nature.

Appointments will typically be for three (3) years, renewable once. If an elected member becomes unavailable, the position will normally be filled by election at the next meeting of the Departmental Council.

Meetings of the GSC are typically held monthly during the academic year (fall and winter terms). Additional meetings regarding policy matters or the direction and needs of the graduate program may be called at the request of the Chair or Head, depending on issues or requirements which may arise outside the usual schedule. A meeting schedule will be developed (usually at the beginning of August) by the chair of the GSC in coordination with the member of administrative staff who is designated to support the Graduate Studies Committee and Program. Minutes of the meetings will be kept confidential to the committee.

The committee is responsible for considering aspects related to student selection and admission, advisory committees, thesis proposals, candidacy examinations, student performance and progress, as well as the need for review and recommendation for changes to the graduate program.

Members of the committee are collectively responsible for serving as a resource to supervisors, academic staff, and graduate students regarding the processes and regulations of the graduate program; conducting an evaluation of a new applicant's suitability for the graduate studies program within the Department of Biological Sciences; providing information to interested students on the requirements and expectations associated with the program in the department; and reviewing and discussing, once per year, the annual progress reports of all graduate students in the Graduate Studies Program in the Department of Biological Sciences, and evaluate the needs for particular attention. This review will be communicated to the Committee on Adjunct Professors via minutes of the GSC committee regarding review of progress reports of graduate students supervised by an Adjunct Professor. This process is to ensure that the quality of the program is maintained.

In addition members of the committee are responsible for providing academic staff (supervisors and members of the advisory committee) and graduate students with a copy of the current regulations of the Faculty of Graduate Studies and the supplemental regulations on Graduate Studies for the Department of Biological Sciences. Members also assist the member of administrative staff assigned to support the committee, with that work by providing input and information as requested, and review of minutes in a timely and respectful manner, and assist with oversight of file and record keeping on graduate students enrolled in the program and their progress through the program. Members are to coordinate with the website manager, to maintain currency and accuracy of posted information, and work in conjunction with the Scholarships and Awards Committee, to facilitate communication with department members and students regarding opportunities for funding of graduate student stipends, travel and or research.

Members of the GSC are also responsible for reviewing and making recommendations to Department Council on the graduate studies program and course offerings in the Department of Biological Sciences. One member, typically the Chair also represents the GSC at the Graduate Studies Committee at the Faculty of Science, and represents the Department at meetings of the Faculty of Graduate Studies Council.

In addition to the above responsibilities, the Chair is also responsible for representing the department at the Faculty of Graduate Studies Council, and reporting back to the Graduate Studies Committee on FGS decisions and deliberations; providing a brief oral report to Departmental Council regarding matters related to graduate student progress; providing a brief annual written report on Graduate Studies Program to Departmental Council (e.g., the number of students, progress, completion); overseeing record-keeping regarding the progress of each graduate student in the program, in coordination with the member of administrative staff assigned to support the program and the GSC; to serve as or designate a member of the GSC to serve on the Candidacy Examination committees of each PhD

student; and for working with the Head of the Department to address time-sensitive issues that may arise from the Faculty of Graduate Studies.

Adjunct Professor Committee

The purpose of the Department of Biological Sciences Adjunct Professor Program is to enhance the scientific expertise of the Department, provide specialized supervision of graduate students, and increase cooperation in research and teaching with other departments and institutions. The duties of an Adjunct Professor primarily involve graduate student supervision, but other duties may involve teaching (graduate and/or undergraduate) and service. Adjunct Professors are invited to the Department Council meetings as voting participants in matters relevant to graduate studies.

The Department's Adjunct Professor Committee supports the graduate programs by reviewing applications by scientists whose primary appointment is external to the Department and recommending to Departmental Council the granting or renewal of Adjunct status (or Provisional Adjunct status). The chair of the committee (Dr. Jim Roth) further supports the Department's graduate programs as a voting member of the Graduate Studies Committee, participating in annual reviews of the progress reports of graduate students who are supervised by an Adjunct Professor, and communicating with Adjunct Professors on departmental policies and procedures.

Adjunct Professors are appointed by the Faculty of Graduate Studies under its policy on Adjunct Professors, following a positive recommendation from the Adjunct Professor Committee and approval by the Department of Biological Sciences Department Council. Appointments are based on the qualifications of the applicant, and the requirements and philosophy of the Graduate Program in the Department of Biological Sciences. If an applicant has not yet identified a student for graduate study but otherwise meets the criteria for an Adjunct Professor appointment, Provisional Adjunct Professor status may be granted. This unofficial "pre-approval" is at the Department level only, and is intended to facilitate graduate student recruitment on the explicit understanding that full Adjunct Professor status and a Letter of Offer from the Department will be forthcoming once the student is accepted by the Department of Biological Sciences and the Faculty of Graduate Studies.

In cases where applicants for Adjunct appointment have little prior supervisory experience, the committee may recommend that the student be co-supervised by tenured/tenure-track staff member from the Department. This mentoring arrangement is primarily intended to familiarize first-time Adjunct Professors with formal University and Department- and program-specific procedures regarding graduate student supervision. In practice, this arrangement also fosters collaboration and familiarity between adjunct professors and academic staff in the Department.

Appointments of Adjunct Professors lapse at the end of the 3-year term of appointment, but the term may be renewed by the Department of Biological Sciences upon reapplication. Provisional status is granted for a maximum of two years. Currently our Department includes 15 adjunct professors whose primary appointment is elsewhere: six from Fisheries and Oceans Canada (housed at the Freshwater Institute, adjacent to campus), two from other governmental organizations (the Manitoba Museum and the United States of America Fish & Wildlife Service), five from other Canadian universities (Lakehead, Trent, Alberta, and Winnipeg), and two from private organizations (the Assiniboine Park Zoo and Ducks Unlimited). We also have two Provisional Adjunct Professors (from Brandon University and the Canadian Food Inspection Agency).

The Terms of Reference of the Adjunct Professor Committee are as follows.

The purpose of the Adjunct Professor Committee is to support the Department's graduate program by recommending to Departmental Council the granting or renewal of Adjunct status (or Provisional Adjunct status) to scientists external to the Department of Biological Sciences. This process is designed to broaden and/or strengthen the scientific expertise of the Department, enhance training opportunities for graduate students, and facilitate cooperation with other departments and institutions.

The guiding principles of the committee are that members will act with fair and impartial judgment, decisions on recommendations will be reached in a timely manner, and information regarding applications or current Adjunct faculty member's files will be maintained in strict confidence.

The Committee on Adjunct Professors is composed of 3 tenured or tenure-track academic staff from Biological Sciences, a voting Chair, and the Department Head, *ex officio* (voting). The Head will designate the Chair and one member of the committee, following the democratic election by simple majority of two faculty members by the Biological Sciences academic staff. Aside from the Head, at least one member of this committee must also sit on the Graduate Studies Committee to facilitate communication between these complementary committees regarding Adjunct Professors and their students. Appointments will typically be for three (3) years. If an elected member becomes unavailable, the position will normally be filled by election at the next meeting of the Departmental Council.

Meetings are typically called at the request of the Chair once a completed application for Adjunct status is received. Additional meetings regarding policy matters or the direction and needs of the graduate program may also be called at the request of the Chair, Head, or two committee members. Advance notice for meetings will typically be two weeks; however, this interval may be reduced for time-sensitive matters.

The committee is responsible for conducting the evaluation of a new applicant's suitability for Adjunct status, or Provisional Adjunct status, within the Department of Biological Sciences, and to make a recommendation to Department Council on the merit of each application for Adjunct Professor status. The committee also makes recommendations to Departmental Council to make changes to the application and evaluation procedures for Adjunct status in the Department of Biological Sciences.

As well, the committee is also responsible for providing information to interested scientists on the requirements and expectations associated with Adjunct Professor status plus any recent changes to the Adjunct Professor program, and to evaluate whether Adjunct Professors should be considered for reappointment once their 3-year term has expired. The committee reviews and discusses graduate student progress for those students who are supervised by an Adjunct Professor. This process is to ensure that any shortcomings in graduate performance or the quality of supervision are addressed. The Head will communicate any concerns to the respective Adjunct Professor in a timely manner, and in consultation with the Chair of the Committee on Graduate Studies. The Chair provides Adjunct Professors with a copy of the current regulations of the Faculty of Graduate Studies and the supplemental regulations on Graduate Studies for the Department of Biological Sciences.

The Chair of the Adjunct Professor committee also has responsibility to communicate in writing with an applicant for Adjunct Professor appointment about procedures, recommendations, and status of the appointment. As well, the Chair provides a brief oral report to Departmental Council regarding recommended new and renewal applications coming forward from the Committee on Adjunct Professors for a vote by Council. The Chair is to provide a brief annual written report on the

Adjunct Professor Program to Departmental Council (e.g., the number of Adjunct faculty, their affiliation, and graduate students), and to maintain records on the start and expiry date of the appointment term of each Adjunct and Provisional Adjunct Professor in coordination with the department staff and the Graduate Studies Committee (on which the Chair serves as a voting member). The Chair will normally notify Adjunct Professors within the last three months of their term to discuss the potential need for a reapplication.

Areas of specialty

The range of expertise in the Department of Biological Sciences enables graduate students to conduct original research across diverse areas of interest using a broad range of technical approaches to these disciplines, including (in alphabetical order):

- Animal behaviour
- Animal physiology and metabolism
- Aquatic biology (wetland, freshwater, marine)
- Arctic and boreal ecology
- Cell biology and biochemistry
- Conservation biology
- Environmental and comparative/evolutionary physiology
- Evolution of sociality and mating systems
- Evolutionary developmental genetics
- Fisheries
- Foraging and trophic ecology and food-web dynamics
- Forest ecology and habitat restoration
- Germ-cell development and sperm competition
- Molecular biology
 - mechanisms of development
 - pest control
 - plant reproduction
 - plant-lipid and secondary-compound production
- Parasite evolutionary ecology
- Plant molecular physiology and biochemistry
- Skeletal muscle biology
- Statistical modelling and analysis, and landscape genetics
- Symbiosis and co-evolution
- Phylogenetics
- Plant systematics
- Pollination ecology

Novel or innovative features

One of the main innovative features of our MSc program is the direct access of students to a broad range of overlapping and complementary expertise, owing to a breadth of expertise in the Department (see Areas of Speciality). Additionally, students have access to cutting-edge technologies in labs on campus, as well as in a diversity of field-based research programs both in terrestrial and aquatic settings. A high proportion of students are co-supervised by multiple faculty within the Department and Adjunct professors, thereby promoting a high level of interdisciplinary research. Many adjunct professors are

employed by government and industry, which provides students with advice and mentorship during graduate studies, and numerous post-graduation opportunities for employment.

Strengths

The main strength of our graduate programs is the breadth of expertise in the Department, with experts in diverse speciality areas (see above) working on plants, fungi and lichens, as well as mammals, fish, birds, aquatic and terrestrial invertebrates. Owing to this diversity, students have access to multi-user facilities and the technical staff who support those facilities (e.g., Animal Holding Facility, greenhouse, analytical and microscopy suites).

The median times-to-completion for our Master's and PhD programs are 28 months (range 24-32 months) and 52 months (range 48-60 months), levels slightly over the goals of 24 and 48 months, respectively, established at the Faculty of Graduate Studies and NSERC, through the criteria for scholarship eligibility. As of 2015-16, there are 33 PhD and 56 MSc students registered in the graduate programs of the Department of Biological Sciences

Engagement of the graduate students in the Biological Sciences Graduate Students' Association (BSGSA) is another major strength of the program. BSGSA runs a graduate student seminar series (Crackerjack Seminars), which provides a rigorous training environment to enhance oral presentation skills. Additionally, graduate students are encouraged to attend conferences through departmental funds allocated to support travel by graduate students to present at national and international conferences. This support also allows students to start building a network to increase research collaborations as well as opportunities for employment or further education (i.e. PhD). Students can also build their network by meeting with a diverse group of invited speakers for our regular departmental seminar series throughout each semester as well as three named (distinguished) series of lectures (Hanna, Barrett-Hamilton, and Lubinsky) throughout the year. The Department and endowed funds from generous donations through Private Funding, make these lectures a major opportunity to network with the broader community. BSGSA students organize and host these lectures after inviting suggestions for the speakers. The events are highlights in the academic calendar.

Our program gets further strength from the clarity and transparency of the expectations and responsibilities of students and advisors (http://umanitoba.ca/faculties/graduate_studies/media/Biological_Sciences_2016.pdf), available online through our webpage or the Faculty of Graduate Studies table of Supplemental Regulations. This begins even before the outset of a student registering in the graduate program, as the advisor must write a letter of offer to the student for his/her application to be submitted to the Faculty of Graduate Studies. The letter needs to establish for the student, the level of financial support that can be expected throughout the program and outlines the advisor's expectations before the student starts. Many of these letters of offer are highly informative and provide considerable mentorship even before the student starts in a graduate program. This interaction continues early, as students and advisors also must complete the Advisor Student Guidelines (ASG) form online (available through the JUMP portal on the University website), during the first year of their program. Discussion of the student and advisor during completion of the ASG form also further clarifies the expectations and responsibilities of the advisor and the student. The ASG can be revised if and when conditions change between the advisor and student. Students are required to complete a mandatory academic integrity tutorial (GRAD 7500), which starts them with an overt emphasis on the value of a strong foundation on acceptable academic practices.

There is a strong selection of courses available in graduate-level statistical methods (BIOL 7360, Problems in Biological Statistics, BIOL 7540, Methods for Analysing Biological Data) and molecular biology (BIOL 7554, Molecular Biology of Eukaryotes - DNA, and BIOL 7556, Molecular Biology of Eukaryotes - RNA) that are offered regularly, as well as numerous Special Topics courses in particular research areas, for students who wish to learn specific topics/skills in depth.

Other strengths are found in the range of shared facilities available to graduate students (e.g., including the core molecular biology lab in Duff Roblin Building and the microscopy suite in Buller Building), the opportunity to work in other labs across the Department and also outside the Department, and the willingness of faculty to share equipment and also to train interested students in appropriate use of that equipment.

The ratio of MSc to PhD students in our graduate program (approximately 2:1) is considered appropriate given the requirements and job prospects for the two degrees.

The Department is strongly committed to maintaining the academic integrity of the graduate (and undergraduate) programs, and frequently discusses problems related to allegations of academic dishonesty, especially plagiarism. Even at the level of the two core courses in our Master's (BIOL 7100) and PhD (BIOL 7220), course outlines include strong emphasis on the need for students to understand the importance of academic integrity and not to plagiarize work by others. Both courses also use an Honesty Declaration form that students are expected to sign when submitting assignments. For instance, instructors in BIOL 7220 have included detailed definition of plagiarism in the course outline, as follows. "Plagiarizing is taking words or ideas of another person and passing them off as your own. Rearranging or replacing a few words in a sentence or paragraph is not enough to avoid plagiarism. Citing your source allows you to use information from that source but it does not entitle you to use the author's words without quotation marks. Do not, however, simply put everything into quotation marks to avoid charges of plagiarism. In scientific essays, you rarely need to use another writer's words; direct quotations are only necessary if you want to use a particularly apt phrase coined by another writer or if the issue is controversial and you feel it is necessary to quote an author exactly to avoid charges that you have misinterpreted your source. Stringing together a number of direct quotations will allow you to avoid charges of plagiarism, but it constitutes bad writing. Taking information that has been synthesized by another person (e.g., the introductory paragraphs of a paper, where an entire field of research has been succinctly reviewed) and passing this synthesis off as your own (regardless of whether you change some of the wording to avoid directly quoting the original author) is also plagiarism. Even if you cite the original author somewhere in your writing, it still constitutes plagiarism if there is no indication that all or the majority of the synthesized material derives from that source." All allegations of plagiarism are reported to the Faculty of Graduate Studies for investigation and assignment of penalties where necessary. In the past 5 years, at least 3 allegations were reported and investigated, and penalties were provided for student discipline by the Faculty of Graduate Studies. The need to emphasize the serious nature of breaching policies on academic integrity is not a "pleasant strength" of our program; it is included here for completeness, and is not considered a weakness of our program despite the apparently wide variation in cultural expectations of academic performance by students from different nations, worldwide.

Overall, the active research programs and exciting investigations that are conducted by faculty in the Department are strongly attractive to potential graduate student; they are a huge strength of the graduate programs, as they offer so many diverse opportunities.

Major awards, honours and publications to graduate students in the past 5 years

The following information on graduate students in the past 5 years, was collected from research faculty. Twenty-four of 32 possible supervisors responded to the request for input, and provided information on 194 graduate students (not distinguishing whether the student was in the MSc or PhD program, or might have transitioned from the MSc to PhD program. The Department considers the following information particularly rewarding.

- 16% - percentage of graduate students received an NSERC-PGS award
- 21% - percentage of graduate students received another major award/scholarship
- 18% - percentage of graduate students received a University of Manitoba Graduate Fellowship

- 29% - percentage of graduate students over the past 5 years with 1 publication
- 40% - percentage of graduate students over the past 5 years with 1 conference presentation
- 32% - percentage of graduate students over the past 5 years with > 1 publication
- 57% - percentage of graduate students over the past 5 years with > 1 conference presentation

The Department is very proud of the success of the graduate student body, in garnering awards, including prestigious NSERC-Vanier Scholarships (2 in the past 5 years, plus one additional nomination forwarded to Ottawa from the Faculty of Graduate Studies in Fall 2015). We wish to note that the GETS funding is not considered a scholarship to students, as it is awarded to faculty members who hold a Tri-Council grant (completely from NSERC in this Department, to date) to increase the “power” of those NSERC grants to support graduate student stipends. This has provided invaluable support to faculty as supervisors.

The Department prioritizes conference-travel support in its budget, and this facilitates the ability of graduate students to attend conferences to present their research findings and network toward collaborations, employment, or future training opportunities. In the past 6 years, the Department has committed \$8,000 annually (\$250 per student, per fiscal year, until the budget is exhausted), and in some years we are able to exceed that level of travel support. Funding from the Faculty of Science (that matches the Department’s allocation) and from the Faculty of Graduate Students and/or the Graduate Students’ Association, essentially make conference attendance (to international, national and/or regional meetings, specialized or more general) an expectation of our graduate programs.

The high proportion of graduate students with peer-reviewed publications is a very positive measure of achievement. It must be noted that many supervisors strongly encourage graduate students to publish (or at least draft manuscripts) prior to submitting their thesis, as the experience of writing, and the benefits of early publication are extremely valuable in gaining future opportunities, in advancing the whole research program, and to increase the competitiveness of the student for future scholarships. We acknowledge that many papers are submitted after students complete their graduate program, often some years later, given that additional research may need to be conducted on a particular project before it is acceptable for publication. Publication can be quite delayed, given that a manuscript may need iterative submissions, reviews, and revisions before it is finally a published paper. However, especially for graduate students, learning this process is also invaluable, particularly if the student is aiming toward a research and/or academic career trajectory. These types of opportunities generally increase time-to-completion beyond the “ideal” 2 years (the time during which the student and supervisor are eligible for external support); after 2 years, funding responsibility falls entirely on the

student and/or their supervisor, which is unfortunate, given the importance for our students of doing "more than just a thesis."

Weaknesses

One main challenge to graduate students, which become a weakness of our graduate programs, is that stipend support and TA funding are generally not competitive with other institutions, this makes it more difficult to recruit a strong student to the graduate programs. Stipend funding is available for graduate students through departmental, institutional (University of Manitoba Graduate Fellowship, UMGF), national (NSERC-PGSs) and international scholarships. In addition, the Faculty of Graduate Studies Graduate Enhancement of Tri-Council Stipends (GETS) program provides matching funds to researchers for their students' graduate stipends, but this is only toward stipends paid by an advisor holding Tri-Council funding (i.e., NSERC, SSHRC, CIHR, and Collaborative Health Research Projects). GETS funding is also restricted to funding in only the first two years of a Master's program and the first four years of a PhD program. Together the conditions of funding result in a variable level of stipend support within the Department and sometimes within individual labs. Students with less funding may need to be employed during their graduate program, leading to longer time to completion (i.e., more than 2 or 4 years for MSc or PhD students, respectively).

The Department feels it is difficult to attract Canadian graduate students from out of Province. To some extent, this difficulty is due to our prairie climate but the larger reason is that the level of student support is not competitive with other universities (fewer provincially-sponsored graduate scholarships). Our TA positions cannot be offered in advance as TA-ship positions (i.e., with the letter of offer to a student), due to provisions of the CUPE-TA Collective Agreement. Additionally, the remuneration for TAs is much better at other institutions; we know that some students will take an offer from University of Saskatchewan, Calgary, or Alberta rather than Manitoba, due to financial arrangements of the competing offer, even when they are enthusiastic about the research areas and projects they have identified with prospective supervisors and potential projects here.

Among all the departments reporting at retreat for Graduate Chairs in the Faculty of Science (Fall, 2015), our Department seemed to have the highest proportion of graduate students that are Canadian/Permanent Residents (reported at 62% PhD and 71% MSc as of Nov 2013, although considered to have declined somewhat since 2014). While we would like to feel the proportion was even higher as a result of being competitive with funding and the overall attractiveness of the program, not simply because we retain our own graduates. We encourage our excellent Honours-program graduates to go to another institution for graduate training. A change in institution will broaden the horizons and experiences of a student. However, we would also like to feel, in turn, that we can attract excellent graduates from other Canadian universities. The flip side of this consideration is that as individual faculty, we celebrate when an Honours student does decide to continue into our Master's program, as they are already trained in many of the methods they will use in research during graduate training, and we know the Honours program evaluation has very high standards. Faculty have a range of opinions and practices (regarding their mentorship and advice to students) related to this issue.

The relatively few students recruited from other provinces within Canada also suggests that our current website is not helping our success at recruiting graduate students.

We have a relatively limited number of formal graduate courses (since the low number of credit hours required in the program means that few students will enrol in a given course). Instead we have Special Topics courses, whereby students can increase their knowledge in a particular subject area either

related or unrelated to their research project. This limited breadth in available formal courses may be perceived as a weakness, although the flexibility of Special Topics courses, and the willingness of faculty to instruct those courses on top of the typical teaching assignment (mostly courses in the undergraduate program), could also be considered a strength.

Although the low number of required courses in both MSc and PhD programs is a strength in the program, the number of courses offered at the graduate level is restricted to common topics of specific interest toward a particular research area or skill development. This means that students have less formal, course-based academic exposure to information of a general nature. While it would be good to offer general-interest courses at a graduate level, it would be difficult to support through courses offered every year or every other year without impacting teaching load and/or the availability of courses in the undergraduate program, and many courses would tend to become offered only occasionally after the first few years. Thus, the feasibility of offering additional courses is challenging.

The availability of Special Topics courses is seen as a strength, although it could also be seen as a weakness, since a student may tend to take a special topics course from their own advisor. However, the advisory committee can recommend additional courses (or special topics from another faculty member) and the students can request a particular special topics course.

We currently do not have an accredited professional biologist program. This does not appear to limit the employment opportunities for our graduates.

The number of graduate carrels (working space at a desk) in the Buller Building is essentially zero; given the large number of graduate students in laboratories that are in that building, this situation may reduce the attractiveness of our program. However, the use of carrels is inconsistent among students who are assigned one of the carrels available in Duff Roblin and BSB. Their use depends on the particular schedule of experiments and fieldwork, the timelines of each student's progress, and especially their work-area preferences. This means that the carrels we do have available, are not always used.

There are some weaknesses related to facilities, including the plant-growth facilities that are still in need of improvement, replacement, and further space in growth chambers. We lack a core genomics facility and use of the facility on Bannatyne campus is not efficient or really effective for student projects.

Students of adjunct professors who are housed off campus need to be encouraged to affiliate with the rest of the Department.

We do not have a system for tracking the success of our graduate students once they complete their degrees; this made it somewhat challenging to compile the information presented in the combined program review. There is no template at the Faculty of Graduate Studies, for tracking the many details of the program (e.g., courses, funding and sources of funding (with start/end dates and fund/account information such as FOPs), contact information for students and every committee member, years in program, assessments of student progress, start and end dates, etc.). Such a database would facilitate data entry in real time (already challenging in a large department with many students), and help our administrative staff make their support of the program even more effective.

Seminar attendance fluctuates, depending on teaching activities by students, experiments in progress, conference attendance, speaker topic, etc. but is generally good to excellent, particularly for the CrackerJack Seminar series that is coordinated and delivered by graduate students.

MASTER OF SCIENCE

Objectives of the MSc program

The objective of the MSc program is to educate and train students in research so that they can further their careers in the Biological Sciences using critical thinking, communication, research design, and technical skills. These skills qualify students to understand how to work independently using scientific methodology. Thesis work is original and typically publishable (hopefully within or shortly after completion of the MSc program).

The MSc is considered the appropriate “terminal degree” for many students who may decide to seek employment on the basis of their Master’s experience, as they want a career other than one in independent research.

Novel or innovative features of the MSc program

Our core MSc course (BIOL 7100 Core Skills in Biological Sciences) is designed from principles of training and research, and provides a solid foundation on which students begin their graduate program.

Strengths of the MSc program

Students typically start their program by taking the core MSc course (BIOL 7100), offered in Fall semester, which aids in developing important research-related skills (e.g. proposal writing, hypothesis testing) as well as fostering collegiality within each cohort. The latter results in collaborations among students and between labs, as well as a strong graduate student community.

Additional strength in the program comes from the availability of many subject experts in industry or government agencies, who can become adjunct faculty (to supervise or co-supervise a student’s graduate-thesis project) or serve as external members of a Master’s thesis-advisory committee. The availability of this additional expertise adds significantly to the opportunities and diversity of student experiences, mentorship, and learning.

The small number of courses required for the MSc program (two, 3-CH courses is the minimum requirement) means that students do not have a heavy course load. Instead, their learning can be flexible and they can access courses from the very wide range available in the whole University Calendar, to suit their particular research area, needs, and interests.

Students are able to engage in collaborations outside their main projects, sometimes initiated with the development of the student cohort from BIOL 7100, in addition to their interactions in one or more of: BSGSA activities, the CrackerJack seminar series, in field-based and lab-based research activities, conference attendance, and event planning on campus.

Weaknesses of the MSc program

Masters students seem more likely to be recruited from Manitoba rather than the rest of Canada. This is especially notable as we are reasonably successful in recruiting graduates of our Majors and Honours programs into the MSc program, as they are competitive for graduate-training positions. Although this may be considered a strength of our undergraduate programs (in preparing competitive students) and a strength of the MSc program (to recruit competitive students from Manitoba), it can also be considered a weakness of our MSc program (that we don’t have very many MSc students from Canada who

completed their BSc training elsewhere in Canada (i.e., outside Winnipeg). This can be a problem in the long term, if students are not exposed to a diversity of ideas and opportunities through experiences in different institutions. Some faculty feel more strongly than others that this is an issue; we often make reference to the topic in discussions at the GSC and Department Council.

MSc - Program Structure

Admission requirements to the MSc program

The minimum requirements for Canadian and International students applying to the Department of Biological Sciences are set by the Faculty of Graduate Studies at the University of Manitoba. Briefly, Canadian students require a minimum GPA of 3.0 (out of 4.5) from a 4-year undergraduate degree in biology or a relevant field, or equivalent. An additional requirement for international students includes demonstration of English language proficiency.

Student applications to the Department must include two letters of reference, with at least one from an individual not directly involved in the proposed research, a letter of offer from the potential advisor outlining the expectations and financial requirements for the position, and a response letter from the student accepting those conditions. Once the student makes formal application online, these documents are uploaded (along with transcripts), the Graduate Studies Committee reviews the application. The Committee then makes a recommendation on whether the student is accepted into the program. Once accepted by the Department, the student receives the official acceptance from the Faculty of Graduate Studies.

Course requirements of the MSc program

Masters students in the Biological Sciences are required to take a minimum of 6 CHs of course work at the 7000 level (usually as two 3-CH courses) and submit a thesis for evaluation.

BIOL 7100 (Core Skills in Biological Sciences, 3 CH) is the one required course for all Master's students in the Department. The focus of the course is the development of the scientific method and students advance their skills in abstract and grant writing, maintaining a Curriculum Vitae, statistical design, research ethics, literature searching, critiquing the literature, and giving research presentations.

The second course is an elective that is selected by the student in consultation with their advisor and advisory committee. Selection of the second course is usually based on a student's need for information in a particular subject area, and generally related to the topic/field and methodological aspects of their research, such as quantitative or laboratory skills (see Table 18). Electives may involve one or more Special Topics courses which can vary substantially depending on the subject matter (Table 18A). Sometimes, a Special Topics course is offered in combination with a 3000- or 4000-level undergraduate course (e.g., if the graduate student has not taken this course and is trying to learn more in this subject area), but in that case, the graduate Special Topics course includes additional assignments and expectations (over and above those for an undergraduate student) to ensure that the course is being delivered at the 7000 level. In unusual circumstances, the student or members of the advisory committee may request or recommend additional course work to provide further background, as needed. Coursework outside the Department, both on and off campus, may also be used as credit toward the degree program (e.g., NRI 7350 – Study Design and Quantitative Methods for Resource and Environmental Management; or courses from the University of Winnipeg or elsewhere through the Western Deans agreement). A zero-CH, Mandatory Academic Integrity Tutorial was recently instigated (2015) by the Faculty of Graduate Studies for all graduate students at the University; it must be completed in the first year of registration in the graduate program.

Evaluation procedures for the MSc program

All graduate students are required to meet with their advisory committee at least once a year where the progress of the student is evaluated by the advisory committee. These progress meetings can occur more frequently at the request of the student, the advisor or one of the advisory-committee members. Students are asked to provide a two-page report that describes their progress over the previous year and a schedule for the coming year toward completion of their program. Students will usually accompany this report with a presentation describing their research progress since the last progress meeting. The advisory committee will evaluate the student, based on their research progress, their performance in courses, conference presentations, writing/publications, etc. A minimum GPA of 3.0 with no grade lower than a C+ must be maintained throughout the student's program. Graduate students are also expected to attend at least 50% of all seminars and student thesis defences conducted in the Department during their program. At the progress meeting, students are graded as "satisfactory", "in need of improvement" or "unsatisfactory". Students graded as "unsatisfactory" are required by the Faculty of Graduate Studies, to withdraw from the program and students with two consecutive grades of "in need of improvement" are normally required to withdraw from the program, or a timeline is developed for them to address deficiencies. The Department has had very few Master's students be required to withdraw for these reasons. Occasionally, students withdraw voluntarily and may or may not reinstate their registration in the program.

Thesis procedures and regulations for the MSc program

As mandated by the Faculty of Graduate Studies, the student and advisor are required to complete and sign off on the Advisor Student Guidelines form. This form outlines the goals and expectations of the advisor with the student and those the student has with the advisor.

The student's advisory committee is normally selected by the advisor in consultation with the student and approved by the Department Head. The advisory committee is typically struck within the first three months of a student's MSc program. The advisory committee must be comprised of a minimum of three members, including the student's primary advisor, an internal member from the Department, and an external member who is not a member of the Department of Biological Sciences. The external member need not be a researcher at an academic institution but must be an expert in a field of study related to the student's research and be able to provide significant input to the student's research program. Adjunct professors are considered members of the Department and may serve as internal members of the advisory committee. At least one member of the advisory committee must be on the academic staff of the Department, and at least two members of the advisory committee for a Master's student must be members of the Faculty of Graduate Studies at the University of Manitoba. There can be a guest scientist or other experts on the committee, but those individuals do not deliberate on progress or examine or vote on the final thesis.

The thesis proposals for Master's student projects are typically submitted to the student's advisory committee within the first 6 months of study and are normally developed by the student with feedback from the advisor. They are normally 5-10 pages (excluding figures, tables and references) and ideally should be submitted prior to the student beginning the research. The specific goals for the MSc proposal vary between committees but provide the advisor and advisory committee the opportunity to:

- Test the student's ability to formulate testable hypotheses and apply the scientific method,
- Examine the student's understanding of the area of research, and
- Identify specific weaknesses in background and/or methodology that can be addressed through additional coursework, if necessary.

The MSc thesis is written by the student, with feedback from the advisor before it is submitted for examination to the MSc thesis examining committee. The structure of the examining committee is normally the same as the advisory committee. The thesis can be submitted for examination as a “manuscript” thesis (overall introduction, research chapters, concluding chapter) or a “traditional” thesis (separate chapters for introduction, methods, results, and discussion). Students who take the “manuscript” approach may have submitted or even published the research chapters before graduating, but this is not an expectation. That said the formatting of the thesis must be consistent throughout with the research chapters contributing to the overall theme of the thesis. Where research chapters are multi-authored papers, the nature and extent of the student’s contribution and those of the other authors must be explicitly specified in a section entitled “contributions of authors” in the preface of the thesis.

The student will submit the thesis for examination to the thesis-examining committee at least three weeks in advance of the oral thesis defence. The examination is a public event where all members of the University of Manitoba community are invited to attend; typically students and faculty from the Department are the majority of attendees. The exam is normally chaired by a member of the Department’s Graduate Studies Committee. The Chair introduces the student and topic, and the student gives a research presentation normally 20-25 minutes in length. The presentation is followed by questions from the audience (5-10 minutes), and then the examining committee asks questions on the presentation and the written thesis, and the student defends their ideas. The exam is to last no longer than two hours, including the presentation. After the audience and the student leave the examination room, student performance is discussed by the examining committee and the Chair of the defence, with the assessment based on the written-thesis document, the presentation, and the student’s ability to address the examiners’ questions. If two or more examiners do not approve the thesis, the student is deemed to have failed the defence. Students who successfully defend their thesis are normally required to address corrections and revisions of their thesis, as requested by the examining committee. Final submission of the thesis to the Faculty of Graduate Studies (now done online through MSpace) is not possible until the required corrections are completed and approved by the advisor and/or the other examining committee members, as determined at the .

Transferability of course credits from post-secondary institutions

Graduate-level courses from other post-secondary institutions would generally be acceptable as the second required course (elective) in the MSc program. Such courses are approved initially through consultation among the student, the advisor, and the advisory committee, often with the Chair of the Graduate Studies Committee in the Department. Courses for transfer credit would ultimately have to be approved by the Faculty of Graduate Studies, on recommendation by the Department Head.

Sample Program Listing, MSc – Table 8

The average time-to-completion for students in the MSc Biological Sciences program is 28-32 months.

YEAR 1	YEAR 2	YEAR 3	YEAR 4
<u>Required Courses</u>	<u>Required Courses</u>	<u>Required Courses</u>	<u>Required</u>
BIOL 7100 (3 CH)	Alternate start: BIOL 7100 (3 CH)		

<u>Any graduate level, research-relevant course (3 CH), often BIOL 7600 (Special Topics) or statistics-related course</u>	<u>Any graduate level, research-relevant course (3 CH), often Special Topics (BIOL 7600) or statistics-related course</u>		
<u>Electives - 3 CH</u>	<u>Electives -</u> Additional course, approved by advisory committee (3 CH)	<u>Electives</u>	<u>N.A.</u>
TOTAL HRS. 6 CH	TOTAL HRS. 3 CH	TOTAL HRS.	TOTAL HRS.

STUDENT BODY - MSc Program

Table 9 shows data for both MSc and PhD students. Table 9 shows that enrollment in the MSc program has risen progressively since 2011 while the cohorts registered in the MSc Botany and MSc Zoology programs have very largely graduated. There are very few part-time students in the MSc program, and very little advantage to being considered part time in this program. The ratio of females to males registered in the MSc program appears to be increasing. The number of international students (proportion of total registered students) has also increased since 2010.

Notably, the proportion of self-declared Indigenous students in our graduate programs has also increased since 2010-11.

As of 2015-16, enrollment continued to increase: there were 56 students registered in the Master's program.

The average GPA of MSc students at admission to the program is well above the requirement of a minimum GPA = 3.0, as per the Faculty of Graduate Studies. Typically there is at least one student admitted each year, who has a very strong research potential and/or excellent work experience, who may not have a GPA > 3.0 at admission. In such cases, the Department's Graduate Studies Committee has been able to successfully justify that the student should be admitted without meeting the minimum requirement of the Faculty of Graduate Studies.

The maximum GPA of students admitted to the MSc program continues to be very high. This is interpreted to mean that we are able to attract students who are very competitive for scholarship awards.

Graduate Student Body and Enrollment Trends for past 5 years - Table 9

		Student Demographics								
		Total Number of Students	Full-Time			Part-time			Self-Declared Indigenous	Int'l
			Female	Male	Total	Female	Male	Total		
Fall 2010	M.Sc.	29	13	14	27	2	0	2	0	12
	Ph.D.	6	5	1	6	0	0	0		
	Pre-Masters	0	0	0	0	0	0	0		
	M.Sc. Botany	9	2	6	8	1	0	1		
	Ph.D. Botany	11	4	6	10	1	0	1		
	M.Sc. Zoology	11	5	6	11	0	0	0		
	Ph.D. Zoology	9	4	5	9	0	0	0		
	Total	75	33	38	71	4	0	4		
Fall 2011	M.Sc.	41	20	20	40	1	0	1	1	17
	Ph.D.	12	8	4	12	0	0	0		
	Pre-Masters	0	0	0	0	0	0	0		
	M.Sc. Botany	6	1	4	5	1	0	1		
	Ph.D. Botany	7	3	3	6	0	1	1		
	M.Sc. Zoology	6	1	5	6	0	0	0		
	Ph.D. Zoology	7	3	4	7	0	0	0		
	Total	79	36	40	76	2	1	3		
Fall 2012	M.Sc.	52	31	20	51	1	0	1	1	20
	Ph.D.	15	9	6	15	0	0	0		
	Pre-Masters	1	0	0	0	1	0	1		
	M.Sc. Botany	2	0	2	2	0	0	0		
	Ph.D. Botany	6	3	1	4	1	1	2		
	M.Sc. Zoology	1	0	1	1	0	0	0		
	Ph.D. Zoology	4	2	1	3	1	0	1		
	Total	81	45	31	76	4	1	5		
Fall 2013	M.Sc.	49	33	15	48	1	0	1	2	26
	Ph.D.	24	16	8	24	0	0	0		
	Pre-Masters	0	0	0	0	0	0	0		
	Ph.D. Botany	4	3	0	3	0	1	1		
	Ph.D. Zoology	4	2	1	3	1	0	1		
	Total	81	54	24	78	2	1	3		
Fall 2014	M.Sc.	50	38	12	50	0	0	0	5	25
	Ph.D.	26	16	10	26	0	0	0		
	Pre-Masters	0	0	0	0	0	0	0		
	Ph.D. Botany	2	2	0	2	0	0	0		
	Ph.D. Zoology	2	1	1	2	0	0	0		
	Total	80	57	23	80	0	0	0		

		Entrance GPA**6				
		Admitted Students	New Students ⁴⁵	Avg. GPA	Min GPA	Max GPA
2010	22	22	3.65	2.65	4.48	
	5	4	3.89	3.60	4.25	
	NA	0	NA	NA	NA	
	NA					
	27	26	3.70	2.65	4.48	
2011	15	14	3.48	2.88	4.35	
	5	4	3.81	3.49	4.07	
	NA	0	NA	NA	NA	
	NA					
	20	18	3.56	2.88	4.07	
2012	21	17	3.72	3.00	4.48	
	3	2	3.82	3.56	4.05	
	NA	1	NA	NA	NA	
	NA					
24	20	3.77	3.00	4.05		
2013	18	17	3.86	2.89	4.28	
	10	7	3.72	3.40	4.12	
	NA	0	NA	NA	NA	
	NA					
28	24	3.81	2.89	4.28		
2014	25	18	3.82	2.89	4.50	
	5	4	3.53	3.02	4.04	
	NA	0	NA	NA	NA	
	NA					
	30	22	3.77	2.89	4.50	

* Enrolment as of November 1 of each year.

** New Students include any graduate students starting Fall, Winter and Summer of that **calendar year**; admitted students are the number of students admitted for these terms. GPA reflects all admitted students and is calculated on last 60 hours of study, or equivalent. GPAs for counts of 2 or less have been redacted to protect the privacy of the individuals but have been included in the total weighted averages.

- Sources: 1. Graduate Enrolment by Program <http://umanitoba.ca/admin/oia/students/3504.html>
 2. Indigenous Enrolment, Biological Sciences OIA, September 30, 2015
 3. International Graduate Students by Area of Study <http://umanitoba.ca/admin/oia/students/1470.html>
 4. Masters Students - faculty/major, ft and pt, new and continuing, year in program. <http://umanitoba.ca/admin/oia/students/3504.html>
 5. Ph.D. Students - faculty/major, ft and pt, new and continuing, year in program. <http://umanitoba.ca/admin/oia/students/3504.html>
 6. Graduate Students, Admission GPAs for Biological Sciences FGS, September 21, 2015

Financial Support of MSc Students – Table 10

The accuracy of our tabulation of graduate student funding is much more reliable since 2013-14 than in previous years. In 2014-15, our record keeping was reorganized to integrate financial aspects of student appointments with award and stipend payments. This is now managed by our financial officer. Since 2014-15, NSERC awards to Master's students have not been posted on the NSERC website, as they are administered internally through the Faculty of Graduate Studies, so information is not as accessible as it was previous to 2014. Also notable for this tally, the GETS funding to researchers is included here within the "Other" category, as it is related to payment from funds available from the supervisor's research funding (GETS funds are allocated to the supervisor) not as an award.

Notably, the source(s) of funding to each student may also change month-by-month (sometimes even for those supervised by one researcher). Funding is typically available for disbursement from more than one (often many) financial accounts ("FOPs"), each of which may be extended or end mid-way through the appointment period for one or more students. For these reasons, the table on financial support is considered an estimate, although recently (over the past 2 years), this estimate is much more reliable. This level of detail also shows the necessity of having a financial officer (AA3) track student funding, as it is so closely related to funding available to researchers, the financial-reconciliation processes with purchasing services and budgets and grants officers, and the many details of student travel, on record and under the responsibilities of the same staff position. This context supports the statement that the Department needs additional administrative (office) support for the graduate program, as it would be considerable benefit to all faculty and students.

Despite the frustration of tracking graduate student funding, the level of funding that is garnered by MSc students in the Department is increasing. This is apparently related to an increase in the number and level of external scholarships, and the increased funding available via grants and contract-research funds to the faculty. In addition, a relatively small number of Biological Sciences Scholarships (3-5 per year) are funded from soft money available to the Department (see table footnote).

The general increase in funding to Master's students over the past 5 years is, therefore due, in part, to funding through the GETS program, increases in the level of NSERC Discovery-Grant funding to faculty in the Department, an increasing proportion of successful NSERC proposals, and increases in the level of non-NSERC funding. This means that Master's students are, now, almost always offered stipends upon acceptance to the program; very few receive zero funding from their advisor, even if they are ineligible for NSERC scholarships (as non-Canadians or non-Permanent Residents) or have a GPA and record of accomplishments that do not merit the award of competitive funding.

International students are eligible for the International Graduate Student Entrance Scholarship (IGSES) from the Faculty of Graduate Studies if they apply for the program with a GPA ≥ 3.5 . Notably, this GPA may not be the same as the the GPA on the student's final transcript at the time of admission, for example after the student graduates from an undergraduate degree).

Some students are very successful in their applications for a number of smaller awards that are merit-based, and often specific to a field of study or research interest. Other students take opportunity to apply only for larger awards, and/or to work as TAs, Grader-Markers, and occasionally in an appointment classified as a Sessional Instructor (e.g., for very skilled work as a lab coordinator or as part of leave replacement for faculty). Bursaries are also available, based on financial need, although the Department does not track those funds.

Table 10 - MSc support		\$ Amount of Support in 1000s ¹						# MSc Funded		# Students with Major Awards ²				
Year	Enrolled MSc students ³	External Scholarships ⁷	FOS	#TAs in MSc program	Other ⁴	Biological Sciences ⁸	Total \$	% students funded ⁵	mean \$/ student	NSERC	UMGF	MHRC, MICH	Internal Scholarships ⁶	Barrett-Hamilton
2014-15	70	241 (16)	49 (7)	103 (86)	286 (33)	21 (2)	700	97	10	9	6	2	17	1
2013-14	58	164 (11)	63 (9)	87 (72)	173 (35)	34 (6)	521	91	8.9		2		14	1
2012-13	60	35 (2)	63 (9)		192 (25)	15 (3)	305+	70		2			19	1
2011-12	62	53 (3)	84 (12)		202 (29)	25 (5)	364+	80		3			18	1
2010-11	59	134 (8)								8			4	1
2009-10	52	122 (7)	100 (10)							7			5	1

¹ the number of students in each category is given in brackets. Note: the number of students in each category does not add up to the total number of students enrolled; some students have more than one source of funding.

² the number of students in the Department in receipt of the awards/funding listed.

³ the total number of students enrolled in graduate programs for the past 5 years; note that this number may not agree with the enrollment numbers from the Office of Institutional Analysis, as it includes all students registered in a given academic year, regardless of graduation date.

⁴ Includes fellowships (stipends) from faculty member research grants (including GETS funds), the Barrett-Hamilton, Dalgarno, Welch, Roger Evans, Scherer, Reimer, and Lubinsky scholarships, and other internal awards. Amount does not include salary funding from supervisor (e.g., at Department of Fisheries and Oceans). Also does not include funding from bursaries that are available to students through University of Manitoba or other agencies, or other scholarships that students receive directly.

⁵ Includes the percentage of students funded, relative to the total number of students in the program. NOTE: this tally does not include students who receive funding to be TAs, Sessional Instructors (a few in the past 4 years), or Grader-Markers, as that is employment income, rather than scholarships or fellowships.

⁶ Includes Rauch Demonstrator, International Graduate Student Entrance Scholarship (IGSES), and the Ileen Stewart, the Lubinsky, Welch, Roger Evans, Scherer, and Reimer Scholarships, plus FGS top-up awards.

⁷ Includes NSERC awards (PGS-M, CGSM, MGS, Alexander Graham Bell), Experimental Lakes Area graduate fellowships, Manitoba Plant Biologists, Delta Marsh fellowship, Saudi Arabia graduate scholarship.

⁸ The Biological Sciences Scholarships are funded by the International College of Manitoba (ICM), which is a private institution for international undergraduate students, taking courses toward entrance to the University of Manitoba at the second-year level.

Enrollment Trends

The trend is for enrollment in the MSc program to increase, year over year. Overall, the growth in the Master's program enrollment is welcomed, and is considered a reflection of the overall attractiveness of the research programs of our faculty, the departmental atmosphere of collegiality, the diversity of opportunities available for fieldwork and laboratory research projects, and the diversity of expertise available to students for mentoring and skill development. The level of attrition for students in the program is very low considering that students can either continue in the program, withdraw, or transfer from the Master's to the PhD program. For example, although 1-2 students seem to leave the program after a typical first year, as seen by following a cohort through subsequent program years in Table 11, the reason for the decrease is not identified in the table, and is likely due to transitioning to the PhD program by excellent students in each cohort.

The Department anticipates particularly strong growth in the number of students enrolled in the MSc program due to growth in funding, the recent recruitment of dynamic faculty members with exciting research programs in areas that are overarching established programs in the Department, the anticipated renewal of a CRC Tier 2 position, and the recent (2015) award of an Industrial Research Chair position in the Department.

The Department places high value in the MSc program as comprehensive training and experience in research. Further program growth makes this a very strong cohort of students engaged in research and departmental activities. As well, the whole Department benefits by the dynamics of a larger BSGSA (Biological Sciences Graduate Students' Association).

With the expectation of a larger cohort, the Department will need to consider how to provide the Core Skills in Biological Sciences Research course, BIOL 7100, for even more students each year. The Graduate Studies Committee will need to consider whether an additional section in the Fall or Winter term or a revised course will be necessary, to provide opportunity to maintain the small-group interactions of the course. The Department will also need to consider whether team teaching, or a modular course would be effective, given the essential nature of the detailed feedback currently provided on written assignments and oral presentations by students.

The maximum GPA at graduation from the MSc program is high (approaching or at 4.5 in the past 3 years). The median number of months to graduate is 28 (2013, 2014 cohorts), which is considered quite acceptable, given the diversity of research projects undertaken by MSc students (many with datasets from multiple years of fieldwork or lengthy lab-bench experiments). However, this does have funding implications (see above), which can be challenging to the student and advisor, since student eligibility for virtually all scholarships and the advisor's eligibility for GETS funding both expire after the student has been in the Master's program for 2 years. It is important to state that this does not reflect in a negative way on the students or the Department, even though it can have serious funding implications.

The most important considerations in planning for growth in enrollment to the Master's program will be:

- sustaining the effectiveness and value of the core BIOL 7100 course in view of increasing enrollment in the Master's program,

- transitioning the instruction of BIOL 7100 to a member of the Department; the course is currently taught by the Department Head, who is retiring and will deliver the course for the last time in Fall 2016,
- providing reliable opportunities for more students to benefit by what is now given as Special Topics courses to broaden the knowledge base,
- finding ways to support allocation of stipends of MSc students within NSERC and other funding opportunities that cover research costs,
- managing the financial and programmatic workload of running the program itself, and having the necessary administrative and office staff positions available for that work, and
- sustaining the excellent workings of the Graduate Studies Committee as the Department evolves through faculty renewal and recruitment.

MSc Students by Year in Program – Table 11

Two cohorts of students in the MSc program are identified by either a red square or red oval. By following one cohorts, it appears in the table, that 22 MSc students started in 2010 and that there were 21 and 18 of the cohort registered full-time in the program after 1 or 2 years. Similarly, in 2012, 17 MSc students began the MSc program, and by 2014 there were 14 registered full-time in the program. However, the Department also had students transfer from the MSc to PhD program within that time, which reduces the level of attrition from the Master’s program to a very low proportion of full-time students.

		Full-time					Part-time					Grand Total
		1	2	3	4+	Total	1	2	3	4+	Total	
Fall 2010	Biological Sciences	22	5	0	0	27	0	3*	0	0	3	30
	Botany	0	2	2	4	8	0	0	1	0	1	9
	Zoology	0	5	4	2	11	0	0	0	0	0	11
Fall 2011	Biological Sciences	14	21	5	0	40	0	0	1	0	1	41
	Botany	0	0	1	4	5	0	0	0	1	1	6
	Zoology	0	0	4	2	6	0	0	0	0	0	6
Fall 2012	Biological Sciences	17	13	18	3	51	0	0	1	0	1	52
	Botany	0	0	0	2	2	0	0	0	0	0	2
	Zoology	0	0	0	1	1	0	0	0	0	0	1
Fall 2013	Biological Sciences	17	17	7	7	48	0	0	0	1	1	49
Fall 2014	Biological Sciences	18	15	14	3	50	0	0	0	2*	2	52

* Counts include student's on leave from program.

Source: *Masters Students by Year in Program*
<http://umanitoba.ca/admin/oia/students/3504.html>

Graduate Programs in Biological Sciences, Graduate Counts for past 5 years – Table 12

		Student Demographics*			Graduation GPA			
		Total Number of Grads	Female	Male	Self-Declared Indigenous	Avg. GPA	Min GPA	Max GPA
2010	M.Sc.	0	0	0	0	NA	NA	NA
	Ph.D.	0	0	0		NA	NA	NA
	M.Sc. - Botany	4	2	2		3.88	3.25	4.00
	Ph.D. - Botany	1	1	0		XX	XX	XX
	M.Sc. - Zoology	5	5	0		4.22	4.00	4.50
	Ph.D. - Zoology	3	1	2		4.02	3.17	4.50
	Total	13	9	4		0	4.04	3.25
2011	M.Sc.	0	0	0	0	NA	NA	NA
	Ph.D.	0	0	0		NA	NA	NA
	M.Sc. - Botany	3	2	1		3.87	3.70	4.17
	Ph.D. - Botany	3	1	2		3.74	3.38	4.25
	M.Sc. - Zoology	4	4	0		4.15	3.75	4.5
	Ph.D. - Zoology	2	1	1		XX	XX	XX
	Total	12	8	4		0	3.95	3.38
2012	M.Sc.	4	2	2	0	3.97	3.75	4.38
	Ph.D.	0	0	0		NA	NA	NA
	M.Sc. - Botany	2	1	1		XX	XX	XX
	Ph.D. - Botany	2	0	2		XX	XX	XX
	M.Sc. - Zoology	5	1	4		3.95	3.00	4.50
	Ph.D. - Zoology	1	0	1		4.17	4.17	4.17
	Total	14	4	10		0	4.00	3.00
2013	M.Sc.	17	7	10	0	4.21	3.50	4.50
	Ph.D.	0	0	0		NA	NA	NA
	M.Sc. - Botany	2	1	1		XX	XX	XX
	Ph.D. - Botany	2	1	1		XX	XX	XX
	Total	21	9	12		0	4.15	3.25
2014	M.Sc.	10	6	4	0	3.98	3.50	4.50
	Ph.D.	1	0	1		XX	XX	XX
	Ph.D. - Botany	2	1	1		XX	XX	XX
	Ph.D. - Zoology	2	2	0		XX	XX	XX
	Total	15	9	6		0	4.02	3.50

*Given the possibility of change in status during a program, international student counts are not provided at time of graduation.

XX GPA's for counts of 2 or less have been redacted to protect the privacy of the individuals but are included in the total weighted averages.

- Sources:** 1. Graduate Degrees, Diplomas, Certificates Conferred by Faculty/School, Degree, Program/Major and Gender http://umanitoba.ca/admin/oia/program_reviews/2065.html
 2. Self-declared Indigenous Graduation Counts, Biological Sciences OIA, September 30, 2015
 3. Graduation GPA's, Majors in Biological Sciences OIA, September 30, 2015

MSc in Biological Sciences, Time to Completion – Table 13A

The apparently high “median number of months to graduate” in 2009 (52 months) may be an artefact of a very high average “months-to VW” rate among a small cohort of 8 students who started in the new Biological Sciences program in 2009. The median number of months to graduate has declined considerably since 2009. Note that 2009 was the year of a major fire, and many of our graduate students had research essentially on hold for 4-6 months while the university responded to the disruption. Data are not available for 2014, although the Department’s impression is that the median number of months-to-graduate has decreased further since 2012. Tables 13B and 13C are provided for the legacy programs in which students continued in parallel with the Biological Sciences program, although there are now, no longer any MSc students registered in either program.

Cohort Year	Status	Number of Students	% Graduated or Promoted	% VW	% Cont	Median # Months to Graduate	Average # Months to VW	% Graduated			
								Year 2	Year 3	Year 4	Year 5
2009	Complete	8	38	38	25	52	31	0	13	13	38
2010	Complete	23	91	4	4	32	8	13	70	91	91
2011	After 4yrs	14	79	7	14	28	32	36	71	79	
2012	After 3yrs	17	41	0	65	28		18	41		
2013	After 2yrs	16	0	6	94		8	0			

Source: *Research-Based Masters Students - Cumulative Rates of Graduation, Continuation and Withdrawal by Faculty/School and Department, for the cohorts from 2004-2013*
http://umanitoba.ca/admin/oia/program_reviews/2065.html

MSc In Botany, Time to Completion – Table 13B

Cohort Year	Status	Number of Students	% Graduated or Promoted	% VW	% Cont	Median # Months to Graduate	Average # Months to VW	% Graduated			
								Year 2	Year 3	Year 4	Year 5
2004	Complete	4	75	25	0	32	24	25	75	75	75
2005	Complete	8	88	0	13	36		25	50	75	88
2006	Complete	6	100	0	0	34		17	67	100	100
2007	Complete	5	60	0	40	48		0	20	40	60
2008	Complete	3	33	33	33	28	56	0	33	33	33
2009	Complete	2	50	50	0	52	8	0	0	0	50

Source: *Research-Based Masters Students - Cumulative Rates of Graduation, Continuation and Withdrawal by Faculty/School and Department, for the cohorts from 2004-2013*
http://umanitoba.ca/admin/oia/program_reviews/2065.html

Cohort Year	Status	Number of Students	% Graduated or Promoted	% VW	% Cont	Median # Months to Graduate	Average # Months to VW	% Graduated			
								Year 2	Year 3	Year 4	Year 5
2004	Complete	6	83	17	0	28	24	17	67	67	83
2005	Complete	9	56	33	11	28	39	22	44	44	56
2006	Complete	6	83	0	17	28		33	67	67	83
2007	Complete	7	86	14	0	28	8	14	86	86	86
2008	Complete	4	100	0	0	32		0	75	100	100
2009	Complete	5	80	20	0	34	52	20	60	80	80

Source: *Research-Based Masters Students - Cumulative Rates of Graduation, Continuation and Withdrawal by Faculty/School and Department, for the cohorts from 2004-2013*
http://umanitoba.ca/admin/oia/program_reviews/2065.html

DOCTOR OF PHILOSOPHY

Objectives of the PhD program

The objective of the PhD program is to educate and train students to be independent researchers with strong skills in critical thinking, communication, and research design, and high levels of technical proficiency. Successful PhDs should be able to develop an independent research program, either in academia or in biology-related professions.

Novel or innovative features of the PhD program

Our MSc and PhD programs are highly integrated; most of the program features, specializations, strengths and weaknesses described above for the MSc program are shared by the PhD program. In particular, the areas of specialty of our PhD program mirror those of our MSc program. Novel and innovative features include all those described for the MSc program, plus the core PhD course (BIOL 7220), the public PhD proposal presentation, and the PhD Candidacy Exam. Below are listed the strengths and weaknesses that are unique to the PhD portion of our graduate program.

Strengths of the PhD program

The core PhD course on Critical Thinking, BIOL 7220, is designed to stimulate discussion in key research areas within the Department, and prepares students for the PhD Candidacy Examination.

The PhD proposal presentation is open to all members of the University of Manitoba community, offering an opportunity for the student and the supervisor to benefit from a broad, critical appraisal of the research proposed for the thesis, and to share the innovative research conducted by our PhD students with the University community. The proposal is examined by members of the advisory committee.

The format of the Candidacy Exam is a research-program proposal written in the style of an NSERC Discovery Grant. This format provides the Department and the examining committee an opportunity to mentor and give feedback to PhD students in developing a research program on a topic that differs from, but may be related to their thesis research. The examining committee is chaired by a member of the Graduate Studies Committee, and voting members are the thesis-advisory committee and a representative of the Graduate Studies Committee (to ensure standard procedures and level of examination). The proposal is the intellectual property of the student; the proposed research outlined in the Candidacy Exam proposal may form the basis of subsequent research conducted after the student graduates. See below for more detail on this examination.

The median time-to-completion for the PhD program is 52 months, which is only slightly higher than the 4-year period of student eligibility for scholarships or GETS-supported stipends.

To date, a small proportion of students in the Biological Sciences PhD program have needed to apply for an Extension to their program (currently required for continuing in the program beyond 6 years, although the limit was previously 7 years).

Weaknesses of the PhD program

The core PhD course in Critical Thinking (BIOL 7220) is currently offered only in alternate years, given need for a “critical mass” of 10–14 students for effective group discussions in class. Since the course is not offered every year, students may have to take the course earlier or later than otherwise desired. As the PhD program grows, the course could be offered every year. This opportunity will need to be considered in view of teaching load by the Department members and pressure to deliver the undergraduate program. It is possible that the team-teaching format of the course may be modified to have course coordinators rotating on a 2- or 3-year cycle. Currently the course depends on participation of 10 guest speakers from within Department (including Adjunct Professors) to give students (and the faculty members who contribute as course directors and guests) a good opportunity for direct interactions in discussing 10 different research-topic areas. It also provides students with a greater diversity of opinions and expertise, and exposes them to a wider range of research fields than represented by the research conducted by the student cohort in a given year when the course is offered. However, the potential involvement of more individuals as course coordinators and the need for them to evaluate the students’ work for each of 10 assignments, will mean a significantly greater teaching load if the course is to be offered every year (for example, when there is a large cohort of first-year PhD students).

Time-to-completion is somewhat longer than desired by the Faculty of Graduate Studies (52 months). The Department considers that the relatively small variance from 4 years in time-to-completion is not a major issue. However, we also recognize that even this small variance from the time-to-completion goal of 48 months, has important implications for funding students, since they are no longer eligible for NSERC-PGS funding after 4 years. Supervisors are also unable to garner GETS funding for their PhD students who stay in the program beyond 4 years, and therefore have to cover the entire cost of any stipend after that time. However, students in the program have many opportunities over and above “finishing a thesis within 4 years”. Students generally put a lot of independent effort into their projects, since the typical level at least of NSERC funding, does not support us to pay research technicians in most labs. As a result, PhD students develop expertise through direct experience as they progressively develop analytical and technical skills. Students also network during their training, as the Department and supervisors encourage students to attend conferences and present their research. Supervisors also emphasize that preparing manuscripts prior to thesis completion rather than after graduation (or not at all) brings significant opportunities to build their own research network, and also makes them competitive for scholarships and positions.

The Department notes that the increasing number of international students means that not only that students face challenges with language, particularly written English. The faculty are required to give considerable additional instruction, advice, and often editing services to facilitate their student’s progress, and it can be challenging to mark assignments and separate language-related feedback and evaluation of content. However, the Department encourages students to take advantage of many research and professional development opportunities (e.g., to develop language skills and teaching skills) prior to thesis completion. Despite this positive support and the trend toward a shorter median time-to-completion in the PhD program in Biological Sciences, students and supervisors are often challenged to find funding for stipends in the final years of a PhD program (when it extends beyond 4 years). The limitations on eligibility for funding at that time places additional pressure and stress on students precisely at a time when they are under pressure to “finish up” and write their thesis and papers. When students take jobs, particularly off campus, and/or get involved in life’s major events, the time-to-completion is very often extended further. The Department tries to encourage students and

advisors to plan well, for a time-to-completion that is realistic in accommodating life, and yet not too long.

The Faculty of Graduate Studies requires non-departmental members of PhD thesis-advisory committees (but not MSc committees) to be members of the Faculty of Graduate Studies at the University of Manitoba. This requirement restricts the participation of otherwise highly-qualified researchers with expertise in the area of the student's thesis research who are not members of the University.

The Faculty of Graduate Studies selects the University's External Examiners for each PhD thesis defence, based on a restrictive approval process. The supervisor nominates individuals for this role who must be Full Professors with fairly recent experience in graduating PhD students from research an academic setting. Supervisors are not to contact potential External Examiners in advance of nominating them. The criteria process are considered to prohibit the selection of potential examiners with excellent expertise in the student's area of research, who may be, for example, appointed at a lower academic rank, including Associate Professors or Tier 2 Canada Research Chairs who have accelerated success in graduate training and graduation. The criteria also excludes subject-area experts who are conducting cutting-edge research as Adjunct Professors appointed at another institution, as they are employed in industry or at a government agency (nationally or internationally). The Department understands that these individuals may be considered to have less formal academic experience with graduate training programs, and therefore seem unacceptable for the role of External Examiners. The selection criteria also seem to exclude those scientists who are journal editors appointed at the rank of Associate Professor at another University, even though such individuals would typically be considered by a supervisor and the advisory committee to be highly qualified to examine a particular thesis in the subject area of the journal. In one case, at least 15 nominations were provided by an advisor before the Faculty of Graduate Studies approved the External Examiner for a PhD defence. This whole process begins with the submission of the thesis to the Faculty of Graduate Studies, and can significantly extend the time between submission and defence.

There is a relative shortage of Canadian PhD students in our program, who did their MSc or BSc outside the Province of Manitoba.

The requirement for female students to be de-registered as students (and lose library privileges) during maternity leave has meant that many PhD students do not take a formal leave. Family leave is valuable and new parents and children benefit from a recognized break from full-time status as a student, but losing access to the library (important for writing and keeping up with the literature during a leave) seems punitive. The other alternative, when a student stays formally in the program during the first few months after a baby is born, may not be realistic, since the "time-to-completion clock" is ticking during that time when the student won't be able to concentrate as well on their research; that essentially lengthens the student's time in the program, and adds additional stress to the student and advisor in coping with the challenges of finding funding for the student's stipend after the end of 4 years in the program.

PhD Program Structure

Admission requirements

The admission requirements for applicants to the PhD program are generally the same as those to the MSc program (GPA \geq 3.0, English proficiency, two reference letters, letter of offer from the potential advisor), with the addition that a Master's degree in biology or related discipline is normally expected.

Exceptional students without a MSc may enter directly into the PhD program if they have completed an Honours Bachelor's degree in Biological Sciences or another undergraduate program that is directly relevant to their chosen research topic and received a minimum GPA of 4.0 in their last 60 credit hours (or equivalent) of study. In exceptional circumstances students with a lower GPA or with a four-year Major degree may be considered for direct entry to the PhD program if they have significant work experience that is directly relevant to their chosen research topic.

Students registered in the MSc program may apply to transfer to the PhD program without completing the MSc program. A student wishing to transfer must write a PhD-research proposal with a minimum level of direct assistance from the advisor. The proposal is presented to the Department and advisory committee as usual for a student who started in the PhD program initially (see below). The proposal is to demonstrate the student's potential to do independent research, show that they have a thorough grasp of the most relevant literature in their area of research, and that the depth and breadth of their conceptual understanding is already that expected for PhD-level research, even though they have not completed a Master's program. The proposal and transfer request must first be approved unanimously by the student's advisory committee and subsequently by the Department's Graduate Studies Committee. The recommendation by the Graduate Studies Committee should occur within 18 months of the student starting their MSc program. Students who transfer into the PhD program are not awarded a Master's degree by default, in the event of non-completion of the PhD program. In one case, the student reapplied to the MSc program (resetting the program-start date), and was able to "rescue" the thesis work, defend a Master's degree, and graduate.

Course requirements – required and elective

PhD students in Biological Sciences are required to take a minimum of 6 CHs of course work at the 7000 level, usually as two 3-credit hour courses, one of which must be the core PhD course (BIOL 7220 Critical Thinking in Biological Sciences). They must also take a 0-credit hour Mandatory Academic Integrity Tutorial that was recently instigated (2015) by the Faculty of Graduate Studies for all graduate students at the University. In addition, PhD students must write a PhD proposal, present their proposal in public and defend it to their advisory committee, pass the Candidacy Exam, and submit an original thesis for examination.

The required PhD core course, BIOL 7220, Critical Thinking (3 CH), is formatted as seminars and discussions that promote development of students' ability to critically evaluate and write (in the form of abstracts, proposals, and critiques) about 10 different areas of research conducted within the Department of Biological Sciences. The purpose of the course, which is offered in alternate years, is to expose students to the breadth of research topics currently undertaken within the Department, provide students with critical writing and verbal discussion skills (in preparation for the PhD Candidacy Exam), and foster intellectual collegiality within a cohort of students. The BIOL 7220 instructors have developed a very specific Honesty Declaration form (included in the course outline) and strongly emphasize the importance of academic integrity to the classes while giving instruction that the declaration is required with each assignment. In part this has developed from a few experiences by the instructors over the

past 5 years indicating that some PhD students still have not understood how important it is to submit only their own original work.

The second 3-CH course is an elective that students select in consultation with their advisor and advisory committee. Similar to the Master's program, the choice of a second course is usually based on the student's need for information on a particular area/topic, and generally based on methodological aspects of their PhD research, such as quantitative or specific laboratory skills (Table 18). Special Topics courses, which can vary substantially depending on the subject matter (Table 18A) are also available, and can be designed by a member of the Department to a particular need. In unusual circumstances, the student may request or the advisory committee may recommend that additional course work is needed to provide further background. Coursework outside the Department, both on and off campus, may also be used as credit toward the degree program (e.g. NRI 7350 – Study Design and Quantitative Methods for Resource and Environmental Management; or courses from Faculties of Environment, Earth and Resources, Kinesiology and Recreation Management, Arts (e.g., Psychology), or Agriculture and Food Sciences, or from other universities such as the University of Winnipeg (through the Western Deans agreement).

Students who have entered directly into the PhD program or who have transferred from the MSc program must complete a minimum of 12 CHs of graded 7000 level course work during their PhD studies (including both the core MSc course, BIOL 7100 and the core PhD course, BIOL 7220).

Evaluation procedures for the PhD program

Evaluation procedures for PhD students are similar to the procedures for MSc students, although with higher expectations for student performance and achievement. PhD students must meet regularly with their advisory committee (at least once per year) to review their progress, maintain a minimum GPA of 3.0 (with no grade below C+), and attend at least half of the departmental seminars and thesis defence presentations.

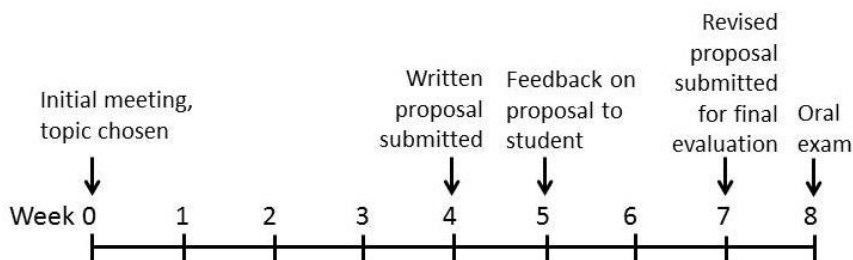
Evaluation of PhD student progress is based on performance in courses, progress on research (including PhD proposal presentation), conference presentations, publications, other seminars, and their successful completion of the Candidacy Examination.

Students who fail to maintain satisfactory performance may be required to withdraw from the program; two consecutive "in need of improvement" ratings on progress reports, normally means the student is required to withdraw

Candidacy Exam procedures

The Candidacy Exam typically occurs in the later part of a student's Ph.D. program, after the thesis proposal has been approved, and no later than 1 year prior to graduation.

The Candidacy Examination consists of a written proposal in the form of an NSERC Discovery Grant proposal and an oral examination, which together will be completed over an eight-week time period. This timeline is meant to limit the time that students spend away from research and ensure equitable conditions for all students.



The maximum page limit for the proposal is five pages plus any additional pages for references. Students should not include budget information.

The topic of the grant proposal is chosen by the Candidacy Examining Committee in a discussion with the student during a meeting that takes place four weeks before the proposal is first submitted to the committee along with a signed Honesty Declaration form. The Honesty Declaration includes the following statement: "I, the undersigned, declare that the initial proposal that I have submitted for my PhD Candidacy Examination in the Department of Biological Sciences is wholly the product of my own work, and that no part of it has: been copied by manual or electronic means from any work produced by any other person(s) or other source including, but not limited to, textbooks, original scientific manuscripts and web sites, or received feedback or editing from anyone, including tutors or tutoring services." The specific details of this declaration are considered by the Department, to be very important.

Examiners provide constructive written feedback on the proposal within one week of submission. The student then has two weeks for revision and resubmission of the written proposal, based on his or her use and evaluation of the written feedback. The student also submits a letter with the final proposal outlining how he or she addressed the committee's major comments. By using the Honesty Declaration, the Examining Committee has more confidence that the student has indeed written the whole proposal. International students or those who have difficulty with written English, are able to receive assistance on the writing/editing of the revised version of their proposal (e.g., from their advisor and/or a writing tutor) which is resubmitted to the examiners a week before the oral examination.

The student is evaluated on both the quality of the first version of the proposal and on how well he or she used or rebutted the Examining Committee's feedback on the original proposal.

The oral exam consists of a 20-minute presentation by the student on the written grant proposal, followed by two rounds of questioning from the examiners. Questions assess the student's breadth and depth of knowledge in areas related to the rationale and themes of the research topics in the grant proposal, related areas outside the grant background, and current topics in the field. Questions may also explore how feedback provided by the Examining Committee on the first version of the written proposal was incorporated or rebutted.

The student is evaluated (Pass or Fail) separately on the written proposal and on his or her performance during the oral exam. In order to receive a Pass on the written proposal, the Examining Committee should not expect that the grant would be funded by NSERC; rather, students are to be evaluated on how well they have achieved the goals of the examination, as outlined in the Supplemental Regulations. The goals related to the written proposal include being able to: 1) use pertinent information in the literature to formulate a research program related to, but not the same as, the student's PhD project; and 2) use the scientific method and formulate testable hypotheses. The other goals of the Candidacy

Exam are to examine: 3) the student's depth of knowledge in the particular research specialty; and 4) the breadth of knowledge required to research and write the background material for the proposal.

In order to receive a Pass on either component, the decision of the examiners must be unanimous. If the student fails either the written or oral exam (but not both), he or she will have an additional two weeks to make further revisions to the proposal or to repeat the oral exam (as required). Successful completion of the repeated component will be deemed a Pass.

If the student fails both components at the eight-week point, or fails to successfully revise the proposal or the repeat oral exam at Week 10, this will be considered a “first failed attempt” at the Candidacy Examination. In this case, the combined written and oral exam may be taken a second (and final) time; this second attempt should occur with one year of the failed attempt, and a new topic will be chosen for the second attempt.

Thesis procedures and regulations

The advisory Committee, normally selected by the advisor in consultation with the student, should be struck within the first six months of a student's PhD program, and must consist of a minimum of three members: the student's advisor, at least one other member of the Department, and another scientist who is not a member of, or adjunct to, the Department but who is a member of the Faculty of Graduate Studies.

PhD proposals are typically written within the first year of the program, prior to beginning the research component and before the Candidacy Examination. In addition to the written component (approximately 5–10 pages, excluding reference list, figures, tables and appendices), PhD students are required to give a public presentation of their thesis proposal. The goals of the PhD thesis proposal and presentation are: 1) to examine the student's understanding in the area of specialization, 2) to provide the student and the supervisor with a critical appraisal of the research proposed for the thesis, 3) to identify specific weaknesses in the student's background relevant to the proposed research-specialty area, and 4) to test the student's ability to use the scientific method and formulate testable hypotheses.

The thesis can be written in the “regular” thesis style or in a “manuscript” or “sandwich” style, where research chapters are prepared in the format of manuscripts that have been or will be submitted for publication, preceded and followed by a general introduction and general discussion. The formatting of the thesis must be consistent throughout, and the collection of papers must contribute to the overall theme of the thesis. Where research chapters consist of multi-authored papers, the nature and extent of the student's contribution and those of the other authors must be explicitly specified in a section entitled "Contributions of Authors" in the “Preface” of the thesis/practicum.

For the thesis defence, the Examining Committee consists of the Advisory Committee plus an external examiner who is a distinguished scholar from outside the University of Manitoba with particular experience in the field of the thesis research. The Dean of the Faculty of Graduate Studies (FGS) chooses the external examiner from the list provided by the candidate's advisor/co-advisor and makes the formal invitation to the external examiner.

After the student submits the PhD thesis to FGS, the Dean of the Faculty of Graduate Studies requests the internal examiners to give, within three weeks of the thesis distribution, a detailed written report on the thesis and place it into one of the following categories:

1. The thesis represents a distinct contribution to the candidate's field of research and is acceptable as it stands. Minor revisions to content, structure, or writing style may be required.
2. The thesis has merit and makes a contribution to the candidate's field; however, there are research-related concerns that have the potential to be addressed in the oral examination. The structure and writing style are acceptable or require only minor revisions.
3. The thesis has some merit, but is not acceptable in its current state and requires major revisions to one or more of its core components, such as research content, structure or writing style.
4. The thesis is unacceptable with respect to its core components, such as research content, structure, and writing style.

If none or one of the internal examiners fails the thesis (i.e. places it in categories 3 or 4, above), the thesis receives an internal pass and can proceed to external distribution to the University's External Examiner. Prior to external distribution, the candidate has the opportunity (up to 2 weeks) to incorporate changes suggested by the examining committee before resubmitting the thesis to the Faculty of Graduate Studies. However, if two or more members of the internal examining committee fail the thesis, the student is deemed to have failed the thesis. After a failure, the student can revise their thesis for a second submission to the internal examining committee. If more than one of the internal examining committee members fail the resubmitted thesis, the student is required to withdraw from the Faculty of Graduate Studies (having had 2 failures of the thesis). The awarding of a passing grade on the thesis by an individual internal examiner does not preclude that examiner from awarding a failing grade at a subsequent stage in the thesis-examination defence process.

The external examiner is then requested to provide, within three weeks, a detailed written report of the thesis and rate it either as a pass or fail. If the external examiner passes the thesis, the student can proceed to oral defence. If he or she fails the thesis, the student will have the opportunity to revise the thesis; if the external examiner fails the resubmitted thesis, the student is required to withdraw from the Faculty of Graduate Studies. The awarding of a passing grade by the external examiner does not preclude them from awarding a failing grade at a subsequent stage in the examination process.

The oral examination (defence) must be held at the University of Manitoba and is generally open to all members of the University of Manitoba community. The Dean of the Faculty of Graduate Studies (or designate) acts as Chair of the Examining Committee; typically this is a member of the Faculty of Graduate Studies from another department, who holds appointment at the rank of Professor and has recently supervised and graduated PhD students. The attendance of the External Examiner in person at the candidate's oral examination is encouraged. In some cases, if the External Examiner is not able to attend in person, that person will submit questions to the Faculty of Graduate Studies in lieu of asking them directly; these questions are typically put to the student by the advisor, immediately following their defence presentation. In many cases, if the External Examiner cannot attend the oral examination (defence) in person, he/she will participate via voice or video-conferencing (e.g., Skype). It is required that all internal members of the examining committee be present at the defence, unless exceptional circumstances prevent this and the Dean of the Faculty of Graduate Studies gives prior approval. Regardless, no more than two participants can use voice or video-conferencing. Under no circumstances can the candidate participate by voice or video conferencing.

During the oral examination, the PhD Candidate first gives a 20-minute presentation of the thesis results, and this is followed by questioning from the Examining Committee. If two or more examiners or

the External Examiner do not approve the thesis, then the student is deemed to have failed the defence. Following a successful defence, the advisor is normally responsible for ensuring that revisions are completed according to the instructions from the Examining Committee. In the event of a failed defence, the student is given a second opportunity to defend their thesis, and that again is chaired by the Dean (or designate) of the Faculty of Graduate Studies.

Transferability of course credits from post-secondary institutions

Graduate-level courses from other post-secondary institutions would generally be acceptable as the second required course or as an additional course (elective) in the PhD program. The Department has completed applications for transfer credit from a few students who take courses at other institutions in the past few years.

Sample Program Listing, PhD - Table 14

The time-to-completion for PhD students in the Biological Sciences program ranges from 48-60 months (median ~52 months).

YEAR 1	YEAR 2	YEAR 3	YEAR 4
<u>Required Courses</u> BIOL 7220 (3 CH)	<u>Required Courses</u> (alternate start BIOL 7220) <u>Any graduate level, research relevant course (3 CH), often BIOL 7600 (Special Topics) or a course relevant to statistics</u>	<u>Required Courses</u> <u>(alternate start - any graduate level, research-relevant course)</u>	<u>Required Courses</u>
<u>Electives</u>	<u>Electives</u>	<u>Electives</u> Other course of interest as approved by the advisory committee (3 CH)	<u>N.A.</u>
TOTAL HRS. 3 CH	TOTAL HRS. 3 C	TOTAL HRS.	TOTAL HRS.

STUDENT BODY – PhD Program

Table 9 shows that enrollment in the PhD program has risen since 2011, although more slowly than for the MSc program; again this has happened while the cohorts registered in the PhD Botany and PhD Zoology programs graduated (or withdrew). As with the Master’s program, there are very few part-time students in the PhD program, since there is little benefit to a student declaring part-time status (with some tax implications).

The ratio of females to males registered in the PhD program has increased since 2010 and is now over 2:1. This is not seen to be a negative or a positive, and is thought to be similar to national trends. The ratio of MSc to PhD students is roughly 2:1, as is expected for stepwise programs; the Department has a strong consensus that the PhD program should not have more students registered than the Master’s program, as there are insufficient career positions for PhD graduates.

Although the trends cannot be identified by program, the proportion of international students (out of the total registered students) has increased since 2010, as has the proportion of self-declared Indigenous students in our graduate programs since 2010-11.

PhD student financial support – Table 15

Again, please note that the accuracy of our tabulation of graduate student funding is considered an estimate, only, until the most recent 2 years.

Funding has generally increased over the past 5 years, in part due to funding through the GETS program that is available to faculty holding a Tri-Council grant (included under “Other”). As well, the level of NSERC Discovery Grant funding to the Department and the level of non-NSERC funding have also increased. This means that students have nearly always been offered stipends upon acceptance to the program; very few have zero funding from their advisor at any time, even if they are ineligible for NSERC scholarships (as non-Canadians or non-Permanent Residents) or have a GPA and record of accomplishments that does not merit a competitive-funding award. Some students are very successful in applications for smaller awards and accumulate a list of many awards in their CV. Others are more selective or are ineligible for smaller awards (e.g., in particular fields of study), and take opportunity to apply only for larger awards. Bursaries are also available, based on financial need.

Table 15 - PhD support	\$ Amount of Support in 1000s ¹	# PhDs Funded	# Students with Major Awards ²
------------------------	--	---------------	---

Year	Enrol. ³	External Scholarships ⁷	FOS	TAs	Other ⁴	Biological Sciences ⁸	Total \$	% students funded ⁵	mean \$/ student	NSERC	Vanier - NSERC	UMGF	Internal Scholarships ⁶
2014-15	34	122 (6)	28 (4)	19 (14)	132 (20)	7 (1)	308	~95%	9.1	2		5	11
2013-14	32	201 (8)	28 (4)	31 (21)	263 (27)		523	~95%	16	4	1	4	6
2012-13	21	109 (4)	14 (2)		128 (11)		251+			2	1	1	8
2011-12	14	107 (4)	42 (6)		43 (8)		192+			1	1	1	7
2010-11	8	71 (2)	14 (2)		26 (4)		111+	100		1	1	2	
2009-10	4	71 (2)	14 (2)		26 (4)		111+	100		1	1	2	4

¹ the number of students in each category appears in parentheses. Note: the number of students in each category does not add up to the total enrolled students, as some students have more than one source of funding.

² the number of students in the Department in receipt of the awards/funding listed.

³ the total number of students enrolled in graduate programs for the past 5 years; note that this number may not agree with the enrollment numbers from the Office of Institutional Analysis, as it includes all students registered in the program in any given academic year (regardless of graduation date).

⁴ Includes fellowships (stipends) from faculty member research grants, Barrett-Hamilton, Scherer, Reimer, Lubinsky, Welch, Roger Evans, Ileen Stewart, UMGFs, Faculty of Graduate Studies top-ups, and other internal awards. Does not include salary funding from supervisor (e.g., at Department of Fisheries and Oceans, Centre for Earth Observation Science, etc.). Also does not include funding from bursaries that are available to students through University of Manitoba or other agencies, or other scholarships that students receive directly.

⁵ the percentage of students funded (estimated), relative to the total number of students in the program. NOTE: this tally does not include students who receive funding to be TAs, Sessional Instructors (a few in the past 4 years), or Grader-Markers, since those monies are employment income, rather than scholarships or fellowships. The average is total \$ divided by total PhD students enrolled.

⁶ Includes Barrett-Hamilton, Rauch, International Graduate Student Education (IGSES), Lubinsky, Welch, Roger Evans, and Reimer Scholarships, and FGS top-up awards.

⁷ Includes NSERC awards (PGS-M, CGSM, MGS, Alexander Graham Bell), Science Without Borders – Brazil Scholarship, Scholarship funding from the Egyptian Government, ELA Graduate Fellowship, Manitoba Plant Biologists award, etc.

⁸ The Biological Sciences Scholarships are funded by the International College of Manitoba (ICM), which is a private institution for international undergraduate students, taking courses toward entrance to the University of Manitoba at the second-year level).

PhD Program Enrollment Trends

Trends in the enrollment for graduate courses, *per se*, are not easy to interpret, despite the availability of institutional data found in Tables 9 and 12 (above) and Tables 16 and 17 (below). The numbers are extremely variable, and hard to track in view of the progression of graduate students in their program (MSc or PhD). The tally of PhD students includes those who have transferred from the Master's program (e.g., in Table 16). The numerical data also include information for particular students who may face unique/exceptional non-academic difficulties (i.e., not related to their research) that extend their program well beyond the expectation of a typical time-to-completion in PhD program. As well, it needs to be remembered that identifying averages (e.g., average number of months to graduation, or average time to withdrawal, voluntary or required) or percentages (e.g., in time-to-completion) may not be very useful when there are only a few students in a particular cohort year. However, the tabulated data show that a PhD degree takes longer than 3 years to complete, and that there are some students who withdraw. The latter group includes those who do not pass the Candidacy Examination; at least one person in that situation re-entered the MSc program from which they had transferred to the PhD, some years earlier.

Overall, the number of PhD students in the Biological Sciences program is generally the same as the total of those enrolled in the Botany and Zoology PhD programs, before the launch of graduate programs in the Department of Biological Sciences. Therefore, the merger did not 'derail' the PhD program. However, the impact of the 2009 fire likely affected recruitment of graduate students that year, since only a cohort of 2 PhD students entered the program in 2009 (the first year of the Biological Sciences programs).

To some extent, it is too early to evaluate the impact of recent faculty recruitment on the enrollment data for PhD (or MSc) programs. However, to project into the next 5 years, the number of students in both graduate programs, MSc and PhD, is likely to rise, due to the recent recruitment of new faculty members, each establishing a new research program, and the increasing levels of research funding in labs of new faculty members and a number of well-established and very productive mid-career faculty. As well, there is growing attraction of graduate students to particular areas of biology research including animal behaviour, ecology, fish physiology, plant and animal metabolism, plant and animal physiology; plant and animal molecular biology; molecular biology and genetics of pest control; parasitology; and molecular population genetics/genomics. Recent increases in the matching formulae of funds available to researchers through the GETS program at Faculty of Graduate Studies should also help further boost the number of students that can be supported by each researcher in the Department, given the recent increases in success rate for NSERC Discovery Grants by our faculty members.

The Department is hopeful that the attractiveness of our programs, coupled with a now-refreshed national vision of science and its value to society, will allow us to recruit the best-possible graduate students from among all the applications and inquiries from students at national and international institutions. This optimism is balanced by practical considerations, however, since we do not envision our program will see a doubling of PhD trainees. That goal was encouraged by the previous federal government vision of graduate training programs as conduits for building innovation capacity in industry) and strongly encouraged by the Faculty of Graduate Studies.

We also do not anticipate seeing a huge adjustment in the ratio of Master's to PhD students in the program, although the Faculty of Graduate Studies encourages this shift to PhD training. We recognize that our program does have a 'direct-entry' route from a BSc Honours into the PhD program. Rather, as a Department, we see that the Master's degree is valuable in its own right, for raising employment prospects and for training a sub-set of the MSc students for success in further education as a PhD student. Despite a 'knowledge-based economy', the Department is skeptical that there are sufficient jobs available for a lot more PhD graduates, particularly with the recent massive economic shifts in Canada and in Manitoba.

Essentially we recognize that there are real and very important limitations on programming derived from constraints on national and provincial research funding, and on the University of Manitoba budget, all of which translate to constraints on student funding and on our ability to maintain and upgrade research facilities. However, we strongly recognize that we need to maintain the excellence of the student experience and the research success of PhD students on balance with our "productivity" in HQP training at the PhD level. Additionally, faculty would benefit from having more funding for post-doctoral fellows (who are now formally "employees", under Revenue Canada regulations, requiring full benefits, if they are paid at all, from a research grant), more support for departmental or University-allocated research technicians, since those personnel are invaluable in assisting faculty with student/trainee mentorship and supervision. Finally, additional support for the administrative staffing that is so critical to program support and financial and human-resources matters related to graduate student is needed, as it so completely integrates with supporting the research programs by our faculty.

PhD Student by Year in Program – Table 16

		Full-time					Part-time					Grand Total
		1 Yr	2-4 Yrs	5 Yrs	6+ Yrs	Total	1 Yr	2-4 Yrs	5 Yrs	6+ Yrs	Total	
Fall 2010	Biological Sciences	4	2	0	0	6	0	0	0	0	0	6
	Botany	0	3	0	7	10	0	0	0	1	1	11
	Zoology	0	4	1	4	9	0	0	0	0	0	9
Fall 2011	Biological Sciences	4	7	1	0	12	0	0	0	0	0	12
	Botany	0	2	1	3	6	0	0	0	2*	2	8
	Zoology	0	1	3	3	7	0	0	0	0	0	7
Fall 2012	Biological Sciences	2	13	0	0	15	0	0	0	0	0	15
	Botany	0	2	0	2	4	0	0	0	2	2	6
	Zoology	0	0	1	2	3	0	0	0	1	1	4
Fall 2013	Biological Sciences	7	15	2	0	24	0	0	0	0	0	24
	Botany	0	0	2	1	3	0	0	0	1	1	4
	Zoology	0	0	0	3	3	0	0	0	1	1	4
Fall 2014	Biological Sciences	4	15	6	1	26	0	0	0	0	0	26
	Botany	0	0	0	2	2	0	0	0	0	0	2
	Zoology	0	0	0	2	2	0	0	0	0	0	2

* Counts include student's on leave from program.

Source: *Ph.D. Students by Year in Program*
<http://umanitoba.ca/admin/oia/students/3504.html>

PhD Time-to-Completion – Table 17

Cohort Year	Status	Number of Students	% Graduated or Promoted	% VW	% Cont	Median # Months to Graduate	Average # Months to VW	% Graduated							
								Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
2009	After 6yrs	2	50	50	0	52	32	0	0	0	50	50			
2010	After 5yrs	4	25	0	75	60		0	0	0	25				
2011	After 4yrs	6	0	0	100			0	0	0					
2012	After 3yrs	4	0	0	100			0	0						
2013	After 2yrs	9	0	22	78		12	0							

Source: *Ph.D. Students - Cumulative Rates of Graduation, Continuation and Withdrawal by Faculty/School and Department, for the cohorts from 2001-2013*
http://umanitoba.ca/admin/oia/program_reviews/2065.html

Graduate Course Offerings for past 5 years – Table 18

Enrollment in the core PhD course over the past 5 years has fluctuated. The most recent year of registration in the BIOL 7100 course (the core course for the MSc program) had n=30 students (Fall 2015).

Table 18 (below) includes the total enrollment by academic year (including VWs) for Master’s (M); PhD (D); or both (M/D)

Course	Title	Credit Hrs.	Program [†]	2014	2013	2012	2011	2010	2009
				-15	-14	-13	-12	-11	-10
				# Students	# Students	# Students	# Students	# Students	# Students
BIOL 7100	Core Skills in Biological Sciences Research (required in M, available to M/D)	3	M	21	21	24	17	28	20
BIOL 7140	Advanced Physiology	6	M/D				1		
BIOL 7150	Selected Topics in Avian Biology	6	M/D						1
BIOL 7220	Critical Thinking (required in PhD)	3	D	13		10		6	
BIOL 7230	Advanced Topics in Zoology	6	M/D						
BIOL 7240	Wetland Ecology	6	M/D				2	3	7
BIOL 7340	Problems in Developmental Zoology 1	3	M/D						4
BIOL 7360	Problems in Biological Statistics	3	M/D		7		5	1	
BIOL 7370	Special Topics in Algal Ecology	6	M/D						1
BIOL 7410	Special Topics in Botany	3	M/D					1	7
BIOL 7502	Cell and Developmental Biology	3	M/D		6		6	2	
BIOL 7530	Molecular Biology Techniques for Eukaryotes (split to 7554 + 7556 in 2014)	3	M/D	-	-	10	8	8	

Course	Title	Credit Hrs.	Program†	2014	2013	2012	2011	2010	2009
				-15	-14	-13	-12	-11	-10
				# Students	# Students	# Students	# Students	# Students	# Students
BIOL 7540	Methods for Analysing Biological Data	3	M/D	9		7	18	18	
BIOL 7554	Molecular Biology of Eukaryotes (DNA)	3	M/D	7	4				
BIOL 7556	Molecular Biology of Eukaryotes (RNA)	3	M/D	4	4				
BIOL 7600	Special Topics (multiple sections)	3	M/D	23	8	10	14	15	
BIOL 7602	Directed Studies in Biological Sciences	3	M/D		1				
BIOL 7880	Ecology Project Course	3	M/D						1

Special Topics Graduate-Level Courses - Enrollment by year and term - Table 18A

Term	# Students	"Topics" Title (Section)	Instructor	Course #
F2009	1	Selected Topics in Avian Biology	Sealy	7150
	1	Microtechniques (Part A)	Huebner	7230
	1	Marine Ecosystems Communities (Part A)	Davoren	7230
	1	Mine Remediation (Part A)	Markham	7410
	1	A Review of Ecological Modeling Approaches	Roth	7880
W2010	2	Lichen Symbioses	Piercey-Normore	7410
	5	Molecular Development of Plants	Schroeder	7410
F2010	2	Lamprey Development	Docker/Whyard	7600
	1	Advanced Respiratory Physiology	Campbell	7600
	1	Animal Behaviour	Hare	7600
	1	Advanced Wildlife Management	Riewe	7600
W2011	3	Plant Stress Physiology	Renault	7600
	1	Arctic Marine Communities and Ecosystems	Dick	7600
	1	Comparative Endocrinology	G Anderson	7600
	1	West Nile Virus	Whyard	7600
	1	Behavioural Ecology	Hare	7600
	2	Molecular Development Biology	Whyard	7600
	1	Analysis of Spatial Data in Ecology	Markham	7600
F2011	1	Evolutionary Biology	Docker/Worley	7600
	1	Pathological Mechanisms	J Anderson	7600
	2	Advanced Microtechniques	Huebner	7600
	1	Arctic Marine Communities and Ecosystems	Dick	7600
	1	Marine Mammal Energetics and Health Consequences	Loseto (Adj)	7600
W2012	1	Advanced Fish Systematics	Docker	7600
	2	Developmental Biology Techniques	Whyard	7600
	1	Protein Mass Spectrometry	Whyard	7600
	1	Analysis of Protein Structure	Whyard	7600
	1	Mass Spectrometry Analysis of Nucleic Acids	Whyard	7600
	1	Neonatal Gastrointestinal Physiology	Diehl-Jones	7600
	1	Plant Stress Physiology	Renault	7600
F2012	2	Cell Adhesion Molecules	Whyard/Kormish	7600
	1	Analysis of Ecological Data	Renault	7600
	1	Advanced Microtechniques	Huebner	7600
	3	Cell and Tissue Culture	Diehl-Jones	7600
	1	A critical evaluation of in stream fish capture and anaesthesia techniques	Palace (Adj)	7600
	1	Principals of Neural Science	Fry	7600
W2013	1	Lichens and Bryophytes	Piercey-Normore	7600

F2013	2	Techniques in Microscopy	Huebner	7600
	1	Cellular and Genetic Basis of Organ Development	Kormish	7600
	1	Lichen Ecology Methods	Piercey-Normore	7600
W2014	1	Functional Characteristics of RH-Protein	Weihrauch	7602
	1	Evolution and Adaptation	Worley	7600
	1	Bioacoustics	Hare	7600
	1	Developing Quantitative Ecological Analysis	Gillis	7600
F2014	1	Advanced Evolutionary Biology	Docker/Worley	7600
	3	Analysis of Ecological Data	Roth	7600
	1	Mammalogy	Waterman	7600
	1	Techniques in Microscopy	Huebner	7600
	1	Project Management in the Lab	J Anderson	7600
	1	Analyzing Wildlife Habitat use with ArcGIS	Roth	7600
	4	Cell-Specific Gene Detection in Plants	Belmonte	7600
	2	Plant Ecology and Physiology	Renault/Markham	7600
	3	Plant Stress Physiology	Renault	7600
	1	Principles of Animal Learning	Hare	7600
	3	Principals of Neural Science	Fry	7600
W2015	1	Lichens and Bryophytes	Piercey-Normore	7600
	1	Identification and Functional Characterization of Putative K ⁺ -channel (HIAT)	Weihrauch	7600
F2015	4	Molecular Genetics of Plant Development	Schroeder	7600
	2	Analysis of Ecological Data	Roth	7600
	1	Cellular and Genetic Basis of Organ Development	Kormish	7600
	1	Ecological Modeling with GLMMs using Frequentist and Bayesian Methods	Gillis	7600
	2	Modifying Gene Expression	Whyard	7600
	1	Plant Stress Physiology	Renault	7600
W2016	1	Comparative Endocrinology	G Anderson	7600
	1	Molecular Genetic Controls of Reproduction	Whyard	7600
	1	Lichens and Bryophytes	Piercey-Normore	7600

SERVICE TEACHING

The Department provides a significant contribution to undergraduate service teaching at all levels. The vast majority of this service teaching is at the 1000 level, and is also primarily delivered in large-enrollment courses (BIOL 1000, 1010, 1020, 1030, 1410, and 1412). Despite attempts to increase our capacity to serve the many students wishing to satisfy science-course requirements or fill pre-requisites for entry to particular programs (e.g., Nursing, Kinesiology, Medical Rehabilitation, etc.), often the laboratory capacity for a course is the limiting factor that caps enrollment in the course. Nonetheless, the instructors of courses that have major service-teaching enrollments aim to maintain standards that are equivalent to those desirable for students we wish to attract to our own undergraduate programs. The aim is also to provide “real science” experiences in BIOL 1020, 1030, 1410 and 1412, by retaining laboratory teaching and assessment of students on that laboratory material. The budget for our Teaching Assistants (including Grader Markers, and Invigilators) is significant, and considered important by the Department, specifically to sustain this hands-on learning opportunity for students, and build their skillset toward applications in more advanced learning and/or employment.

Overall, from 2010-11 to 2014-15, the total CHs of instruction (Fall plus Winter terms) increased (Table 19), as has Summer Session teaching (also increasing although not shown in Table 19). The increase in enrollment is distributed slightly more into the Winter term for 1000- and 2000-level courses, and slightly more into the Fall term for 3000- and 4000-level courses. Note that Table 19 shows data for final enrollment, and does not include tabulation of any CHs related to the students who VW from courses, particularly at the first-year level.

Undergraduate Teaching Loads by Course Level – Table 19

Academic Period	Total	Course Level				Percentage			
		1000	2000	3000	4000-5999	1000	2000	3000	4000-5999
2010-2011									
Fall 2010	15,039	10,059	3,456	1,116	408	67%	23%	7%	3%
Winter 2011	13,644	8,232	3,921	1,233	258	60%	29%	9%	2%
2011-2012									
Fall 2011	16,359	10,860	3,615	1,317	567	66%	22%	8%	3%
Winter 2012	14,289	8,169	4,059	1,821	240	57%	28%	13%	2%
2012-2013									
Fall 2012	16,437	10,803	3,564	1,554	552	66%	22%	9%	3%
Winter 2013	15,153	8,340	4,269	2,247	297	55%	28%	15%	2%
2013-2014									
Fall 2013	16,286	10,806	3,522	1,413	545	66%	22%	9%	3%
Winter 2014	15,053	8,460	4,011	2,274	308	56%	27%	15%	2%
2014-2015									
Fall 2014	16,668	11,115	3,291	1,758	504	67%	20%	11%	3%
Winter 2015	14,295	8,340	4,251	1,404	300	58%	30%	10%	2%

*Excludes courses taught through distance and summer on-load credit hours.

A sample year overview of CHs delivered by the Department in Fall 2014-Winter 2015 is provided below (Table 19 A), with the same breakdown by course level. This table has different tallies of CHs per term to those in Table 19 above, as these are from the Taught-to, Taught-by data as of November 1 (Fall) and March 1 (Winter) for that year. The difference illustrates there is still a 1-2% drop in CHs that occurs with very late VWs. Figure 14 (below) illustrates the Taught-to, Taught-by data for second-year courses. Even at that level, the Department’s contribution to service teaching is significant.

Credit hours by course-year level in Fall 2014 and Winter 2015 terms – Table 19A & Figure 14

level	F14	%F14	W15	%W15	F14+W15	%(F14+W15)
1000	12006	68.38	9606	61.73	21612	65.25
2000	3291	18.74	4251	27.32	7542	22.77
3000	1758	10.01	1404	9.02	3162	9.55
4000	504	2.87	300	1.93	804	2.43
total	17559	100	15561	100	33120	100

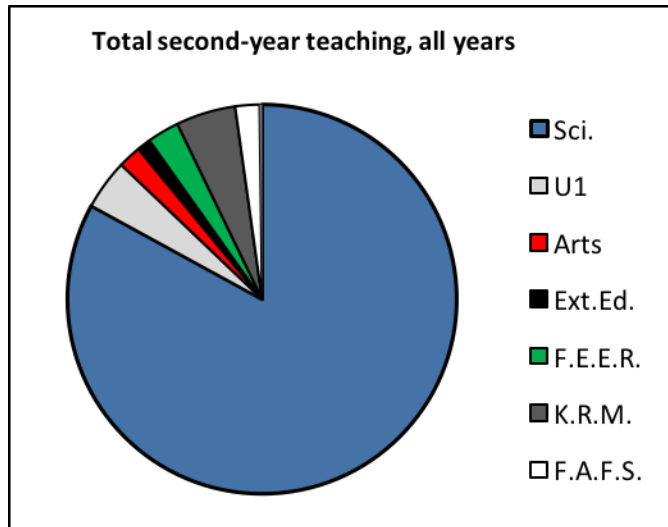


Figure 14 (above): Total teaching in 2000-level courses by the Department of Biological Sciences delivered **TO** the eight Faculties that have the next-highest number students taught in BIOL courses, 2010-2015. Legend: the largest part of the pie chart represents students from the Faculty of Science (Sci.), then clockwise, students registered in University-1 (U1), Extended Education (Ext.Ed.), the Environment, Earth and Resources (F.E.E.R.), Kinesiology and Recreation Management (K.R.M.), Agriculture and Food Sciences (F.A.F.S.), and Human Ecology (H.E.).

Courses

Course outlines are provided for reference, in Appendix 12.

Graduate level

There are 23 courses listed in Aurora Student within the graduate program (BIOL 7000 - BIOL 7999), as follows:

- 7100 – Core Skills in Biological Sciences Research
- 7140 – Advanced Physiology (6 CH)
- 7142 – Advanced Physiology (3 CH)
- 7202 – Evolutionary Biology
- 7220 – Critical Thinking
- 7230 – Advanced Topics in Zoology
- 7240* – Wetland Ecology

7250 – Advanced Evolution and Systematics
7302 – Environmental Biology and Ecology
7352 – Aquatic Biology
7360 – Problems in Biological Statistics
7370 – Special Topics in Algal Ecology
7440 – Methods and Approaches to Analysis of Biological Data 1
7450 – Methods and Approaches to Analysis of Biological Data 1
7502 – Cell and Developmental Biology
7540 – Methods for Analysis of Biological Data
7554* – Molecular Biology of Eukaryotes (DNA)
7556* – Molecular Biology of Eukaryotes (RNA)
7580 – Topics in Plant Pathology
7590 – Pathology of Trees and Shrubs
7600* – Topics in Biological Sciences
7602 – Directed Studies in Biological Sciences
7880 – Ecology Project Course

The trend has been to reduce the number of courses required for graduate degrees, and in some cases, to have courses “double numbered” (*, above, when they are offered to graduate and senior undergraduate students together). This conserves faculty time and allows faculty to focus their teaching expertise toward teaching students about research and how to do it (i.e., research training). It also opens up opportunities for advanced skills training and education to senior undergraduate students. The syllabus requirements for the graduate students enrolled in such courses are more rigorous (e.g., often with a major paper or a grant proposal, in addition to the assignments given to undergraduate students).

Undergraduate level

The number of courses offered in our undergraduate programs is large, with 57 unique course numbers listed in the course schedule. Some are offered in Fall and Winter, and others are offered in all 3 terms (Fall, Winter, Summer).

Trends related to course offerings in the Department

The trends are to:

- add courses when important subject-area deficiencies are noted
- develop a course in an area relevant to the expertise of a new faculty member,
- add courses as the program matures (e.g., molecular population genetics/genomics, biological sustainability),
- change course requirements and lab sessions/assignments as the field develops and the faculty cohort evolves,
- allow another unit to deliver a BIOL course if the expertise is not available in our Department or when it increases course opportunities for our students, and
- co-teach a course with particular departments where there is opportunity to share responsibility and teaching load while reducing overlap (e.g., Plant Physiology is now co-taught with Plant Sciences).

As well, a new course can be “beta-tested” once or twice as a section designated under the Special Topics course (BIOL 4890), with the plan to propose it as a new course in a subsequent year (e.g., Biology and Society, see below). However, while we know there is currently a trend to add new courses with newly available expertise and interest among recent recruits, we need and want to be careful that our human resources (as well as the physical and fiscal resources available to us) are not stretched too thinly for teaching, as that will constrain time for research activities and the mentorship of research students. Thus, we are also considering the consolidation of a few existing courses, as recently occurred with Plant Physiology.

Faculty also offer a variety of sections of the Special Topics course to one or more students interested in an area of research or knowledge, on a year-by-year basis (e.g., offered in Winter 2016: fungal bioinformatics, molecular genetics in animal models, molecular genetics of UV-damaged DNA repair, functional characterization of plant genes II, computational approaches to canola development, best practices for using remote trail cameras to monitor wildlife, genetic control of parasites in root-knot nematodes, and molecular ecology of parasites). These course offerings add to the breadth of learning opportunity for undergraduate students, and also develop student interest in research (toward recruitment to our graduate programs). The Department is considering how best to manage the commitment required to deliver these small-enrollment courses and the communications to students who may be interested and qualified to succeed in such advanced courses where the expectations of student performance are high.

Possible new courses

Some new courses under consideration at the graduate level are:

- Current Topics in Cell, Molecular and Developmental Biology (possibly to be incorporated as a regularized Special Topics Course every 2 years) – would require a coordinator

Some new courses under consideration at the undergraduate level:

- Biology and Society (4000 level, restricted to Biological Sciences, Environment, Biotechnology, Animal Science, Microbiology)
- A new field course, such as a local terrestrial-based ecology course
- Plant Metabolism (3000 or 4000/7000) and/or Metabolic Techniques (laboratory applications)
- Molecular Population Genetics/Genomics (4000/7000)
- Reviving the BIOL 4216 course on Biology of Amphibians and Reptiles (possibly alternating every 2 years with Fish Systematics); this would require that the teaching of Evolutionary Biology in Fall term is reassigned, and
- Bioinformatics – a modular course co-taught by a number of faculty in Biological Sciences together with Computer Science (new recruit) and Statistics (pending recruitment).

Distribution of course-teaching load

The workload of teaching the courses in our programs is typically distributed among faculty based on discussions early in the Winter term, between the Associate Head (Undergraduate) (who also serves as the Chair of the Undergraduate Curriculum Committee) and individual members of the faculty, and concurrent discussions between the Department Head and individual faculty members at their annual activity report meeting (and other meetings) also inform the discussion of teaching assignment and academic planning in the Department (e.g., program changes, plans for research-study leaves or career

progression). These discussions, and the ultimate assignment of teaching duties, consider the following parameters together:

- the available faculty human resources (e.g., position vacancies, research, parental/medical leaves),
- the Department's need to deliver programs, especially the required courses for our programs,
- the student demand (related to number of lab or lecture sections) and enrollment in a course,
- whether a course should be offered in more than one term,
- the load of administration and service load of each member of the Department (e.g., Associate Head and Head, Chairs of major committees in the Department (GSC, UGCC, HTC), outreach activity, Senate, Senate committees, Associate Dean, or UMFA),
- the time since recruitment to the Department (e.g., there is some teaching relief for new faculty especially in the first year of appointment, under the UMFA-UM Collective Agreement),
- appointment status of faculty members who have expertise to teach a course (% full-time, professor or Instructor rank),
- the expertise of faculty available and willing to provide instruction,
- the nature of a position (e.g., appointment as a Canada Research Chair or an Industrial Research Chair),
- input from discussions among theme groups (e.g., Physiology theme) which facilitate assignment of teaching in a group of courses,
- individual preferences for schedule or section, and sometimes for a change in teaching assignment,
- past contributions to teaching courses in our program,
- whether courses are lecture-only, lecture plus lab, large or small enrollment,
- course level (1000, 2000, 3000/4000, 7000),
- research activity and scholarly activity by a faculty member (e.g., writing or editing a textbook, writing or editing a research or reference book, renewing a grant, applying for/renewing a research chair, leadership/program chairs in professional societies, etc.),
- the experience of a faculty member in teaching per se, and specifically expertise in the subject area of a course or courses and whether an individual has previously taught the same or a closely related course,
- the Department budget in relation to the number of sections, whether to offer a course or not (budget to recruit Sessional Instructors), and the fiscal support for hiring TAs and/or Grader-Markers),
- the core nature of graduate courses (BIOL 7100, BIOL 7220),
- career plans (e.g., for sabbatical/research leave, applications for promotion and/or tenure), and
- the availability of Sessional Instructors (and approval to recruit).

The "default" assignment or teaching load of faculty in the Department typically is 3 courses (3-credit-hour) distributed over the Fall and Winter terms (regular session), with offset for some subset of the considerations above, related to each person. Teaching by full-time appointees in the Department, during Summer-Session and Distance Education (online courses), is typically 'over load' or above the load assigned to an individual (i.e., voluntary and therefore paid over the annual salary), at least to date.

Faculty contribute to the programs through a wide variety of teaching innovations, including the examples below, offered at different levels by individual instructors:

At the 1000 level: YouTube videos “Talk to a Biologist”; use of marine aquarium to demonstrate living invertebrates; use of carnivorous plant and greenhouse plant collections to demonstrate the diversity of organisms;

At the 2000 level: Science Fridays with a “*CBC Quirks & Quarks*” listening assignment; peer-wise assignment; mushroom collection; writing multiple-choice questions, digital imaging by microscopy;

At the 3000 level: in-class debates on genetically modified organisms, gene editing, and pop-up labs; Journal club presentations; creative expressions (e.g., drawing, photography, posters); plant collection; poster afternoon for student research proposals; a guest lecture in medical genetics; weekend field trips; animal behaviour projects at the zoo; field courses at Manitoba wetlands

At the 4000 level: poster evenings to present student assignments; winter treasure hunt; reviewing public perceptions of genetically modified organisms, stem-cell research, and organism cloning; peer reviews of essay assignments; visits to museum collections; visits to museum preparation and display areas; field trips to Fort Whyte Alive; field courses at Churchill Northern Studies Centre and Wapusk Park, and to Costa Rica; field-course modules (5 modules for 3 CHs); field experiences in Manitoba wetlands; guest lecture in climate change; observations of Purple Martin nesting behaviour; and

At the 7000 level: giving peers constructive feedback; current affairs; discussions of biology and the politics of science in the news; an in-class experiment related to the scientific method with follow-up for assignments in abstract writing and hypothesis testing; career panels at the Master’s level; an “Oops!” panel on the approach to graduate studies and avoiding mistakes; practising introductions by introducing a classmate; writing a job application (covering letter, CV); discussion of a case scenario on research ethics; small-group discussions on research areas and future directions of research, etc.

Taught-to, Taught-by, Undergraduate Course Offerings – Table 20 and Figure 15

[Table 20: Taught to Taught By, Undergraduate Course Offerings](#)

(Control click the hyperlink above to view table 20)

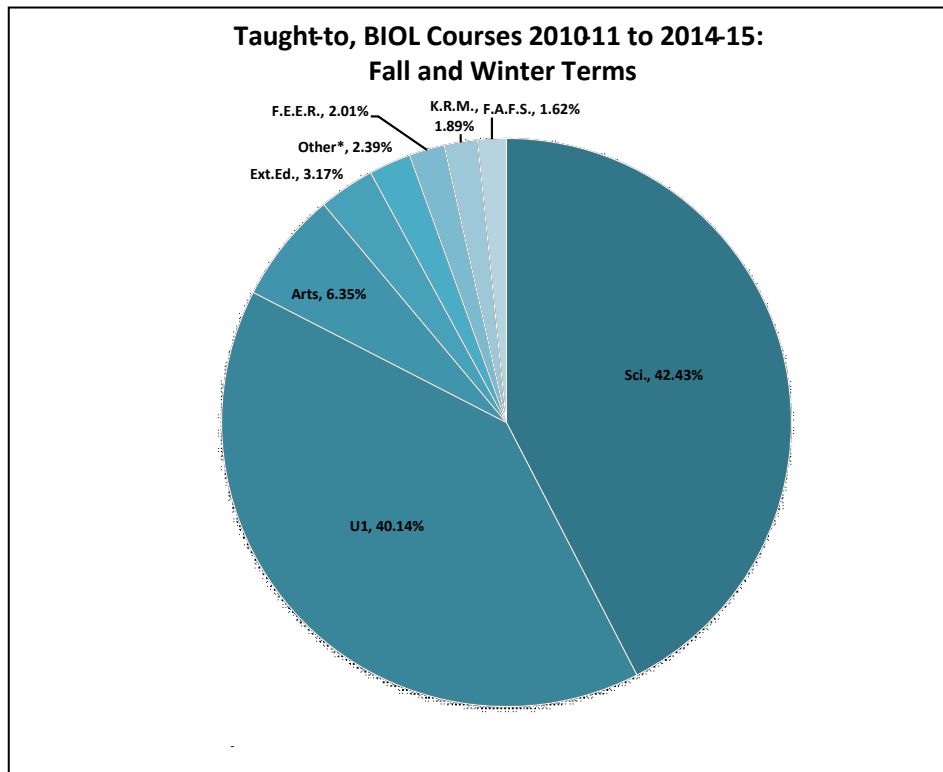
Data in Table 20 shows that in 2014-15, courses delivered by the Department of Biological Sciences had more students from outside the Faculty of Science (53.6%) than students who were registered in the Faculty of Science (46.6%). The students from outside Science had home Faculties in: University 1 (34.1%), Faculty of Arts (7.95%), Extended Education (3.89%), and the Faculty of Earth, Environment and Resources (1.87%). The chart below shows overall distribution of the “home Faculty” for students registered in BIOL-designated courses between 2010-11 and 2014-15.

The Department is optimistic that the ‘direct entry’ route for high school students to declare Science as their home Faculty in first year has the strong potential to increase the proportion of Science students that register in the upper-level courses offered by the Department (if the Department can accommodate that demand, which is not certain) and in the Department’s Majors and Honours programs (again, if the Department can accommodate that demand).

However, it is important to note that we do not consider a “service” course any less important than a core course in a Biological Sciences Majors or Honours program; in fact, we are serious in considering these courses opportunities to engage students and really teach science for a well-rounded education. This approach to teaching also opens doors to learning opportunities and careers that students from other Faculties taking a “science course” or an elective from the Department might not otherwise find available in their home Faculty or program. Department faculty members feel that it can be just as

rewarding to interact with students in a non-Majors or service course outside the list of our core courses, and to watch them learning successfully or see “ah-hah!” moments, as to teach someone who wants to be in science.

Figure 15 (below) shows all the service teaching by the Department, for the top-ranked Faculties at the University of Manitoba. Legend: Sci. = Faculty of Science; U1 = University-1, Ext.Ed. = Extended Education; F.E.E.R.= Faculty of Environment, Earth and Resources; K.R.M.= Kinesiology & Recreation Management; F.A.F.S.= Faculty of Agricultural and Food Sciences; and “Other”. Other includes students enrolled in Human Ecology, Nursing, Engineering, Management, Faculty of Graduate Studies, Dental Hygiene, Music, School of Art, Education, Social Work, Architecture, Pre-Masters, Pharmacy and Law.



HUMAN RESOURCES - ACADEMIC STAFF

There are 40 full-time academic staff in the Department (15 are female and 25 are male), including one who will arrive in July, 2016. The roster includes 7 Instructors and 33 research faculty: 12 Professors (1 holds an Industrial Research Chair position), 14 Associate Professors, and 8 Assistant Professors (1 holds a Tier 2 Canada Research Chair position). Two Professors hold 50%-time appointments. The areas of specialty, and the roles of each faculty member are tabulated below. Faculty CVs appear as Appendix 14.

Academic Staff by Specialty and Role – Table 21

Name	Rank ¹	Tenure	Specialty Area	Undergraduate ²			Graduate ³			Admin. Service ⁴		
				Teaching	Honours Supervision	Thesis Committees	Teaching	Supervision	Thesis Committees	Department	Faculty	University
Dr. Judy Anderson	Head Professor	Y	Skeletal muscle satellite –stem cells, regeneration	X	X	X	X	D	X	X	X	X
Dr. Jim Hare	Assoc. Head Professor	Y	Animal behaviour; sociality, communication & cognition	X	X	X	X	D	x	X	X	X
Dr. Michele Piercey-Normore	Assoc. Head Professor	Y	Lichenology, evolution, ecology	X	X	X	x	D	X	X	X	X
Dr. Gary Anderson	Professor	Y	Fish physiology, sturgeon conservation	X	X	X	X	D	X	X	X	X
Dr. Thomas Booth	Professor	Y	Mycology, ecology	X	X	X	X	D	X	X	x	X
Dr. Kevin Campbell	Professor	Y	Evolutionary & environmental physiology, phylogenetics, ancient DNA	X	X	X	X	D	X	X	X	
Dr. Bruce Ford	Professor	Y	Vascular plant systematics, sedges, evolutionary biology	X	X	X	X	D	X	X		
Dr. Brenda Hann	Professor	Y	Limnology, ecology, invertebrate biology	X	X	X		D	X	X	X	X

Name	Rank ¹	Tenure	Specialty Area	Undergraduate ²			Graduate ³			Admin. Service ⁴		
				Teaching	Honours Supervision	Thesis Committees	Teaching	Supervision	Thesis Committees	Department	Faculty	University
Dr. Erwin Huebner	Professor	Y	Cell, developmental and reproductive biology, microscopy	X	X	X	X	D	X	X	X	
Dr. Norman Kenkel	Professor	Y	Forest ecology	X	X	X	X	D	X	X	X	
Dr. Jane Waterman	Professor	Y	Behavioural ecology, wildlife biology, mammalogy	X	X	X		D	X	X	X	
Dr. Mark Belmonte	Assoc. Professor	Y	Plant molecular biology and genomics	X	X	X	X	D	X	X	X	X
Dr. Gail Davoren	Assoc. Professor	Y	Marine predator-prey ecology, foraging behaviour	X	X	X	X	D	X	X	X	
Dr. Margaret Docker	Assoc. Professor	Y	Fish biology, evolution, genetics	X	X	X	X	D	X	X	X	
Dr. Darren Gillis	Assoc. Professor	Y	Fisheries and behaviour, quantitative ecology	X	X	X	X	D	X	X	X	
Dr. Gordon Goldsborough	Assoc. Professor	Y	Wetland/marsh and freshwater lake ecology	X	X	X		D	X	X	X	
Dr. Jeffery Marcus	Assoc. Professor	Y	Butterfly phylogenomics, evolution and development	X	X	X		D	X	X	X	X
Dr. John Markham	Assoc. Professor	Y	Soil rehabilitation and ecology, nitrogen fixation/herbivory	X	X	X		D	X	X	X	
Dr. Sylvie Renault	Assoc. Professor	Y	Land reclamation, plant stress physiology	X	X	X	X	D	X	X	X	
Dr. Jim Roth	Assoc. Professor	Y	Quantitative ecology, food webs, stable isotopes	X	X	X	X	D	X	X	X	
Dr. Dana Schroeder	Assoc. Professor	Y	Plant genetics and plant stress	X	X	X	X	D	X	X	X	

Name	Rank ¹	Tenure	Specialty Area	Undergraduate ²			Graduate ³			Admin. Service ⁴		
				Teaching	Honours Supervision	Thesis Committees	Teaching	Supervision	Thesis Committees	Department	Faculty	University
Dr. Dirk Weihrauch	Assoc. Professor	Y	Animal physiology, osmoregulation, ammonia excretion, acid-base regulation	X	X	X	X	D	X	X	X	
Dr. Steve Whyard	Assoc. Professor	Y	RNAi biotechnologies in insects, fungi & plants, regulation of insect reproduction	X	X	X	X	D	X	X	X	
Dr. Anne Worley	Assoc. Professor	Y	Pollination and reproductive success, ecology and evolutionary genetics	X	X	X	X	D	X	X		
Dr. Mark Fry	Assoc. Professor	Y	Neurobiology, regulation and electrophysiology of obesity and feeding behaviour	X	X	X	X	D	X	X	X	X
Dr. Jillian Detwiler	Assistant Professor	N	Parasitology, genetics and ecology	X	X	X		D	X	X		
Dr. Kevin Fraser	Assistant Professor	N	Ornithology, migration behaviour	X	X	X		D	X	X		
Dr. Jay Kormish	Assistant Professor	Y	Developmental biology, molecular genetics of pharynx development	X	X	X	X	D	X	X		
Dr. Jake Stout	Assistant Professor	N	Plant biochemistry of secondary compounds	X	X	X		D	X	X	X	
Dr. Jason Treberg	Assistant Professor	N	Metabolism and energy balance, mitochondrial regulation	X	X	X		D	X	X	X	
Dr. Gavin Chen	Assistant Professor	N	Molecular plant physiology	X	X	X		D	X	X		
Dr. Colin Garroway	Assistant Professor	N	Molecular population genomics/genetics	X	X	X		D	X	X		
Dr. Ken Jeffries as of July 2016	Assistant Professor	N	Fish physiology and genetics, conservation biology	X	X	X		D	X	X		

Name	Rank ¹	Tenure	Specialty Area	Undergraduate ²				Graduate ³			Admin. Service ⁴		
				Teaching	Honours Supervision	Honours Thesis	Committees	Teaching	Supervision	Thesis	Committees	Department	Faculty
Dr. Jennifer McLeese	Senior Instructor	Y	Animal physiology, human anatomy and physiology	X							X	X	
Dr. Kevin Scott	Senior Instructor	Y	Teaching of animal physiology, gut physiology, introductory biology	X		X					X	X	X
Mr. Michael Shaw	Senior Instructor	Y	Biology of earth's environment	X							X	X	X
Dr. Isobel Waters	Senior Instructor	Y	Plant ecology and biology	X		X					X		
Dr. Joy Stacey	Instructor II	Y	Animal biology and physiology	X		X					X		
Dr. Paul Messing	Instructor I	N	Ecology, human anatomy and physiology	X							X		
Dr. Carla Zelmer	Instructor I	N	Plant genetics, ecology, growth and pest control	X							X		

¹ academic staff is sorted by rank –Professor, Associate Professor, Assistant Professor

² the roles contributed by academic staff in delivery of the undergraduate programs, including participation and/or supervision on Honours thesis committees.

³ the roles contributed by academic staff in delivery of the graduate programs; for supervisory responsibilities, the highest level at which individuals are permitted to supervise is indicated as: M = Master's level; D = PhD level.

⁴ the roles contributed by academic staff in the administration of program delivery (e.g., administrative roles, committee participation, etc.) including participation at the departmental, Faculty, and institutional levels.

Courses Taught by Academic Staff, Undergraduate and Graduate – Table 22

[Table 22: Courses Taught by Academic Staff, Undergraduate and Graduate](#)

(Control click the above hyperlink to view table 22)

*Includes courses taught during the past five academic years (Fall, Winter and Summer terms).

† Level: U = Undergraduate; G = Graduate

Student Supervision and Advisory Committees

All research faculty are able to supervise MSc and PhD students, as well as Honours students in the Department's programs. In addition, a number of faculty also currently supervise or previously supervised students in programs in other departments (e.g., through cross-appointments or adjunct

status). Most research faculty also serve on thesis-advisory committees for students in the Department, the Faculty of Science, and other Faculties in the University, and some are active on graduate student advisory committees at other universities (especially but not limited to students at the University of Winnipeg).

Typically, new faculty have fewer graduate students than more established, well-funded faculty, although some individuals rapidly recruit undergraduate Honours and graduate students to their research program. Typically new faculty recruit their first graduate student within a year of their appointment (taking advantage of research start-up funds). To some extent, the timing depends on the start date of their position and our ability to give them good visibility (a “presence”) such as happens by having new faculty give a guest lecture or presenting their area of research (and interest in recruiting students) in one or more courses (e.g., Skills in Biological Sciences, BIOL 3100; Cell Biology, BIOL 2520). These presentations can help new faculty attract and recruit undergraduate research students. Presentations in the Honours information sessions also help them attract students who will be graduating from a BSc with significant research experience and know they are interested in seeking a graduate-training position. Some individuals in the Department (at any academic rank) prefer to limit the number of graduate students in their research program for a variety of reasons (management style, certainty of funding, risk aversion related to previous experience, and/or activities in teaching, administration, and service); others prefer to fill their laboratory or research program to the limit of their scholarship capacity and the budget of their research funding.

The number of students per laboratory/research program also depends on successful recruitment for graduate degrees (MSc or PhD) with the financial, training, and academic considerations of managing programs of different research questions, approaches, and particular model organisms or study subjects, as well as managing logistics and costs of the location where research is conducted.

Overall, there is a trend over the past 5-6 years to have more graduate students in the MSc and PhD programs in the Department, and for there to be more female than male students enrolled (which is fairly typical for Life Sciences programs in Canadian universities). For adjunct professors appointed in the Department, the area of study, available levels of funding, and workplace conditions (e.g., with industry or government laboratories) also affect the number of graduate students in the program. For example, some students supervised by adjunct professors are hired on contract, while others receive a stipend or scholarship from the supervisor or an external agency.

Academic Staff Thesis Supervision and Committee Participation – Table 23

Name ¹	Thesis Supervision ²								Committee Participation ⁴ (past 5 years)			
	Current (2015)				Career Total				Internal		External	
	H	M	D	Other ³	H	M	D	Other	M	D	M	D
Dr. Judy Anderson	0	0	1		7	15	7	7 BSc(Med) 5 PDFs 4 technicians 1 research assoc.	1	3	4	8
Dr. Jim Hare	0	5	1		19	15	2	1 PDF	10	10	12	13

Name ¹	Thesis Supervision ²								Committee Participation ⁴ (past 5 years)			
	Current (2015)				Career Total				Internal		External	
	H	M	D	Other ³	H	M	D	Other	M	D	M	D
Dr. Michele Piercey-Normore	0	3	2	2 BSc volunteers 3 BSc projects	10	6	9 (2 visiting)	2 PDFs 13 summer students, 9 volunteers 9 research projects 1 technician	0	2	7	14
Dr. Gary Anderson	0	6	1		15	12	4	3 PDFs	12	10	0	3
Dr. Thomas Booth		1									2	
Dr. Kevin Campbell	0	1	1		7	4	1	1	0	4	3	1
Dr. Bruce Ford	0	2	0		6	3	1		6	3	1	
Dr. Brenda Hann	0	0	0		12	15	0	0	8	3	4	2
Dr. Erwin Huebner	0	0	0	1 in Biology Uof Winnipeg	5	12	4	2 PDFs	7	1	2	1
Dr. Norman Kenkel	0	1	0		10	24	5		5	1	0	1
Dr. Jane Waterman	1	4	2		6	22	3		4	1	1	3
Dr. Mark Belmonte	1	3	2		5	5	2	1	7	10	0	0
Dr. Gail Davoren	1	2	1		10	10	3	30	10	7	3	1
Dr. Margaret Docker	1	2	4		7	10	4		7	4	4	1
Dr. Darren Gillis	0	3	0		3	11	2**		3	3	2	0
Dr. Gordon Goldsborough	1	3	0		19	19	5		5	1	0	0
Dr. Jeffery Marcus	2	2	1	1 Hons, Genetics, 5	7	8	1	18 non-Hons undergraduates	10	5	0	1

Name ¹	Thesis Supervision ²								Committee Participation ⁴ (past 5 years)			
	Current (2015)				Career Total				Internal		External	
	H	M	D	Other ³	H	M	D	Other	M	D	M	D
Dr. John Markham	0	2			2	11	1	14	6	2	6	2
Dr. Sylvie Renault	1	2	1	1 Hons Uof Winnipeg	8	8	2	2 Hons, U of Winnipeg	2	1	9	2
Dr. Jim Roth	2	3	2		6	14	2		10	5	3	2
Dr. Dana Schroeder	0	1	2		8	3	4		4	3	5	7
Dr. Dirk Weihrauch	NA	1	2		5	7	5	15	1	3	3	2
Dr. Steve Whyard	0	3	2	1 Biotech BSc Honours	11	13	15	3	8	6	9	4
Dr. Anne Worley	0	2	1		4	4	2	15 summer undergrads 1 PDF	3	1	1	1
Dr. Jillian Detwiler	3	1	0		3	1	0		1	0	0	1
Dr. Kevin Fraser	2	4	0		6	5	0		0	2	1	2
Dr. Mark Fry	0	2	0		5	5	1	1	0	0	0	5
Dr. Jay Kormish	0	2	0		1	2	0	5	1	0	2	0
Dr. Jake Stout	2	0	0		2	0	0	0	3	0	1	0
Dr. Randall Mooi	0	0	1		4	2	1		2	1	0	0

Research Activities

The Department has a full complement of faculty members. A very large majority of research faculty (professors at any academic rank) hold research funding. All have published peer-reviewed papers in the past 1-2 years, and in the past 5 years, while they continue contributing to service and administration at the level of the Department, Faculty, and/or University levels and externally. As indicated above, the level of research activity is taken into account in deciding teaching assignments, although program

needs, responsibilities for program delivery, and individual preferences by faculty are also considered in allocating teaching and overall workload. Notably, those faculty who have no external funding are still active in contributing to mentorship of graduate and undergraduate students, providing tutoring and instruction to students (through one-on-one or small-group interactions, or through formal courses and service on advisory committees), offering Special Topics courses on a wide variety of research-related subjects of specific interest to one or a few students, and/or contributing scholarly activity within or external to the Department.

Academic Staff, Research Activities – Table 24

Table 24 summarizes the activities of staff in research and other scholarly roles, including academic administration, patenting, manuscript and grant reviews, conference/event organizational committees, editorial boards, etc. This table was completed by faculty in the Department who conduct independent research. The level of information varies in extent (from brief to comprehensive), in part as a function of academic rank. One adjunct member of the Department also completed the table. All faculty are engaged in research, teaching, scholarly activity, and supervisory and/or mentoring activities, in addition to service to the institution and professional scholarly and service activities.

[Table 24: Academic Staff, Research Activities](#)

(control click above link to view table 24)

HUMAN RESOURCES - SUPPORT STAFF – Table C

Table C, below, identifies the support staff in clerical-administrative and technical roles that contribute to the delivery and administration of the academic programs.

Role	FTE status	Name	Program ¹ G or UG	Administrative and/or clerical	Technical
Admin Assistant 3	1.0 FTE	Sylvia Lapointe	G, UG	G & UG: student appointments + scholarships, travel regulations and claims, awards (with Scholarships & Awards committee), reconciliation of funds, keys, information for students + staff, back up for all other clerical/admin staff including Apply Yourself/UM-GradConnect, biograd@umanitoba.ca , inquiries, recordkeeping, scheduling events, coordinating events, advising on procedures, etc.	-
Office Assistant 4	1.0 FTE	Jaime Stringer	G, UG (plus executive secretary to Head)	*G: supports GSC (minutes, emails), GS applications, ApplyYourself/UMGradConnect expert, responds to biograd@umanitoba.ca inquiries, manages G program, GS registrations, progress reporting, advice on procedures, defence schedule, liaise with FGS, keys; poster printing, thesis binding, event coordinator *UG: supports UGCC (minutes, emails), student enquiries, transcripts, grade changes, space overrides, direction to advisors + staff, advice on procedures, Honours defence schedule, Honours thesis progress meetings, event coordinator, liaise with Registrar's office	-
Office	0.6 FTE	Doreen	G, UG	Information, payroll (TAs/GMs, research	-

Assistant 5		Davies		assistants, technicians, invigilators), recruits invigilators, posts TA/GM/Invig/Sessional positions (CUPE), information for students + staff, liaise with HR on collective agreement, payroll, staffing, postings, email correspondence with students (applicants and recruited), backup for FT-OA4 and AA, liaise with Registrar's office, liaise with FGS; liaise with Dean's office, ReachUM, + Extended Education on postings	
Office Assistant 4	1.0 LTD, plans return to work *	Maureen Foster	G	G: student appointments, awards, information for students, registration, backup for other clerical/admin staff including Apply Yourself/UM-GradConnect, coordinating events, booking calendar for Department Head	
Office Assistant 3	0.5 FTE casual *	Hillary Linden	G, UG	Information and communication with students + staff, filing, tracking documentation, examination copying/printing, distributes keys	
Stores Technician	1.0 FTE	John Stoyko	G, UG	-	Liaise with students + staff in general re: lab orders, information, deliveries to labs
Equipment Technician	1.0 FTE	Frauke Fehrmann	G, UG	Liaise with Associate Head (Research & Infrastructure); liaise with Physical Plant as first point of contact for equipment/facility maintenance and repairs; issues Req7s (requisitions) for repairs, and estimates, growth-chamber bookings	Liaise with students + staff re: equipment (and repairs), space utilization and bookings (e.g., growth chambers, Controlled Environment rooms, benches in Buller Greenhouse and CTC Greenhouse)
Anatomy & Physiology Lab Technician	1.0 FTE	Kristie Lester	UG	Supports TA training + monitors attendance (liaise with academic staff) for UG BIOL 1410/1412, considers + drafts Endowment proposals with academic staff	Supports lab activities, specimen prep, schedule preps (all organisms), inventory, setup/removal + cleanup, orders (bulk, as needed), liaise with other technical staff (e.g., re TA training for lab safety and security)
Biology Lab Technician	1.0 FTE	Carl Szczerki	UG	Supports TA training and monitors attendance (liaise with academic staff) for UG BIOL 1020/1030, considers + drafts Endowment proposals with academic staff for 1020/1030 teaching, and many other courses (e.g., utilizing Buller 314, growth	Supports lab activities and specimen prep for BIOL 1020/1030, schedule preps (all organisms), inventory, setup/removal + cleanup, orders (bulk, as needed), liaise with other technical staff (Council rep as of Feb 2016) and with course director re: TA training for lab safety and security, backup on demonstration-AV system, maintain organisms (e.g., incubates fertilized eggs, care of

				chambers, etc.)	carnivorous-plant collection); also assists with lab setup in other courses (e.g., in Buller 314)
Biology Lab Technician	1.0 FTE	Maria Kuraszko	UG	-	Supports lab activities, specimen prep, scheduling preps (all organisms), inventory, setup/removal + cleanup, assist in Greenhouse, assist with specimen delivery to other labs (e.g., from Greenhouse)
Greenhouse Technician	0.5 FTE	Anke Reppchen	UG, G	Coordinates volunteers in Greenhouse	Maintains plant health, watering programs, planting schedules for UG teaching labs + courses, & research activities in Greenhouse by UG and G students
Herbarium Technician	0.5 FTE	Diana Sawatsky	UG, G	Coordinates use of the herbarium by students, staff, faculty in research + coursework	Works with curator (Bruce Ford) to maintain collection, annotate new entries, correspond with international users (mailing specimens, receipt of specimens), works with students + volunteers
Director, Animal Care Facility (Duff Roblin)	1.0 FTE	Terry Smith	UG, G	Coordinates use of Animal Care Facility between academic staff, students, and animal care technicians including correspondence on animal use in Teaching and Research (plus outreach)	Manages animal care staffing in support of the whole facility, supports Local Animal Users Cmte + UM Animal Protocol Review Cmte
Animal Technicians	4.0 FTE	Jackie Nelson, Allison Penner, Mary Ann Ramos, Lisa Kalkhoven	UG, G	JN: orders, maintain drug records + biosafety, liaise with Veterinary Services, inventory, animal orders for research, holiday offset for Terry Smith	All: animal care and contributions to training students (G, UG) before and during use of animals, contribute to outreach + events on campus
Safety Technician (Faculty-level position)	1.0 FTE from Dean's office	Betty Lerner	UG, G	correspondence with staff + students re: training + regulations, record keeping	Monitors training of TAs/Invigilators for UG labs; coordinates +delivers training sessions (biosafety, WHMIS) with academic staff, students, and departmental Safety Group
Electronics Technician	0.1 FTE	Allan McKay	UG, G		Performs electrical repair of teaching and research equipment

1: Graduate= G, Undergraduate=UG

*: position level as casual at 0.5 FTE (Hillary Linden) and a very heavy assignment of duties to support both the G+UG programs (Jaime Stringer) are due to medical leave and Long-Term Disability of a permanent 1.0 FTE employee (Maureen Foster, OA3) from February 2015 to Winter term 2016.

The Department has identified significant need for additional support by staffing in two particular areas in the past few years: office-administration staffing related to program support and delivery, and technical support in the Buller Greenhouse and teaching-lab coordination. These needs are ongoing and increasingly urgent with the expansion of administrative tasks; the increase in program enrollment; the ongoing systems renewals; the increase in financial reconciliations related to student appointment, recruitment, scholarships, and travel; and the growth in plant-related research and teaching programs.

PHYSICAL RESOURCES

Space

The Department of Biological Sciences is housed primarily within the Science Complex on the Fort Garry Campus, with offices, research labs, teaching labs, lecture theatres, graduate carrel rooms, conference rooms, lounge space, equipment rooms, greenhouse facilities and storage space distributed among the Biological Sciences Building, the Buller Building, and the Duff Roblin Building (Table A). Beyond those buildings, members of the Department also occupy greenhouse and research space in the university's Crop Technology Centre. While some labs, offices and common room spaces and facilities are in need of renovation (marked with * in Table A below), the Knowledge Infrastructure Program-funded renovation of the Biological Sciences Building prior to commissioning and initial occupancy in the summer of 2011, the most recent major renovations of the Buller Building through the fall of 2010, and the restoration of areas utilized by Biological Sciences personnel within the Duff Roblin Building following the catastrophic fire of 28 March 2009, have left most of the space occupied by Department members in good condition.

Major facilities and infrastructure operated by the Department are listed in Table B below, and include the Biological Sciences Animal Care Facility, the Buller Greenhouse, the Electron and Light Microscopy Imaging Facility, the Vascular Plant Herbarium, the Cryptogamic Herbarium, the Stewart-Hay Memorial Zoology Museum, Controlled Environment Room facilities, the Plant Growth Chamber facility, and an in-house incinerator (Table 2). Beyond those major facilities, and specialized molecular and analytic equipment maintained by Department members in the Faculty Molecular Lab (W436 Duff Roblin), Analytical Suite (W418/W430 Duff Roblin) and individual research labs (Table 1) each of the three main buildings provide departmental occupants with access to common-use equipment including: -80°C and -20°C freezers, ice makers, autoclaves, photocopiers, glassware washers (BSB & Duff only), Milli-Q water (BSB & Duff Roblin only), and basic infrastructure such as fume hoods, Reverse Osmosis (RO) Water, natural gas, and network access.

Ongoing maintenance, renovations and upgrades to the Biological Sciences Animal Care Facility are necessary to maintain compliance with Canadian Council on Animal Care guidelines, and are achieved using funds provided by the Faculty of Science. Renovations to offices, common-use spaces and both teaching and research labs are proceeding incrementally as both departmental and faculty funds become available to commit to those. Much-needed wholesale renovation and rebuilding of the Buller Greenhouse, which was constructed originally as a temporary greenhouse facility in the 1960s, will require a significant commitment of funds (\geq \$10 million) from the university in general. This commitment cannot be postponed indefinitely, as badly-outdated temperature control and lighting systems are failing, and the basic infrastructure of the greenhouse itself is in a state of advanced decay.

Infrastructure Challenges and Future Opportunities

This section briefly summarizes infrastructure-related challenges that are not captured in the context of renovations highlighted above and that are presently unresolved, or that capture an ideal we'd like to work toward in the future. These include:

Buller Greenhouse. While mentioned above, it bears repeating that the Buller Greenhouse is essentially past the point of being repairable. Constructed initially as a temporary greenhouse to complement the then more expansive Buller rooftop greenhouse in the 1960s, the gravel floor, asbestos benches and walls, antiquated steam-heating system, primitive manual venting, obsolete lighting, shade blinds, humidification and control systems in general, make further significant investment in the existing structure imprudent. It is remarkable in fact, that the plant collection can be as healthy as it is within this current facility, particularly as the human resources to support the facility are so limited (only a 0.5 FTE technician working with the Plant-Growth Facility Director who works at approximately 50% time in the Greenhouse). Thus, our challenge is to convince senior administration to make greenhouse construction to replace the demolished rooftop greenhouse and bring the existing Buller Greenhouse into a top-priority item of infrastructure and to provide baseline funding to establish an ongoing full-time position for *at least* one greenhouse technician (1.5 – 2 FTEs would be ideal) in order to cover essential needs to maintain and expand the collection.

Separating teaching and research space. Areas used for research would ideally be free of the high human traffic associated with undergraduate teaching. It is a potential safety hazard to have high student traffic flow in areas of a building where there are research laboratories, even if we want students to feel we are accessible. While we were largely able to achieve this segregation in both the Duff Roblin Building and Biological Science Building owing to fire restoration efforts and federal Knowledge-Infrastructure Program (KIP) funding respectively, areas devoted to teaching and those devoted to research are commonly interspersed in the Buller Building. Rectification of this situation might involve converting the outdated 523 Buller microtechniques teaching lab into a research lab, and if other lecture halls are available, converting 527 Buller into research space.

Improving teaching space. While renovation of certain specific teaching spaces are highlighted in Table 1, Department members often remark on the inadequacy of lecture halls in terms of seating and writing desks for students, AV systems, or poor room acoustics (e.g. W380 Duff Roblin).

Isolating the potting/cleaning area from the growth chambers in 108 Buller so as to avoid infection of materials in the growth chambers with pathogens or pests emanating from those work areas. The most ready solution may be to move the sink, soil trap and workbench to the 151 Buller Annex, which would also free additional space for Controlled Environment Chambers in 108 Buller.

Optimizing space use by sharing. We have begun the process of optimizing the use of research lab space by establishing certain shared facilities (e.g. Duff Roblin faculty molecular lab) along with multi-PI labs, where interests and instrumentation use overlap (e.g. Docker/Whyard lab, Chen/Stout lab). We are also making progress in optimizing the use of teaching lab space, so that space can be liberated for conversion to much-needed research lab space (e.g. 409 BSB, which was under-utilized as a lab for only 3 undergraduate courses, but now serves as a research lab for two faculty members). It is critical to note that while common use of lab space can provide benefits, it can also create problems. Thus, where possible under existing budgetary constraints, common-use facilities should employ permanent support staff and charge fees to users for service provided (e.g., Animal Holding).

Storage space for research vehicles and large research equipment. While the Department has storage rooms within each of the buildings we occupy, those storage spaces are not suitable for large items, such as research vehicles, trailers, boats, outboard motors and other large pieces of field gear (e.g., canoes). While the university has allowed us to park certain vehicles in their storage compound over the

years, items there have been stolen (e.g. the Department's equipment trailer), and there is no building where vehicles or gear can be sheltered from the elements during the off season. Thus, a storage building, similar to the building owned by the Faculty of Agriculture at "the Point," would be useful.

Keeping spaces clean. With reduced resources devoted to custodial care by the University, all areas on campus are noticeably less clean than they were previously (grounds, corridors, classrooms, and laboratories). We hope this disturbing trend will be reversed in due time, although any action to rectify the problem will be costly.

Stewart-Hay Memorial Zoology Museum renovation. While discussions at Council and within our departmental Museum and Collections Committee initiated a plan to renovate and refurbish the museum, recent discussions with the Dean's office suggest that more ambitious and comprehensive renovations may be made with Faculty of Science support, if Department members are willing to relinquish exclusive control of that space, and broaden the scope of both the materials housed and functions hosted there, to include Science in the broad sense. This clearly represents a unique opportunity in terms of outreach, and the Dean's office has struck a Museum Committee to plan on this larger scale. The Department notes that we must balance the promise of that opportunity with the possible detrimental changes in the function and availability of the space for undergraduate teaching, as a seminar venue, in research activities and as a resource, and as a social venue. This is an ongoing discussion.

Space use within the Department – Table A

See next page

Table A: Space use within the Department of Biological Sciences (BSB = Biological Sciences Building, BUL = Buller Building, DR = Duff Roblin Building) as of 21 December 2015.

Room Type	Building	Rooms	Comments	
Offices – Faculty	BSB	206, 221A, 222, 224, 314, 312, 404, 418, 421B, 421C, 421D, 421E, 424	206 Head's office; 222 & 224 Assoc. Heads' offices	
	BUL	208A, 208B, 219, 317, 318, 408, 432, 433, 503, 505B, 505C, 508, 520A, 524, 525, 600	Phys. Plant floorplan wrong for 505 Buller numbering	
	DR	W361, W363, W365, W463, W465, W467, W469, W471, W473, W475, W477, W479, W481, W483		
Office – Staff	BSB	122, 212A, 212B, 212D		
	BUL	209, 426, 505A		
	DR	W100, W105, 407		
Offices – Sessional Instructors, PDFs	BSB	420, 421A	DR offices house 2 PDFs	
	BUL		none	
	DR	W367, W369, W375		
Graduate Carrels	BSB	116(3), 207 (8), 316(7), 318(6), 421F(4), 422(7)	Max. capacity in parentheses (#)	
	BUL	520(2)		
	DR	315(16), W373(3), W461(4), W482(4)		
Research Labs	BSB	112 (Hare), 305A (Kormish)		
		322 (Goldsborough),		
		329 (Booth/Goldsborough),		
		319 (Waterman),		
		412 (Roth),		
		408/408A (Fraser),		
		409/409B (Chen/Stout)		
		BUL	133* (Weihsrauch),	* denotes renovations needed in these spaces
			137 (Belmonte),	
			140 (Kormish),	
	316/319* (J. Anderson),		319 is a Culturing Facility	
	429 (Garroway),			
	431* (Kenkel), 435 (Kenkel),			
	434* (Ford),			
	501/502* (Worley),			
	509 (Piercey-Normore),			
	511 (Detwiler),			
	517 (Marcus),			
	521 (Schroeder),			
	522 (Docker/Whyard)			
	529 (Marcus),			
	531/531A/532* (Huebner, Belmonte, Whyard)			
	DR	W314* (Vacant for new recruit),	* denotes renovation needed	
W324 (Treberg),				
W370* (Sealy),				
W374 (Davoren),				
W418 (Analytical Suite),				
W436/436A/468 (Faculty Molecular Lab),		shared		
W442 (Faculty Physiology Lab),				
W460 (Hann), W464 (Campbell),				
W466 (Campbell),				
W470 (Fry),		W470 is a Culturing Facility		
W472/472 A-C (Fry),				
W474/W434 A-B (G. Anderson),				
W478 (Markham/Renault)				

Table A: Space use within the Department of Biological Sciences (BSB = Biological Sciences Building, BUL = Buller Building, DR = Duff Roblin Building) as of 21 December 2015.

Facilities/ Equipment Rooms	BSB	101	-20°C freezers
		211A, 221	A&P Teaching Prep
		305B	Genetics/Ecology Teaching Prep
		317	Voice Data Room
		403	-80° & -20° freezers, Incubator
		403A	Walk-in CE cold room
		409 (corr.)	Ice maker
		409A	Autoclave. Milli-Q, glassware
	BUL	108	Plant growth chamber facility
		116	Autoclaves (shared with Micro)
		210	Voice Data Room
		217, 220, 221	Intro Bio Teaching Prep
		426	Vascular Plant Herbarium
		507	Cryptogamic Herbarium
		507 (corr.)	Ice maker
		518	Microscopy/Imaging facility
		533	Electron Microscopy Prep
		534/534A	Transmission Electron Scope
	DR	B04	Incinerator
		W100 – W125	Animal Holding Facility
		N128	Workshop
		W216	Stewart-Hay Zoology Museum
		W230A	Vertebrate Bio Teaching Prep
		W232B/W232C	Physiology Teaching Prep
		W232A/W270A	Physiology Teaching CE Rooms
		W376	Voice Data Room
		W416	autoclave, ice, glass, garburator
		W434	-80°C freezers
		W442/W446	-80°C freezer, growth chambers & CE Room facility
	Armes Link	100-110	Buller Greenhouse Facility
	CTC	3, 6, 7, 9, 10, 10A, 12, 128	Crop Tech. Labs & Greenhouse
Teaching Labs	BSB	110(24), 211(40), 223(40), 305(39)	Max. capacity in parentheses (#)
	BUL	211A*(20), 211B*(20), 212A*(20), 212B*(20), 215(40), 216(32), 314(48), 523*(20)	* denotes renovation needed
	DR	W230*(12), W232*(28), W240*(30), W270*(28), W332(48), W340(20), W346(14)	W340 is Valdimarsson Lab
Lecture Rooms	BSB	301(40), 401(40)	all lecture rooms assigned by Ad Astra, campus-wide basis
	BUL	207(120), 306(111), 527*(93)	
	DR	W380*(36)	
Conference Rooms	BSB	304(35)	has 70" smartboard/videoconf.
	BUL	none	
	DR	W364(20)	
Lounge Areas	BSB	105, 111, 201	105-staff lounge, 111-BUGS
	BUL	528/528A	has kitchenette
	DR	W362/W362A	has kitchenette
Storage	BSB	101, 104, 115A, 117, 124, 220, 421G	
	BUL	144, 151	
	DR	B08, N127, 129, Z129, W103A, W216A, W270C, W372	129, Z129 are Volatiles rooms
		W600	W600 metal rack storage only

Major facilities and equipment operated by the Department – Table B

Table B: Major Facilities/Equipment operated by the Department of Biological Sciences
(BSB = Biological Sciences Building, BUL = Buller Building, DR = Duff Roblin Building).

Facility	Building	Rooms	Comments
Animal Holding Facility (AHF)	DR	W100-W125	The department's Animal Holding Facility serves the needs of animal users across campus, providing holding and procedure rooms, and professional staff supporting research and teaching involving terrestrial and aquatic vertebrates and invertebrates. The facility houses three walk-in controlled environment units, a commercial cage washer, various procedure and holding rooms, staff offices, a staff break area and change room, along with storage areas for food, bedding and supplies, and a walk-in freezer for perishable food storage.
Buller Greenhouse	Armes Link	100-110	The Buller greenhouse includes a head-house and potting area (100), a storage room (101) for supplies potting area (100), a storage room (101) for supplies with a bench-mounted muffle furnace, along with nine individual growing rooms (102-110). With a staff of two, the greenhouse facilitates plant growth and maintenance supporting department teaching and research initiatives, and has become active in outreach activities connecting the campus community and the community at large to departmental undertakings.
Microscopy Suite	BUL	518, 533, 534	The department's Microscopy and Imaging Facility include a Transmission Electron Microscope, a tabletop Hitachi Scanning Electron Microscope, and Zeiss Confocal and Apotome systems. The facility is staffed by a full-time EM technician supporting imaging needs associated with departmental teaching & research.
Vascular Plant Herbarium (WIN)	BUL	426	The Vascular Plant Herbarium constitutes one of the most comprehensive collections of plant specimens in western Canada, which are accessible to researchers around the world via an online database. This collection provides a comprehensive resource supporting departmental teaching initiatives, and a valuable resource for botanical research in general. Curatorial work is supported by a faculty Curator and part-time Assistant Curator, and like the Buller Greenhouse, has been the centre of several outreach and artistic endeavours.
Cryptogamic Herbarium	BUL	507	The Cryptogamic Herbarium provides a collection of fungi, algae and lichens supporting departmental research and teaching initiatives, and is maintained by a faculty Curator.
Stewart-Hay Memorial Zoology Museum	DR	216	The Stewart-Hay Memorial Zoology Museum houses interesting specimens and displays designed to engage members of the campus community and the public at large in zoology. It also provides a gathering place for seminars and outreach activities, and supports organismal aspects of departmental teaching initiatives. Currently in a state of disrepair following the 2009 Duff Roblin fire, the museum is soon to be renovated and reinvigorated under the direction of our department's Museum and Collections Committee formed in 2015.
Controlled Environment Room Facility	DR	W442-W446	The major Controlled Environment Room Facility includes 4 separate Conviron walk-in chambers; one that can maintain temperatures below freezing, one licensed for radioisotope use, one double-size chamber outfitted for aquatic species, and a fourth general-use chamber. As of March 2016, these chambers, along with a state-of-the-art computer monitoring and control system will be commissioned and ready for research use. These walk-in chambers are complemented by eight Conviron Adaptis A1000 growth chambers arranged around the periphery of the facility for smaller-scale CE chamber needs. (other CE rooms are available in the department's Animal Holding Facility (W111, W103J), in association with the Physiology teaching labs (W232A, W270A), or in the Biological Sciences Building (403A) while two additional Adaptis A1000 growth chambers are available in the 108 Buller Growth Chamber Facility, and 5 additional units are available in the east end of the Buller 100 corridor.
Plant Growth Chamber Facility	BUL	108	The Plant Growth Chamber facility house 2- 40 cubic ft. growth chambers (1 Conviron, 1 new Biochambers), 6-15 cubic ft. Conviron growth chambers (1 new), and two Conviron Adaptis A1000 growth chambers that support both research and teaching initiatives involving plant growth under controlled conditions.
Incinerator	DR	B04	The department's incinerator located in the Duff Roblin sub-basement is equipped with an after-burner to incinerate waste generated by the department's Animal Holding Facility in a safe and environmentally-friendly fashion. This unit is operated solely by Animal Holding Facility staff. The facility receives contracts for disposal of other waste (e.g., plant waste from industry-sponsored research)

Equipment

Teaching Equipment

Each classroom used in the delivery of courses/seminars is equipped with a ceiling-mounted projector (or in a few instances a data projector on a cart). There is only one smart board in the Department (in BSB 304) and that is heavily used for seminars, thesis defences, student presentations at thesis advisory committee meetings.

Many instructors utilize the full scope of tools available in UMLearn (formerly D2L), including recent programming for tailoring student access to streaming videos (for BIOL 1030 on a test basis in Winter 2016). The plan is to make the lectures for BIOL 1020 and 1030 available by streaming video to release the resource needs to make physical DVDs and provide staffing to allow students to check out the DVDs from the library (as done up until 2016).

Most instructors utilize a course webpage, a laboratory webpage, and/or the class email list (in Aurora Student) to communicate with students, post notes and PowerPoint presentations or outlines, etc.

A number of courses utilize the infrastructure provided by textbook publishers that have “Mastering Biology” or similar websites. There, students complete online quizzes on a regular basis (e.g., weekly), which prompts them to keep up to date in the course and textbook. An increasing number of course instructors are now using those ‘mastering’ features (e.g., for BIOL 1020/1030, 2410/2420).

A number of courses now have laboratory sessions for which video demonstrations start each lab. The presentations provide background information for particular exercises in a lab, and demonstrate how to accomplish particular tasks, by video projection to monitors in each lab room. These demonstration videos are broadcast from a master controller, under the direction of Michael Shaw (backup by Carl Szczerki).

Computer labs in the Faculty and University are available (see below), although hardware capabilities and software applications may not be consistent across the different platforms. The computer lab in Duff Roblin Building needs new infrastructure to bring a single platform to a whole class (e.g., for use in statistical applications or programming functions).

Research Equipment

Students have essentially full access to all the research equipment in the Department, following appropriate training by research supervisors and mentors, technical staff in this and other Departments (e.g., Microbiology, Human Nutritional Sciences), and safety staff in the Faculty of Science and University of Manitoba. The research infrastructure (not listed here) covers approaches and assays used toward a very wide range of studies in molecular biology, developmental biology, cell biology, ecology and environmental biology, evolutionary biology, genetics/genomics, and physiology. Infrastructure is most often available through collaboration and shared access, although it can always be improved. Typically PIs are successful in funding proposals to CFI (for new investigators and established investigators) when the call for proposals comes, and submit NSERC-RTI requests for particular equipment items.

Additional Support

The programs benefit by participation and contributions from academics throughout the University of Manitoba for service on thesis advisory committees, which all require at least one scientist as a member

from outside the Department (the external member). In some cases, members of the advisory committee for Master's students may be from outside the Faculty of Graduate Studies. Individuals from universities outside the Province of Manitoba, or from governmental or non-governmental agencies in Canada or internationally, have served as external members of an advisory committee (e.g., Fisheries and Oceans Canada, Ducks Unlimited, Stantec, University of Guelph, Agriculture Canada, Memorial University, University of Winnipeg, Brandon University).

The Department also acknowledges the significant work of administrative staff and the academic leadership in the Dean's office in the Faculty of Science, the Registrar's Office, Extended Education and Distance Education, the Science and Technology Library, and the Faculty of Graduate Studies in support of program administration and oversight. The attention to detail, the continuous communications, and the excellence of interactions are important to faculty, staff and students in the department. Other units such as Student Advocacy, Counselling Services, the Bookstore, Information Systems and Technology, AudioVisual Services, Classroom Services, STATIS, Financial Aid and Awards, Purchasing, and others, all contribute to overall support of our programs. It is impossible to recognize everyone who makes the huge range of important and significant contributions in support of student advising, course scheduling, teaching assignments, appointment bookings, job postings (e.g., for TAs, GMs, Sessional Instructors), communications, recruitment, room bookings, printing, examination schedules, registration, VWs, program reviews, financial matters, convocation, Summer Session teaching, textbook orders, writing tutors, etc. As well, resources and consultations available through the Centre for Advancement of Teaching and Learning are very much appreciated by members of the Department.

Expected Changes in Resources

Expected retirements: The main retirement to be anticipated at the time of the review is that of the Department Head, Dr. Judy Anderson, who will step down December 31, 2016 from the headship, and retire at the end of 2017. An external search for a new Department Head is in progress. There will very likely be other retirements from among the academic staff, the administrative-office staff, and the technical staff over the next 5 years.

There is no mandatory retirement at the University of Manitoba; academic staff need to indicate by age 69 whether they will retire at age 70 or change to a 50% (0.5 FTE) appointment (two faculty members are currently at 0.5 FTE). Therefore, it is impossible to know precisely, how many, and from which positions, individuals will retire, apart from a few informal discussions confidential to the Head or Acting Head, to date. The changes in staffing will need to be addressed by the Department and the Dean's office together, working within budget allocations and program needs, and taking full advantage of opportunities for renewing and/or adding support in human or infrastructure resources.

One of the major changes over the past few years has been more centralized management of classroom space by administration, using year-over-year data on enrollment caps and student registration by course, section, and location. Recently, this included inquiry into allocation of laboratory-teaching space, and whether its use can be reallocated centrally. We can foresee that this reassignment of teaching spaces will not be conducive to initiatives for streaming video or lecture material or use of "flipped classroom" approaches to teaching. It also means we anticipate a series of annual communications will be required to retain teaching-lab space in our assignment of classrooms.

However, the Department also notes that the recent push to maximize use of teaching space according to a) the density of students (i.e., in a classroom or laboratory section) and b) the proportion of lecture or lab slots that are occupied by teaching in a given day or week. At times, this initiative seems to be at odds with the ability of the Department to keep lab materials and equipment secure/safe from harm,

effectively set up and clean up laboratories, separate research labs from student traffic to/from teaching areas, manage student demand, and schedule teaching in a room that effectively meets the needs for instruction by a particular instructor and for a particular subject area or areas. For example, scheduling labs for more than one course in a single teaching lab (e.g., Buller 314) requires considerable coordination of course sectioning, student enrollment, infrastructure and equipment, storage space, lab scheduling for set-up and clean-up between lab slots, etc. This seems to preclude the notion of any general practicality for trying to schedule many teaching labs offered by different units in the same lab space, at least without major planning and coordination and some budgeting of funds to cover expenses related to equipment purchase and renovation.

Nonetheless, to find space resources for research, the Department has begun to consolidate the allocation of teaching laboratories. For example, Buller 314 now is booked heavily for labs in Winter term, in order to free up the large area in BSB 405 for a shared research lab; this required some renovation and electrical work (funded by the Department), and purchase of a laminar hood (funded by a proposal to the Endowment fund by the Department), and ideally will require a new, dedicated growth chamber with high-intensity illumination (one is currently available, on loan from a researcher in the Department).

The Department has discussed future possibilities for other ways to meet the continuing need for space. This includes, for example, the idea of moving the Plant Physiology lab from BSB to the Animal Physiology lab in Duff Roblin Building. We might also consolidate labs of other courses into the space in W340 Duff Roblin (currently the Gunnar Valdimarsson molecular biology teaching lab) as it is currently used for teaching only once a week in the Winter term and twice per week in the Fall term. We could renovate Buller 523 into a research lab by moving the teaching of the lab for the Microtechniques course to another location, possibly 200-level Buller in Winter term. These and other changes will take considerable attention to detail (e.g., changing space assigned for equipment and its storage, the scheduling of lab set-up, preparation, and clean up, the scheduling of lab sections, and conflict analysis in student schedules). It will also take considerable resources to complete the required renovations, particularly in the labs in Buller that were not fully refurbished (e.g., by the installation of seamless flooring) during the previous major upgrades in the 1990s-2000s. It will also need the Department, the Faculty of Science, and the whole University to accommodate the evolving needs for appropriate research and teaching space, as well as the modalities of teaching and the use of classrooms and laboratories during the budget cuts and the plans for a new budget model.

Overall, the Department feels that current limitation of research space and changing roles and reduced independence in managing space utilization for teaching, are restricting our ability to take full advantage of our major successes in recruiting undergraduate and graduate students, recruiting excellent new faculty members, and garnering increased research funding. At first glance, this is sometimes considered a problem for a few members of the Department (the academic leadership), but it truly does impact the whole Department and its programs. Therefore, we are aiming for a long-term plan in conjunction with the Faculty of Science Dean's office, in considering prospects for space utilization and teaching assignments. For instance, a new building in Science with room for very large lecture sections (e.g., 400 or 450 students) might allow us to reassign some teaching and accommodate the diversity of research and teaching laboratories that can be anticipated with ongoing and new research activities in the Department.

We will continue to consider how we can work together toward more sharing of research space, when that is reasonable. For example, when new faculty members are recruited to the Department, there may be opportunity for some movement among labs, to accommodate needs and proximate facilities and

equipment. At the same time, we need to be pragmatic about our needs in view of short and longer-term goals, and the overall context of the institution and educational programming. We aim to take advantage of unique and unexpected opportunities for planning, in juxtaposition with the functional space analysis/design exercises that are ongoing at the Faculty of Science and the University of Manitoba. Given the growing internal collaborations within the Department and the high level of collegiality that helps us reach consensus on our mission, the opportunities of iterative recruitment and strategic planning by the Department (in context of the Faculty of Science and the University) could be substantial.

Computer Resources

Computer equipment available to students is identified as follows:

- Desktops (in some laboratories, for student use at 'data-entry stations'),
- Desktops or laptops in some laboratories, connected to research equipment,
- Laptops for short-term use by students in the Department, from the general office,
- Laptops for short-term use by students, attached to 'equipment carts' with a data projector,
- Scanners in some laboratories, with or without attachment to specialized equipment,
- Scanner function available on photocopiers, one per building, in BSB, Buller and Duff Roblin (on an account with login),
- Printers in all labs, as attached to desk- or laptop computers,
- Printers in University Centre (basement, outside Copy Centre) for use with a copy card,
- Printing also via internet connection (not wireless) to departmental photocopiers (for some lab/staff as requested), and
- Large-format wall-mounted smart-board and computer in BSB 304, including AppleTV and Wifi, for use in presentations for courses and thesis-advisory and thesis-defence meetings.

WiFi is now accessible throughout the 3 buildings, Duff Roblin, Buller and Biological Sciences, and in most locations on campus, either secure or unsecured

Shared-drive access for data and document storage is available to faculty who make use of an "H: drive" and to students who have an advisor that makes use of a folder on the "S: drive" for student use

Open areas for computer use include Machray Hall (basement 112, 113), library (Science, Elizabeth Dafoe, Extended Education Complex, etc.)

Computer-use facilities reserved for students in the program include the computer lab in Duff Roblin (W436, although only 2 of the CPUs are working as of Winter 2016) and Buller 435. This is typically for use by students who are enrolled in the data-analysis and statistics courses in the program. The BSB computer lab (BSB 305) was not used as anticipated and is now in use for growing plants with *C. elegans* infestation in a new collaborative program in developmental biology research (Dr. Jay Kormish & Dr. Mario Tenuto).

All students receive a computer account in the format "@myumanitoba.ca" from the University upon registration. Communications with students (in courses or as employees or research trainees at the university) are to use this email. Students (and others) occasionally use accounts with gmail, yahoo, shaw, mymts, etc., and are typically redirected to the myumanitoba.ca account in the responses.

Internet use by students and staff (academic and office) is subject to the university policies governing computer use, security and privacy.

One of the most significant and highly valued resources to all staff in the Department (and Faculty of Science) is provided by expert services of Khosrow Hakimzadeh and Fred Wong in the Faculty of Science. They liaise on our behalf with the central services of Information Systems and Technology, and champion desktop support, the need for server capacity for data storage and back-ups, software migrations and upgrades, and access to high-speed computing (e.g., through WestGrid). They also assist with the purchase and setup of new computer equipment such as desktops and laptops for research, teaching, administration/clerical work, and technical work, and anticipate software upgrades, equipment upgrades, changes in policy and procedures related to computer equipment, and computer use on campus for offices and research labs.

Additional support of computer/internet work comes from “help desks” of the university systems, IST-central, and very knowledgeable academic staff in our Department (e.g., Dr. Darren Gillis, Dr. James Hare) and others, particularly the Information Technologist in the Department of Statistics (Mr. Dave Gabrielson).

Library Resources

The Biological Sciences Librarian, Ms. Vickie Albrecht, coordinate this part of the self-study report. She also attended both departmental retreats, attends Department seminars and meetings, and serves on the Museum and Collections Committee of Department Council. We are fortunate that she is very engaged in knowing our Department and its students.

The library assessment is attached (see Appendix 15), and evaluates existing resources and services available to the programs.

The Department anticipated that the Librarian would express some concern about continued access to journals through the Libraries. The Library collection requires significant support, even to maintain journal and reference materials, in addition to maintaining staffing at levels that can handle the huge fluctuations and extent of use by students and faculty. We are hopeful that the budget available to the Libraries can sustain the small program of purchasing back issues and continue to provide free Document Delivery to give ongoing, timely access to journals for which we do not have subscriptions. The Department very much appreciates the support of the Libraries and the Librarians, and recognizes that budget cuts and inflationary increases will have impact on the spending power of its acquisitions budget. The interdependence of the library collections with the programs of teaching and research in the Department (and also in other units) means that additional funds will be required to meet needs related to evolving curriculum and research.

CONCLUSION

Overview

The Department of Biological Sciences is the largest department in the Faculty of Science and has grown and evolved significantly since the previous program reviews in the founding Departments of Botany and Zoology. The areas of biology living within our research programs are embodied in the many contributions and successes of our students, staff, and faculty. The same areas of biology form a foundation for the strong undergraduate programs (BSc General, BSc Major, BSc Honours, and Co-op options in both Major and Honours degrees) and graduate education programs (MSc and PhD) at the cutting edge of biological sciences. The biological levels of organization (cell-organismal, population-species, and ecosystems-ecology) span five themes in our delivery of undergraduate programs.

Members of the Department have dynamic research programs, and actively contribute to outreach, institutional administration, and services to the profession at every level, in addition to teaching at undergraduate and graduate levels. The same scope of biodiversity that is so advantageous to our teaching programs, also enriches our many strengths and collaborations in research and scholarly activity, and in mentorship. The scope and richness are celebrated internally and recognized externally, as integral to the healthy biodiversity of the Department and its endeavours as it evolves, discovers, innovates, adapts, and takes leadership.

The historically very strong focus on biological sciences includes areas related to botany, integrative biology, and zoology. Our aim for excellence in teaching is integrated with staffing plans for research in organismal biology, ecology, physiology, parasitology, evolution, genetics, systematics, molecular and cell biology, developmental biology, pathological processes and biodiversity. This emphasis on “a biodiversity of expertise” is strategically designed to enable the congruence of our teaching and research goals. The goal is to embrace these fields and integrate them into our programs and planning.

The Department contributes significantly to teaching undergraduate students in Majors and Honours programs, and has the second-largest ratio of students per full-time equivalent (FTE) academic staff member in the Faculty of Science. Every academic contributes to teaching and strives to improve from feedback, opportunity and innovation. The Department provides a major proportion of undergraduate teaching in the Faculty of Science, from ~25% in regular terms (Fall/Winter) to ~33% in Summer Session and Distance Education.

In the 7 years since Biological Sciences programs were launched (September 2009), they have benefited by the strong leadership of 2 particular standing committees, the Undergraduate Curriculum Committee and the Graduate Studies Committee, each supported by excellent office staff under our bylaws. Each receives contributing support by standing committees for Scholarships and Awards, Student Recruitment and Retention, and Adjunct Professors. Our well-attended Department Council considers committee recommendations regularly and seriously, debates and actively guides priorities and changes in programming. All members of academic staff and many support staff contributed to this report.

Strengths

The strengths of the Department and its research and teaching programs are many. We cherish the rigour and quality of the research projects by our Honours students, and celebrate the successes of *all* the students who enter and complete BSc, MSc, and PhD programs in the Department of Biological Sciences. We collaborate to develop plans, recruit to extend the diversity and depth of our collective

expertise, and are able to debate issues to reach a consensus, all the while fulfilling our teaching responsibilities, engaging in research, student training and mentorship in research, outreach, and our professional service commitments. We share in these responsibilities. We discuss programming, research, teaching and program support, and their respective challenges, openly, and we address those challenges by changing the courses we offer, their content, their pre-requisites, and their delivery. We write endowment-funding proposals, and develop new courses and test new approaches to pedagogy while taking best advantage of new opportunities. We aim to hold our students and ourselves to high standards of performance.

Challenges

Perhaps the biggest challenges relate to our ability to sustain and grow both the breadth and the richness of the educational programs, particularly including the hands-on laboratory experiences in courses and the diversity and number of research opportunities in undergraduate and graduate programs.

Our programs need more than sustenance. They need secure and long-term funding from diverse sources. For research, funding initiatives need to avoid a position of “NSERC over-dependence” yet sustain NSERC funding that can be used for leverage by faculty to garner stipend support from GETS funding for more students. We also need take more advantage of funding opportunities for major infrastructure from support by the Canada Foundation for Innovation and Manitoba Infrastructure Research Funding.

Program funding provided by the Faculty of Science and the University of Manitoba, needs to support ongoing demands for laboratory renovations (for teaching and research), the development of new outreach-ready facilities including the Stewart-Hay Zoology Museum and collections, the acquisition of new “state-of-the-science” infrastructure, and long-term support of facilities for rearing animals and plants. The Department will require resources to sustain service contracts for fairly new research equipment (e.g., laser scanning microscope which was acquired on funding from the Canada Foundation for Innovation as CFI funding ends and user fees need to cover contract costs) and also to sustain student and researcher access to reliable equipment that has been in the Department for many years and is an important resource despite sometimes modest use (e.g., TEM).

The Department most certainly requires more administrative staffing to support financial reconciliations and the major work needed for oversight (research compliance). It also requires additional technical staffing (or reallocation of duties among current positions) to sustain the core services (e.g., greenhouses, animal care facilities, controlled environment chambers, plant-growth chambers, etc.). Potential changes to teaching and research programs, particularly the increasing demand for more and more varied research experiences and placement opportunities, affect our ability to support the programs at all undergraduate and graduate levels.

Research and departmental-program funding also needs to be sustained through ongoing changes in administrative systems and current and anticipated budget cuts. Teaching and research programs need to grow, advance, and be renewed, or the creativity of our members and students (current and future) will be eroded, jeopardized, and eventually “history”.

We also need to sustain funding to span the turnover of faculty and staff in the Department. In addition to anticipated renewal and processes to recruit new members of the Department (instructors and assistant professors, technicians and office staff), this challenge will include renewal of the academic

leadership in the Department (including the Department Head), as the more senior members of the Department retire or move to administrative roles in the Faculty of Science, the University of Manitoba, or elsewhere.

There are growing demands for start-up and bridge funding to be competitive with other institutions (especially in a time of reduced buying power against the US dollar) for recruitment and student funding. Student enrollment in research-based programs is also growing, and we know there will be challenges to meeting the demand within our resources, while we strive to advance our productivity, funding, discovery, and innovations from our research programs.

We hope that initiatives by the Faculty of Science, the Department, and the University will continue to increase the involvement and success of Indigenous students in science, education, and research, and that the academic success of all our students, Canadian and international, will also continue to grow. Our aim for the Department is to realize an exciting level of success in the recruitment of excellent students, staff and faculty. Through ongoing renewal and effective, integrated administration of all our educational and research programs, we aim to grow better and stronger as we respond to the many constraints of finances in the institution, industry, governments, and funding bodies.

Conclusion

Overall, and together, we celebrate our workplace and aim for collegial governance as the Department continues to evolve. We recognize the need to keep aiming high while we work to overcome challenges. We continue to improve our programs and increase the success of our students and their and our many activities in research, teaching, and service.

We look forward to the interactions with Reviewers and to the recommendations they will provide following their review of this Self-Evaluation Report from our Combined Review of Academic Programs in the Department of Biological Sciences.

APPENDICES

1. [Department of Biological Sciences Strategic Plan \(September 2013\)](#)
2. [Reports from previous graduate program reviews \(Departments of Zoology and Botany\)](#)
3. [Faculty of Science Strategic Research Plans](#)
4. [University of Manitoba Plan “Taking Our Place” and Strategic Research Plan](#)
5. [Faculty of Science Strategic Plan for Indigenous Achievement](#)
6. [Faculty of Science Report on Indigenous Achievement for 2014-15](#)
7. [Responses to surveys of current and former students in Biological Sciences programs](#)
8. [Program Charts for all the BSc Honours, Majors and General programs](#)
9. [Sample listings of Honours Thesis Symposia](#)
10. [Skills inventory, 2016](#)
11. [Ecology field work courses – survey March 15, 2016](#)
12. [Course outlines](#)
13. [Sample reports of section-by-section enrollment vs. seating capacity \(caps\)](#)
14. [Faculty CVs](#)
15. [Library report](#)
16. [Graduate Studies Supplemental Regulations](#)