

FINAL ASSESSMENT REPORT

REPORT OF ACADEMIC STANDARDS COMMITTEE TO SENATE

June 2, 2015

PERIODIC PROGRAM REVIEW

BIOLOGY (BSc)

Faculty of Science

1. BASIC INFORMATION

a) Program Description

The Bachelor of Science in Biology, which started in 2005, is a full time, four year or five year Co-operative degree program. Students are able to complete the regular program or opt to take an option in Biophysics, Bioinformatics and Computational Biology, or Environmental Biology.

The Biology Program has been the most popular choice for science students. Many students anticipate using their BSc in Biology to enter professional schools (dental or medical) although many will continue into graduate programs, the teaching profession and biological careers in agricultural, chemical, clinical, political, policy and industrial sectors of society.

b) Program History

1948 – Ryerson Institute of Technology was first established; three year Diploma in Chemical Technology offered.

Mid 1960's – Options in Industrial Chemistry, Applied Chemistry and Polymer Chemistry were added.

1967 – Laboratory Science, within the Department of Chemical Technology, was introduced.

1973 – the first Bachelor of Technology (Laboratory Science) was awarded.

1985 – the program was accredited by the Canadian Society for Chemistry and was the only program at that time to offer an accredited Bachelor of Technology degree as opposed to the more traditional Bachelor of Science degree.

1989 – the program changed its name to Applied Chemistry and Biology which more accurately reflected the content of the program and made it easier to interpret for prospective students, for employers and for the general public. The program was reviewed and re-accredited in 1992.

1994 – the program designation was changed from Bachelor of Technology to Bachelor of Science.

2004 – the Applied Chemistry and Biology Program underwent a major curriculum restructuring which concluded with the introduction of 11 new programs in Science in the fall of 2005, including a standalone program in Biology.

2. DEVELOPMENT SINCE PREVIOUS PROGRAM REVIEW

This is the first program review for Biology since its implementation in 2005. Although there was not a previous program review, the Biology Program has grown and evolved over the last seven years with the academic plans of both the University and the Faculty level.

The five key priority areas of the Ryerson Academic Plan, 2008-2013 are (1) new programs that are societally relevant; (2) enhance student satisfaction and success; (3) excellence in learning and teaching; (4) increase in Scholarly Research and Creative (SRC) activity; and (5) enhance Ryerson's reputation.

The goals of the Faculty of Engineering, Architecture and Science are (1) excellence in the quality of our undergraduate and graduate engineering, architecture and science programs; (2) development and implementation of new societally relevant and needed high quality undergraduate and graduate programs; (3) Faculty restructuring; (4) establishment of national and international partnerships; (5) enhancement and strengthening SRC activities and outcomes; and (6) enhancement of the students' and graduates' engagement and satisfaction.

The overall mission of the Biology Department over the last seven years has been to (1) create a strong and comprehensive program in biology that is societally relevant; (2) prepare students to be competitive and successful in obtaining their post graduate goals, either in post graduate studies, professional pursuits or direct employment; (3) excel in student engagement, satisfaction and success; and (4) increase the marketability and visibility of our program through outreach, ombudsman and promotional activities.

The Biology Program's Objectives and Initiatives for 2005-2012 are to (1) improve SRC success; (2) improve quality of undergraduate programmes; (3) plan for growth and development in undergraduate and graduate programmes initiatives; (4) improve student engagement, satisfaction, and success; and (5) increase outreach activities.

3. SOCIETAL NEED

When the Biology Program was introduced in 2005 the new courses that were introduced were modelled after the most fundamental biology concepts offered by most Biology Programs at other Ontario Universities, and on the academic strengths of the faculty members at the time. Therefore the program maintained its microbiology/biotechnology focus and introduced new courses in genetics and cell biology. The Biophysics option courses were cross-listed with the Medical Physics program and the Computational Biology option courses were cross-listed with the Computer Science and Mathematics Department.

There is a strong desire among many students in the Common First Year Science programs (particularly Biology and Medical Physics) to pursue medical or dental school after graduation. The Greater Toronto Area supports a large biomedical and life sciences industry. The Canadian biomedical market is estimated at \$30 billion. The pharmaceutical market alone is estimated at \$21 billion annually and is growing at 6% per year. Many of the largest pharmaceutical companies in the world are located in the GTA. The biotech market in Canada is estimated at \$5 billion. MaRS, the Province of Ontario's incubator for bioscience start-up companies and nexus for university-industry partnerships, is located within a ten minute walk of Ryerson, as are several major hospitals. There are approximately 1300 life science companies operating in the GTA. Clearly, biological science is a growth area for Ontario and Canada, and the demand for highly qualified personnel is likely to increase.

4. PROGRAM LEARNING OUTCOMES

The learning outcomes of the program are aligned with the Undergraduate Degree-Level Expectations of Ryerson University.

A graduate of the Biology program should be able to:

1. demonstrate basic competence in biological related sciences at the university level as well as mathematics, physics, chemistry and computer science and how they relate to biological systems.

Supporting learning outcomes – Students should be able to:

- apply the mathematical, chemical and physical basic knowledge to biological concepts
- understand how basic mathematics, physics and chemistry are necessary for cross-disciplinary learning

- use their general science information to advance their knowledge of how biological systems work
 - interpret and communicate using their basic knowledge to explain general biological concepts
 - demonstrate their knowledge and understanding using various presentation tools and communication methods
2. demonstrate competence in their knowledge base for the major areas of biology and the integration of these areas with each other and all sciences.

Supporting learning outcomes – Students should be able to:

- understand how each of the 8 biological cornerstone courses is necessary for cross-disciplinary learning and integration of ideas in the biology field
 - use their cornerstone course knowledge to advance their understanding of how biological systems work
 - interpret and communicate using their science knowledge to explain current biological methodologies and advancements
 - exhibit their knowledge and understanding of the biological theories and applications using various presentation tools and communication methods
3. demonstrate specialized scientific knowledge appropriate to program courses and program options, and be able to use the knowledge and skills to identify, formulate and analyze information in order to reach substantiated conclusions.

Supporting learning outcomes – Students should be able to:

- apply their advanced knowledge in the selected biological areas to overall scientific concepts
 - interpret and communicate using their advanced science knowledge to explain current biological methodologies and advancement and propose new ideas and innovations
 - propose an hypothesis to investigate a new phenomenon
 - integrate information obtained about one phenomenon to help explain another
 - demonstrate their knowledge and understanding using various presentation tools and communication methods
4. present competency in laboratory skills. To understand safety concerns and measures for working in laboratory areas and to give the appropriate attention to health and safety risks, applicable standards and environmental and societal considerations.

Supporting learning outcomes – Students should be able to:

- perform simple scientific procedures and measurements with proficiency and competency
- carry out experiments safety with applicable attention to health and safety risks, and industry standards
- demonstrate competent laboratory skills
- explain the importance of implementing positive and negative controls in experimentation
- explain the necessity of reproducibility, accuracy and statistical analysis in experimentation
- demonstrate their knowledge and understanding of laboratory practice by complete appropriate laboratory documentation and preparing laboratory reports

5. exhibit familiarity with scientific literacy and demonstrate their knowledge by gathering, interpreting and analyzing scientific information using technologically current and content relevant approaches. To critically evaluate published biological works within a societal conscientious environment.

Supporting learning outcomes – Students should be able to:

- select appropriate methodology and tools to test a hypothesis based on theoretical knowledge on the uses,
- understand the limitations and the ways in which different approaches complement each other.
- collect, organize and interpret data from experimental protocols

- apply statistical processes to data to determine correlations or similarities/differences.
6. articulate their knowledge of biology through illustrations, responses to technical and non-technical written instructions, and citation of evidence to construct and support an argument. To document and illustrate laboratory results in a comprehensive manner. To produce reports using appropriate formatting, grammar, spelling and references.

Supporting learning outcomes – Students should be able to:

- use library electronic resources to search for scientific information
- use other internet sources to gather information about a biological problem
- identify and recognize limits to knowledge, areas of speculation and interpretation
- critically evaluate knowledge acquisition of ideas or thoughts
- recognize and explain limits of knowledge imposed by current conceptions, frameworks and methods that lead to uncertainty, erroneous interpretation, and bias.

7. design and apply solutions for open-ended biological problems in a socially relevant way. To implement experimental protocol and analyze and interpret data that is meaningful to biological communities, the environment and the welfare of humans as a whole.

Supporting learning outcomes – Students should be able to:

- communicate effectively in written form using formats such as essays, summaries, reviews or critiques of original research literature
- deliver oral presentations that summarize, review or critique a research article or an entire topic
- use a variety of communication tools including digital presentation, blogs and posters

The learning outcomes and curricular structure in the Biology Program are consistent with the Ryerson Academic Plan (2008-2013) and the Faculty's goals. The continued improvement in the program addresses two of the Department's Objectives and Initiatives (2005 – 2012) which are to improve the quality of the undergraduate programs and improve student engagement, satisfaction and success. Past program revisions and modifications targeted for improvement for the future have been made with student success and satisfaction in mind. Further additions to the elective package of the program will further enhance the quality and diversity of the education that the students receive.

5. ACADEMIC QUALITY

a) Curriculum

The curriculum in Biology covers life from the molecule, to the cell, to the organism, to the population, to the ecosystem, to the global community.

BACHELOR OF SCIENCE BIOLOGY	
1st SEMESTER BLG 143 Biology I CHY 103 General Chemistry I CPS 118 Introductory Programming for Scientists MTH 131 Modern Mathematics I PCS 120 Physics I SCI 180 * Orientation * This course is graded on a pass/fail basis.	2nd SEMESTER BLG 144 Biology II CHY 113 General Chemistry II MTH 231 Modern Mathematics II PCS 130 Physics II LIBERAL STUDIES: One course from Table A.
3rd SEMESTER BLG 151 Microbiology I BLG 311 Cell Biology CHY 142 Organic Chemistry I MTH 380 Probability and Statistics I LIBERAL STUDIES: One course from Table A.	4th SEMESTER BCH 261 Biochemistry BLG 251 Microbiology II CHY 242 Organic Chemistry II MTH 480 Probability and Statistics II LIBERAL STUDIES: One course from Table A.
5th SEMESTER BCH 361 Advanced Biochemistry I	6th SEMESTER BCH 362 Advanced Biochemistry II

BLG 230 Botany BLG 307 Molecular Biology BLG 400 Genetics PROFESSIONAL AND PROFESSIONALLY-RELATED: One course from Table I.	BLG 340 Environmental Biology CMN 600 Science, Communication and Society LIBERAL STUDIES: One course from the following: ENG 503 Science Fiction GEO 702 Technology and the Contemporary Environment HST 701 Scientific Technology and Modern Society PHL 709 Religion, Science and Philosophy POL 507 Power, Change in Technology PROFESSIONAL AND PROFESSIONALLY-RELATED: One course from Table I
7th SEMESTER BLG 888 Biotechnology Laboratory LIBERAL STUDIES: One course from Table B. PROFESSIONAL AND PROFESSIONALLY-RELATED: Three courses from Table I.	8th SEMESTER LIBERAL STUDIES: One course from Table B. PROFESSIONAL AND PROFESSIONALLY-RELATED: Four courses from Table I

Bioinformatics and Computational Biology Option	
5th SEMESTER	BCH 361 Advanced Biochemistry I BLG 307 Molecular Biology CHY 213 Analytical Chemistry I CPS 313 Advanced Programming for Scientists LIBERAL STUDIES: One course from the following: ENG 503 Science Fiction GEO 702 Technology and the Contemporary Environment HST 701 Scientific Technology and Modern Society PHL 709 Religion, Science and Philosophy POL 507 Power, Change and Technology
6th SEMESTER	BCH 362 Advanced Biochemistry II BLG 340 Environmental Biology CMN 600 Science, Communication and Society PCS 227 Biophysics PROFESSIONAL AND PROFESSIONALLY-RELATED: One course from Table III.
7th SEMESTER	LIBERAL STUDIES: One course from Table B. PROFESSIONAL AND PROFESSIONALLY-RELATED: Two courses from Table II. PROFESSIONAL AND PROFESSIONALLY-RELATED: Two courses from Table III
8th SEMESTER	LIBERAL STUDIES: One course from Table B. PROFESSIONAL AND PROFESSIONALLY-RELATED: Two courses from Table II. PROFESSIONAL AND PROFESSIONALLY-RELATED: Two courses from Table III

Biophysics Option	
5th SEMESTER	BCH 361 Advanced Biochemistry I BLG 307 Molecular Biology PCS 352 Nuclear Physics Radiation/Protection PCS 354 Radiation Biology LIBERAL STUDIES: One course of the following: ENG 503 Science Fiction GEO 702 Technology and the Contemporary Environment HST 701 Scientific Technology and Modern Society PHL 709 Religion, Science and Philosophy POL 507 Power, Change and Technology
6th SEMESTER	BCH 362 Advanced Biochemistry II BLG 340 Environmental Biology CMN 600 Science, Communication and Society PCS 227 Biophysics PROFESSIONAL AND PROFESSIONALLY-RELATED: One course from Table III
7th SEMESTER	LIBERAL STUDIES: One course from Table B. PROFESSIONAL AND PROFESSIONALLY-RELATED: Two courses from Table II. PROFESSIONAL AND PROFESSIONALLY-RELATED: Two courses from Table III.
8th SEMESTER	LIBERAL STUDIES: One course from Table B. PROFESSIONAL AND PROFESSIONALLY-RELATED: Two courses from Table II. PROFESSIONAL AND PROFESSIONALLY-RELATED: Two courses from Table III

See the Ryerson Calendar for Professional and Professionally-Related Electives, and Liberal Studies Electives

b) Curriculum Mapping

The curriculum within the program has been mapped to the program learning outcomes. The first year courses are general science courses and fulfill program Goal 1 which requires graduates to have basic competence in all areas of science. The knowledge at this level is introductory in the first semester and advances to a reinforced level in the second semester. Except for the chemistry area, none of the other areas reach the level of proficiency in those subjects since they are designed to only give the students a basic breadth of knowledge in physics, math and computer science. Chemistry courses in the second year concentrate on organic chemistry and move further into the proficiency level. However CHY 242, Organic Chemistry II, which is mapped as being a course where the students can be considered proficient in basic chemical theories and mechanisms, has now been moved to the elective package. Most students do not need this level of competence in chemistry for the rest of the biology degree; however, students wanting to continue into some disciplines after graduation such as dentistry will need to include this course in their degree requirements to satisfy dental school prerequisites.

Core courses offered in second, third and fourth year base their curriculum on the proficient level of understanding of basic principles from first year (Learning Outcome 1). They also introduce and reinforce more specialized areas of biology such as cell biology, microbiology, genetics, botany, zoology, evolution and ecology (Learning Outcome 2). The core third year courses such as molecular biology, molecular biology lab and the advanced biochemistry rely on some skills acquired in second year and train the student to be proficient in these areas of biology upon successful completion of the courses. These core courses also introduce and reinforce further specialized areas of biological sciences (Learning Outcome 3) on which students can build by taking biological electives from their elective package.

Biological science is a very practical and visual science where hands on activities are an essential teaching and learning tool (Learning Outcome 4). For this reason many of the core courses have laboratory exercises where students are able to practice their experimental skills in a controlled setting. These skills are introduced in early courses and reinforced throughout the curriculum.

Learning Outcomes 5, 6 and 7 concentrate on scientific literacy, communication proficiency and problem solving skills. We consider them to be universal skills for all students and are introduced and reinforced through a wide variety of ways in all of our courses. Most notably, the more advanced elective courses with smaller class sizes are an ideal setting to hone these skills in our students. Elective courses often use assessment methods such as essays, presentations, debates, and group work which contribute to student use and critic of current literature and development of higher thinking skills.

c) Diversity and Inclusion

Curriculum structure has evolved over the last 7 years to include a wide variety of biological areas based on the principle that is important to expose students in the program to as broad an education possible within the realm of general biology. The current core curriculum structure serves the students well in this respect. The establishment of more elective courses for the elective package will further increase our ability to provide a diverse and inclusive biological education.

d) Methods of Instruction

The course content and goals are presented through a combination of lectures, laboratories, and/or tutorials. This pedagogical mode of instruction is commonly employed in science-based programs both here at Ryerson and at comparator institutions. The most common method of instruction in science is lecturing due to the heavy fact driven content. However, our program does also incorporate on-line assignments, laboratory exercises, group work and independent research project to provide various

student learning styles. Our program hopes to provide students with written and oral communication proficiency, resource surfing know-how, and critical thinking skills as outlined in program goals 5, 6 and 7 and therefore it is important to incorporate as many learning styles as possible.

We consistently provide both multiple choice and short answer sections on all tests and exams in many courses. This approach allows students the opportunity to excel in their preferred testing choice while continuing to improve in other areas. Furthermore, laboratory exercises can contribute to students' writing and comprehension skills and assignments and essays can improve both analytical and overall communication skills.

e) Curriculum Structure – Undergraduate Degree Level Expectations (UDLEs)

The Biology Program curriculum is designed to satisfy the program learning outcomes which comply with all the UDLEs set out by the Ontario Council of Universities. Overall, UDLE #1, 'Depth and breadth of knowledge' is satisfied by the majority of courses in the curriculum including the courses offered directly outside of the field of biology including chemistry, physics, mathematics and computer science. All 7 of the program's learning outcomes can be used to satisfy UDLE #1. While the courses in years 1 and 2 instill the fundamental knowledge required in biology, courses offered in years 3 and 4 build on that knowledge to expand the students' perception and understanding of biological concepts. Upper year biological electives further deepen the knowledge in a given area and develop the critical thinking needed to trouble shoot and solve complex biological issues.

For UDLE #2, 'Knowledge of methodologies', all of the program goals encapsulate this concept. The method of inquiry is a fundamental concept for biological sciences and the program begins in first semester in BLG 143 introducing the students to the use of this method for the design and proof of concept of hypothesis in biology. This is followed by the design of experiments, the collection of relevant data and the analysis of the results. Many courses in the curriculum, especially those with laboratories, extensively teach with methods of inquiry in mind. Finally, conclusions to explain the outcomes are formulated and future considerations are expected in many courses.

UDLE #3 addresses 'Application of knowledge'. The very nature of biology lends itself to this concept. All of the courses have some aspect of critically evaluating qualitative and quantitative information. Our program learning outcomes 2, 3, 4, 6 and 7 address applications of knowledge in various degrees and those with laboratories attend to this application by involving the student in hands laboratory experiments. Furthermore, the upper year electives both inside and outside of our program enable the student to practice proposing an argument, designing experiments to prove or disprove the argument and suggesting a solution. The students are expected to make use of scholarly journals and books to gather relevant background information and learn about appropriate methodologies that can be employed to test their hypothesis.

Communication in both written and oral form (UDLE #4) are expected in many of the core courses and most of the biological electives and as outlined in goals 5 and 6. Written communication is practiced in the form of lab reports, essays, critical reviews, and written answers on tests and exam. Oral communication is in the form of in class presentations and discussions. Additionally all biology students are required to take CMN600 a communication course designed for science students to learn how to express scientific concepts in layman's terms.

UDLEs # 5 and 6 concentrate on 'awareness of limits of knowledge' and 'autonomy and professional capacity'. Program learning outcomes 4, 5, 6 and 7 all take into account these two concepts. The biological electives in particular test the students' ability to interpret current literature and critically assess the meanings of experimentation and their limitations. Lastly, academic integrity and social

responsibility are integral to all academic courses at Ryerson as outlined in Ryerson's Student Code of Conduct.

f) Curriculum Development

The curriculum of the Biology Program has implemented several changes over the past seven years. This has been in response to student feedback, implementation of curriculum rigor, and evolving societal demand. The latest curriculum revision took effect in Fall 2012 and satisfies a long term vision of delivering a well-rounded, comprehensive and inclusive core biology curriculum in the program.

To begin, the program identified major areas of biology that are recognized by the global biological community as necessary cornerstones of biological education that would introduce students to all the key concepts in biology. These key concepts would be taught through 9 major courses within the discipline including Biochemistry, Botany, Cell Biology, Ecology, Evolution, Genetics, Microbiology, Molecular Biology, and Zoology. It was our goal to teach most of these courses as a core component of our program to all our Biology students in their second year of study so that specialization courses that are built on these fundamentals could be offered in years 3 and 4 of their degree. Inclusion of these nine subject foci strengthened the delivery of Program Learning Outcomes 2, 3 and 4.

In Fall 2010 only 50% of the core package or 32.5% of the entire program were mandatory biology courses. The rest were science related courses such as physics, mathematics and chemistry that ensured that our students receive a solid foundation in the sciences. Compared to other university Biology Programs, Ryerson students were receiving a much lower number of core biology courses.

As a first step to ensure that our students are exposed to all fundamentals of Biology while allowing room in the curriculum so they can specialize in key areas of Biology in the upper years, three courses were moved into the core package. The course breakdown after the restructuring for the Biology students in the Regular Program is as follows:

- 13 Core courses in Biology and Biochemistry (required)
- 11 Professionally Related Science courses (required)
- 1 Communication course (required)
- 9 Electives
- 6 Liberal Studies

The program now consists of 35% biology and biology related courses and 22.5% other science courses. In addition, students are required to choose at least 3 biology or biology related courses from their elective package. Several new courses have been added to the list of Biology courses. Some new courses will become active when the new program in Biomedical Sciences commences in the fall of 2013 and these will also be offered to the regular Biology Program students as electives.

Recently several biology courses (BLG 181, BLG 599, BLG 699) have been designed to be offered to students outside of the science programs as Liberal Studies electives. In addition to these courses, all other biology courses are available for students outside of Department to take as open electives as long as they satisfy the prerequisites requirements and there is room in the class. Traditionally, very few students from non-science Departments have taken science courses as electives.

g) Enrolment in Program Courses

Enrolment has been on a steady incline over the last several years. The first year Biology course, taken by all first year science students, has reached the 500 students mark and now is offered as 2 groups of 250+ since there are no classrooms on campus that accommodate more than 500. These large numbers pose several issues, the first being the quality of education experience in such a large classroom with so many students with varying learning styles. These 500 students are further divided into groups of 24 for

laboratories. Higher level courses are slightly lower in numbers than the first biology course but most of the biology core courses have enrolments above 100.

Professional electives are somewhat smaller in enrolment than the core courses. There are a limited number of electives that are offered in any one year due to lack of faculty and other resources. The lack of choice causes some of the elective courses to be large (i.e. BLG 600 Physiology, BLG 700 Anatomy).

h) Relationship to Current Discipline and Profession

Biology programs do not feed directly into a professional practice although many biology graduates seek further education in professional disciplines such as medicine, dentistry, pharmacy, physiotherapy and other health care occupations.

Biology Programs are not part of a program accreditation body. Each university self regulates their own biology and biology-related programs. Despite this, there remains significant consistency between programs across Ontario and across Canada.

i) Student Engagement

Data from NSSE indicate that while 36% participated in classroom discussions in first year 52% indicated they participated in classroom discussion by 4th year. Also 4th year students indicated that 49% prepared two or more drafts of papers and 94% indicated those papers required integration of ideas and information from various sources. Both these categories were higher than Ryerson's general student population of 42% and 91%, respectively. NSSE data suggests that the Biology Program uses more written than oral assessments than some other disciplines in general but that overall the students are exposed to a wide variety of assessments.

j) Collaborative Agreements

Currently, the Department has one collaborative agreement with Centennial College to accept graduates of the College's Biotechnology-Industrial MicroBiology Program to complete a BSc.

k) Experiential Learning Opportunities

Starting in first year, the students are introduced to concepts during laboratory and tutorial sessions in Chemistry, Physics, Mathematics, Computer Science and Biology. Second and third year core courses with labs continue to hone the students skills. Recently the Department has added several new laboratories as components of courses, for example, botany (BLG 230) and evolution (BLG315).

The Department also offers a co-operative program which can provide students with 20 months of work experience (5 work terms) that enhances their organizational and technical abilities as well as their oral and written communication skills if they choose this option. The co-op option gives the students and opportunity to obtain practical experience in their field and a better understanding of their profession. This work experience puts the co-op graduate in an advantageous position to obtain permanent employment. 5 to 10% of our students participate in co-op.

l) Student Assessment

Science is a fact based discipline where it is important for the students to be able to recall the information precisely and rapidly. For these reasons, assessments are often in the form of multiple choice questions. Assessments in this form are very valuable for assessing the depth and breadth of recalled knowledge of the students over the topic areas. For the application of the material to biological problems, most courses also include some short/long answer questions on mid-terms and finals where students must demonstrate understanding and not just recall.

Many courses also contain a laboratory component where a variety of assessment are used to assess basic recall (short quizzes), networking (in-lab report forms), understanding and application of knowledge (lab reports) and writing skills (individual lab reports). Laboratories often also have a small 'best lab practice' component to their marking scheme which includes assessing students' 'at bench' lab skills when performing the required exercises.

The fourth year thesis course is an excellent example of a two-semester senior level course that incorporates hands-on experience with critical thinking skills, written and oral presentation skills along with the opportunity to interact directly with researcher in a lab setting. Approximately 1/3 of graduating students participate in this course and consider it a valuable learning experience.

m) Student Success and Achievement

Student success can be measured in several ways:

- 1) the recommendation of the program by the graduates of the program
 - 77% of alumni would recommend the Biology Program to others seeking a BSc in Biology (UPO data poll based on 13 respondents)
 - 100% would recommend the Program although 53% would do so with some reservation (program survey of alumni based on 18 respondents)
 - 77% of the students (UPO data) indicated that they were satisfied or very satisfied with the overall quality of the program
 - 100% of the students agreed or strongly agreed that the quality of the program was high (program survey)
- 2) the ability of graduates to obtain meaningful employment after graduation
 - 20% of graduates found jobs within 3 months but 13% took longer than 1 year
 - 53% were still in school, of that 38% in professional schools (such as medicine or dentistry) and 62% in Master or PhD programs
- 3) the ability of the program to retain students
 - Retention of students in the program was only slightly lower than retention in the Faculty or at Ryerson as a whole
- 4) the overall academic standing of the student in the program.
 - The overall academic standing of students in the program was lower than the average at Ryerson where only approximately 50% achieved clear standing after one year in the program. Although there is an orientation course for first year science students to help them with the first year experience at Ryerson, it is possible that the biology students need a more aggressive integration experience to help them achieve more favourable grades at the end of first year. Changes to the orientation class have been implemented each year in order to further aid the students although the perfect solution has yet to be found.

n) Library Resources

Overall, the library confirms that it is well equipped to support the undergraduate program in Biology. Electronic resources are available to students 24/7. The library noted that specialized in-class library instruction was under-utilized in the Department.

o) Surveys

Student Survey

Undergraduates in the years 2, 3 4 were surveyed about their satisfaction with various aspects of the Biology Program. In all, 166 students were polled, where 151 were in the regular program, 12 were in the co-op option, 1 in the Biophysics option and 3 in the Bioinformatics and Computational Biology option. The Environmental Biology option is new this year and the students were not asked to identify themselves in that option. 18% attended either another university or college prior to attending Ryerson and 9% had worked full time.

The following percentages indicate “agreed or agreed strongly”:

- 100% – program was academically challenging
- 87% – professors were current and knowledgeable in their fields
- 87 % – professors were available to students outside of class time
- 83 % – most of their professors’ teaching was academically challenging
- 82% – the teaching they experienced was of high quality
- 77% – the program helped with their research skills
- 74 % – professors were well organized in their teaching
- 70% – the program was of high quality
- 69-75% found that written assignments, textbooks, learning materials, classroom instruction and laboratory experiences effectively or very effectively contributed to their learning
- 61% found computer based resources to effectively or very effectively contribute to their learning
- 59% – the content in the course was well organized
- 58% –program prepared them for a career
- 58% found tests/exams to be effective or very effective
- 56% – professors provided useful feedback on their academic performance
- 54% – the program helped with their written communication skills
- 52% found the academic workload in the program manageable while 43% found it excessively high and 8% found it too low
- 49% – the program helped to improve their ability to work in teams
- 49% and 44% found the Department was useful at providing academic advice within the Department and outside the Department respectively
- 37% and 44% found group work to contribute effectively or very effectively to their learning
- 35% and 42% – their oral skills and critical thinking ability improved, respectively
- 32%, 37% and 38% – the program helped them to develop a broad knowledge of their career, computer skills and the ability to respond to technological innovations, and their understanding of professional/ethical responsibilities, respectively
- 33% found print based library resources to contribute effectively or very effectively to their learning
- 25% and 29% – the program helped to improve their leadership skills and improve specific employment related skills
- 24% and 25% – the program helped them with international context of their program or helped with understanding people of different cultures
- 13% and 22% – the program helped with their entrepreneurship or creative ability, respectively

Alumni Survey

Alumni of the Biology Program were polled for their satisfaction about the Biology Program. Responses were received from 17 alumni who graduated between 2009 and 2012.

- 100% agreed or agreed strongly that their program was academically challenging and that the quality of the program was high
- 93% agreed or agreed strongly that their professors were current and knowledgeable in their fields
- 87% agreed or agreed strongly that the teaching they experienced was of high quality
- 80% agreed or agreed strongly that their program prepared them for a career

In the Ryerson survey (UPO data based on Canadian Undergraduate Survey Consortium) 13 students responded.

- 77% found the overall quality of the program to be satisfactory or very satisfactory
- 47% would recommend Ryerson for their program without reservation while 53% would recommend Ryerson but with reservations

The NSSE survey found that 85% would come back to Ryerson if they were starting all over again.

Employer Survey

Employers that hire students from our Biology Program were asked to contribute their opinion about the quality of our students. Of the four companies that replied:

- all would prefer to hire students with degrees in chemistry
- 2 indicated that they would hire students with interdisciplinary degrees or those in other fields of science

- one preferred breadth of knowledge over too much depth in one area while another preferred a depth of knowledge over too much breadth
- if they hired a student with a biology degree they would consider additional skills in chemistry as valuable
- the most valuable skills were statistical analysis of data sets, general laboratory skills, sterile technique and microscopy
- two companies indicated that they were satisfied or very satisfied with Ryerson graduates in technical skills, and written and oral communication. They were also satisfied with Ryerson Science students' ability to run and plan projects, organization, initiative, creativity, leadership potential, and overall quality of work. All of the categories were comparable or better than graduates from other university science programs.
- one company indicated that data analysis and problem solving was unsatisfactory although they still considered our students to be compatible to other universities.

Overall too few companies replied to the survey and therefore no conclusions can be made.

6. ACADEMIC QUALITY INDICATOR ANALYSIS

a) Faculty

The core Biology faculty are drawn from the Department of Chemistry and Biology; however, faculty members from other Departments (e.g. Physics, Mathematics and Computer Science) also teach courses (mainly in the first year) in the program. The existing faculty complement for the program is a dynamic, vibrant and accomplished group who conduct teaching and research in a broad range of disciplines.

The external research equipment grants obtained by the faculty over the past decade, augmented by substantial investments from the Faculty and University, have enabled researchers in the Department of Chemistry and Biology to build a considerable infrastructure, much of which is shared. Leading-edge research facilities managed by the Department include an Advanced Microscopy and Imaging Facility, the Ryerson University Analytical Center, and a Clean Room.

In 2011-2012, the 19 research-active core faculty in the Department were supervising or co-supervising 35 Master's students and five Ph.D. students. The group has collectively mentored to degree completion at Ryerson 106 Master's students and 16 doctoral students (through Ryerson's programs or adjunct appointments to other institutions), as well as 11 post-doctoral fellows.

In the last seven years they have published 218 articles in peer-reviewed journals and have acquired over \$9 million in research funding (operating and equipment tools combined) from peer reviewed funding agencies from a wide variety of sources.

The biological research activity that has developed over the past decade or so has resulted in many meaningful opportunities for undergraduate students as well. Between academic years 2005-6 and 2010-11, 104 Biology students completed a laboratory research thesis under the auspices and guidance of one of the biology faculty members. Of those who completed a thesis, at least 49 are known to have gone on to graduate school or professional training after graduating.

b) Admission Requirements

Secondary school diploma with six Grade 12 U/M or OAC courses, including the following: Grade 12 U courses in: English, Chemistry (SCH4U), Biology (SBI4U) and Advanced Functions and Introductory Calculus (MCB4U) with a minimum of 60 percent or higher in each of these courses.

In 2010-2011, the admission average was 79%. This is a 4% increase over the six years since the program was initiated in 2005. Concurrently, the percentage of students who entered the program with an average over 80 % increased from 19% in 2005 to over 40% in 2010.

c) Enrolment, Retention and Graduation Data

The Biology Program has grown each year due to increasing demand for the program. There is a slightly higher enrolment of female students (355 female and 252 male in 2011). The number of students with a full course load has remained fairly constant while the number of students with a part time course load has increased significantly over the same time period. The Department is currently running at capacity for space and enrolment numbers need to be leveled off. The introduction of the new program in Biomedical Sciences in fall 2013 has decreased the interest in the regular Biology Program for this coming year.

First year headcount (University Planning Office data)	F2005	103	F2009	142
	F2006	136	F2010	163
	F2007	166	F2011	212
	F2008	157	F2012	208
Total headcount enrolment (University Planning Office data)	F2005	103	F2009	495
	F2006	232	F2010	529
	F2007	349	F2011	607
	F2008	467	F2012	645

The overall academic standing of students in the program was lower than the average at Ryerson with only approximately 50% achieving clear standing after one year in the program (Table 1).

Table 1. Percentage of students with a clear standing after one year in program

Program	Year						
	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Ryerson	64.2	66.9	66.8	74.7	76.1		
Engineering Architecture & Science	53.0	59.7	56.5	63.9	67.2		
Biology	46.3	54.3	50.0	52.1	64.8	54.7	52.4

Table 2. Percentage of students retained in program after 1 year in program (% retention)

Program	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Ryerson	81.04	81.34	82.09	79.96	80.98	82.3	82.1
Engineering Architecture & Science	75.63	77.40	74.72	73.37	74.20	-	-
Science						73.5	72.0
Biology	76.84	75.00	84.87	65.74	70.00	69.7	76.0

Table 3. Percentage of students retained in program after 2 years in program (% retention)

Program	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Ryerson	70.22	74.76	75.31	72.86	75.9	74.3
Engineering Architecture & Science	62.55	69.19	65.54	60.32	-	-
Science					66.9	66.3
Biology	54.74	66.67	66.39	62.96	67.3	66.4

Table 4. Percentage of students in program after 3 years in program (% retention)

Program	2005/06	2006/07	2007/08	2008/09	2009/10
Ryerson	65.87	71.28	70.27	70.4	69.9
Engineering Architecture & Science	59.10	64.82	59.46	-	-

Science				56.6	58.3
Biology	47.37	54.63	54.62	58.3	60.0

d) Additional Program Feedback

The Biology Program Advisory Committee felt that the current curriculum was strong and provided “solid and comprehensive academic teaching in the areas of biology.” They also stated that recent changes in the curriculum to include a basic course in each of the nine core areas “is a step in the right direction.” They indicated that this was “positive initiative to move the program towards the goal of developing graduates with more globally and societally relevant skill sets.” Additionally it was felt that “opportunities to develop specialization in third and fourth years and the focus on practical, technical and communication skills will position graduates to be successful in industry or further study.”

On the other hand, several of the board members felt that:

- the curriculum in the environmental area could be expanded
- science students still need more instruction and practice at their soft skills within the science context including resume and cover letter writing, presentations on career paths, and networking skills and employment type situations
- curriculum development could include intradisciplinary courses in business law, scientific policy, programming and geographical information systems to name a few
- infrastructure is important for further growth of the program; specifically, laboratory space
- the introduction of part time studies in the sciences would create “an unique opportunity for growth
- the Department’s commitment to cooperative education might be further promoted
- the Department should do more to maintain contact with alumni from the program

7. RESOURCES

The Biology Program is housed within the Department of Chemistry and Biology. The Department of Chemistry and Biology has one Chair, one Associate Chair, two program directors and two faculty co-op advisors. The First Year Common Science Office also has a Program Director that oversees all the first year students in all of the science programs. The departmental office is staffed by an Administrative Coordinator, and two Departmental Assistants. The Biology academic laboratories are managed by three biological technologists.

In 2005 there were 19 faculty members in the Department of Chemistry and Biology; currently there are 26. Although there have been 10 hires over the last 7 years, there has also been 1 retirement, 1 resignation and 1 faculty member assignment to university level administration. Since 2005, the number of biology students has increased from 103 to 645, dramatically increasing the ratio of students to faculty. All but one faculty member has additional student supervisory responsibilities with the School of Graduate Studies.

Most of the teaching assistants and graduate assistants are students from the graduate programs in Molecular Science and Environmental Applied Science and Management (EASM). 58 GA positions were filled in 2012-2013 along with 15 markers.

Additional laboratory space requirements for new courses such as Evolution, and Botany together with the additional lab space required for the increase in the first and second year courses have over-extended the capacity of the lab rooms. The Biology Program finds itself in a cramped location and with significant logistical challenges for laboratory delivery. Although the recent announcement of a new Science building as the University’s top priority for new capital construction projects is welcome news, it will be years before the dream becomes a reality.

8. STRENGTHS, WEAKNESSES AND OPPORTUNITIES

a) Strengths

Because the Biology Program at Ryerson was developed from a well-established interdisciplinary program (Applied Chemistry and Biology), it began with and has maintained a strong curricular structure and a dedicated teaching complement.

- The common first year gives all the students a strong basis in the required fundamental fields of science and ensures all the students have same level of knowledge to enter second year.
- More specialized courses in the subsequent years deliver a good foundation in the eight of the basic biological areas; microbiology, cell biology, genetics, zoology, botany, molecular biology, ecology, evolution and biochemistry. In 3rd and 4th year the students may opt to further specialize in a biological area or increase their breadth of knowledge by choosing appropriate electives.
- Changes to the curriculum have been implemented over the last several years.
- Three options are available to students after 2nd year: Bioinformatics and Computational Biology, Biophysics, and Environmental Biology.
- A strength of the Biology Department lies in its teaching knowledge breadth, depth and enthusiasm.
- Several faculty within the Department have a focus on education and learning pedagogy.
- Currency in scientific education helps all the faculty participate in new teaching models and learning techniques.
- Keeping reasonable student numbers in the classroom helps to increase student participation in the learning environment. Even with the large increase in student numbers the largest sections of first year classes is usually 300 or less. Courses with more than these numbers are divided into multiple sections to maintain a lower student to instructor ratio in the classroom although overall student to professor contact ratio throughout the whole program is quite high.
- The curriculum contains a large percentage of courses with lab components. This applied experience helps to prepare students for graduate programs or careers in biological fields directly after graduation.
- The co-op option increases the hands-on experience for those students who choose the option.
- Many professors teach courses at several different levels within the program permitting the professors and students to develop relationships that is very useful for allowing students to be comfortable enough to ask questions in and outside of class and for professors to be able to identify prospective graduate students.

b) Weaknesses

Although the development of the Biology Program from an existing interdisciplinary science provided a strong curricular structure and a dedicating teaching complement, it also required a substantial increase in the number and variety of biology courses offered. Several areas still needing to be addressed are as follows:

- The number of students in the common first year has more than doubled in biology but in some cases individual courses have seen considerable increases (e.g.90 students in BLG143 in 2005 to over 600 in fall 2013). The space in the Department has not increased accordingly and it is therefore becoming increasing difficult to maintain the quality of labs the Department has traditionally offered.
- Further curriculum constraints have been felt in the electives and option packages. Although the professional electives package has grown over the last 7 years and currently includes 19 biology electives and 3 biochemistry electives, the lack of teaching faculty and funds associated with hiring temporary lecturers limits the ability to offer more than 7 to 8 electives in a given year.
- The diversity of the electives is also restrictive as they have been developed as faculty expertise has come on board in the Department and do not necessarily cover all facets of biological knowledge.

- The popularity of elective courses in other disciplines (such as Psychology) have reduced the numbers of Biology students taking professional electives in their own discipline.
- The two options in Bioinformatics and Computational Biology, and Biophysics, developed when the Biology Program was first implemented, have not been popular. Such transdisciplinary options need to have more exposure and be more accessible from a timetabling and scheduling perspective; however, the low student numbers work against this.
- The increase in class size and the limitations in space constrict the ability to provide individual and selective learning strategies for every student.
- The advancement of technology that allows instructor to provide the learning material in many different formats can sometimes be administratively heavy due to technological difficulties or software interfaces requiring extensive time and effort for proficiency.
- The introduction of the environmental biology option has increased the interest in providing field work opportunities. Because Ryerson is located in the heart of the city, there are limitations when trying to provide greenhouse or field work opportunities for students.
- With the increasing number of sections of biology labs, we need to be able to run 3 labs per day. This is hard to accomplish when liberal arts bands are imposed during prime lab time.

c) Opportunities

- Admission numbers into the Biology Program at Ryerson has increased each year helping us to capitalize on our cohesive and comprehensive curriculum in biology. The stand-alone Biology Program has increased the visibility of science at Ryerson and the recent establishment of the Biomedical Science Program in 2013 has also positively affected Ryerson's reputation as a science school.
- The increase in the quality of student applicants will allow us in the near future to explore other program options such as interdisciplinary programs between science and business, journalism, or social media.

d) Obstacles and Challenges

- The most obvious obstacles are scheduling and timetabling, space and equipment, the requirements to run multiple sections of labs, and the lack of biology electives courses and faculty.
- The challenge is to maintain the integrity of our program and continue to strive for changes that will support the learning and teaching environment in the Department in the face of cutbacks and limitations in infrastructure.

9. DEVELOPMENTAL PLAN

The following developmental plan will focus on four main areas that can be addressed at the program level: a) curriculum development and delivery, b) student satisfaction, c) the learning and teaching environment and d) research growth.

Curriculum Development and Delivery

- The department will strive to continue to hire in our strategic areas, environmental biology, and cell and molecular biology.
- More higher level electives courses will be offered by the department.
- The department will promote the three Options (Bioinformatics and Computational Biology, Biophysics, and Environmental Biology) as viable alternative career directions and provide support to students that choose these non-conventional options. We will continue to track students to assess the impact of recent hires which will enhance the options in Bioinformatics and Computational Biology, and Environmental Biology.
- The department will encourage the Biology curriculum committee to explore a biochemistry option with the biochemistry faculty.
- The department will encourage the curriculum committees of the Chemistry and Biology programs to jointly propose an option in Biological Chemistry.

- The department will support the initiatives of faculty to enhance their course material with on-line modules, in class technology (such as clickers), alternatives modes of delivery (such as flipped and hybrid classrooms).

Student Satisfaction

- The department will continue to support the initiatives of faculty, students and alumni which will increase the involvement of students in activities that enhance their education and satisfaction within the program.

Learning and Teaching Environment

- The program will continue to support innovation and substance in the classroom and strive to create productive learning environments both inside and outside of the classroom. More opportunity to learn through workshops, shadowing experiences, and outdoor classrooms would benefit the engagement of the student and the retention of the material.
- The department will continue to look for other space saving ideas while trying to maintain the experiential education delivered currently through laboratory exercises.

Research Growth

- A well rounded and robust Biology Program requires researchers whose research programs advance not only graduate education in the Department but also undergraduate involvement in the research environment. Many undergrads are keen to experience life in a research lab and gain valuable skills that they can include on their resumes and use in their future careers. The Department and the program will continue to strive to support the faculty engaged in biological science research so that more students have the opportunity to use their knowledge in real life research and the department will continue to support the student mentoring student lab experience program to help integrate more undergraduates into research labs.
- The department will seek additional support for faculty so that they can increase their ability to take on undergraduate students in their labs as volunteers, fourth year thesis students (BLG 040) and graduate students.

10. PEER REVIEW REPORT

i) REVIEWERS

Dr. Roberta R. Fulthorpe, Department of Physical and Environmental Sciences, University of Toronto Scarborough (Chair of Peer Review Team)

Dr. Paula Wilson, Department of Biology, York University

Dr. James Smith, Department of Electrical and Computer Engineering, Ryerson University

ii) OUTLINE OF THE VISIT (June 2, 2014)

- introductory meetings with administrators and a tour of the research and teaching laboratory facilities
- meeting with administrative support staff and technologists
- meeting with two graduate students (graduated from the undergraduate program) and two recent graduates of the program
- meeting with twelve faculty members
- further discussion when joined by Chris Evans (Vice Provost Academic), Imogen Coe (Dean, Faculty of Science) and Darrick Heyd (Associate Dean, Faculty of Science)

Note that we were asked to assess the program as it existed between Fall 2005 and the end of the 2011-2012 academic year. Major curricular changes have occurred in the two years since; therefore, this report may be, even before it is written, obsolete, as we are commenting to some extent on a program that no longer exists.

iii) EVALUATION CRITERIA

a) Objectives

Evidence in the written documentation and from the site visit indicates that the program is well aligned with the mission and academic plans of the university. The program combines theoretical and applied knowledge in the biological sciences together with research skills and opportunities. It provides students with the foundation for further study in the field, careers in the biotechnology and life science sector, and various health-related professions.

The program is providing a modern education in biology which includes the development of professional knowledge and skills, critical enquiry and ethical standards. It is clear that those engaged in teaching students and those supporting the program in other ways are engaged, committed and student-focused. The curriculum provides the breadth to explore other ways of knowing and the broader issues confronting modern society.

In general the program requirements and learning outcomes are clear, appropriate and in alignment with undergraduate degree level expectations. Mapping to courses suggests that the outcomes are being addressed throughout the curriculum. The Self Study and visit provided clear evidence that the program is responsive to changes in the discipline and its students.

The articulation of program goals and their alignment with assessment, outcomes and learning objectives is an iterative process. One area to consider revisiting for better alignment would be the mapping of Program Goals to Knowledge/skills/values and Learning Outcomes, with special attention to mapping for goals 6 and 7.

b) Program Identity

The Biology Program employs a standard lecture-based classroom plus experiential laboratory approach to program delivery. The Biology Program is also taking advantage of the student-centric “Zone Learning”, successfully pioneered in the Digital Media Zone, to develop a “Biology Zone” at the nearby MaRS centre. Initiatives with direct impact on pedagogical goals such as “sequential team teaching” in BLG 143 complement important indirect activities like faculty and staff social retreats to give the impression of a contemporary, adaptable, and multi-faceted biology program.

The Biology Program has some potential weaknesses, as perceived by the reviewers. First is the insufficient number of rooms for lab activities, as attested to the reviewers by students and staff, and described in the program’s self-assessment document. This combines with an apparently growing number of students and a limited number of staff resulting in students having to conduct labs late in the evening. In addition, while it is clear that the first two years include intensive practical experience, it is not clear whether the fourth year courses include significant laboratory opportunities.

While the Environmental Biology option appears to be popular, the Biophysics and Bioinformatics and Computational Biology options are under-subscribed. In particular the trend seen in Bioinformatics and Computational Biology could be due to the same external forces that are driving down Computer Science enrolments at many universities. Regardless, internally, the Computer Science (CPS 118) and Mathematics (MTH 131, 231 and 380) could be tuned to make this important option better understood and more appealing. The switch from a C-based CPS 118 course to Matlab is a step in the right direction towards the programming languages commonly used professionally in biology. Finally, the Program’s self-assessment document highlights a concern with respect to approximately 50% of students having a clear standing the end of first year. This is a concern to the reviewers, as well, and it is unclear what roles low entry grades or program delivery in first year play in this matter.

Admission requirements are appropriately aligned with the learning outcomes and are in line with requirements for similar programs across the province.

c) Curriculum

The Ryerson program does a good job providing the foundational sciences (basic biology, chemistry, math, physics and computer science) in the first year. It builds on this in second year with fundamental biology courses including cell biology, genetics, botany, zoology microbiology, ecology, organic chemistry and biochemistry and the statistics important to the experimental sciences. While the program used to lack the ecology, evolution and zoology of comparator institutions these seem to have been partially remedied. In the third and four years students do study evolution, but also molecular biology, biochemistry. So the Ryerson program is meeting its basic requirements.

To deepen their studies, students choose from a variety of "professional or professional related courses" (P/PR). This is where the curriculum will benefit from continuous review and improvement. The scope for students to specialize in particular areas of biology is limited. Options in Biophysics and Informatics and Computational Biology are being offered, and according to the Self Study, an option in Environmental Biology has been added. While nineteen other offerings in Biology are listed under the P/PR category in the appendices given to the review team, the reality is the students do not have much to choose from. More should be done to make more of these courses available to students.

Overall the offerings are strong in microbiology, biochemistry and the molecular sciences, but somewhat weak in overall organismal biology and ecosystem level courses. As Ryerson cannot be expected to offer specialization in all areas of biology, they are doing an admirable job of trying to find options for the students that can reflect faculty strengths. This needs to be an ongoing process, a fact clearly recognized by the faculty as demonstrated by the curriculum improvements highlighted in the Self Study. It should be noted that the Biology group has limited credit space due to the liberal arts requirements of Ryerson, that both limit science course content and impinge greatly on the scheduling of lab based courses.

Ryerson Biology has the lowest science content of all comparator programs listed (61% science courses). Students identify the lack of diversity of fields in the program as a weakness.

With respect to the content of particular courses, the reviewer noted when talking with graduates that some content may lag current industry standards. In particular, Python appears not be taught within the Bioinformatics and Computational Biology option courses, and yet Python and Perl are the standard programming tools for Bioinformaticians. Collaboration with Ryerson's Biomedical Engineering program, which currently suffers from a lack of option diversity in its final program year, could improve the viability of course offerings for Bioinformatics and Computational Biology and/or Biophysics.

Our meeting with students revealed dissatisfaction with the general Orientation course, which is currently used to provide information on lab health and safety (WHMIS) certificates, coop options and the available fields. Students refer to it as being "monotonous" and suggest a course that focuses on basic technical proficiencies important to both research and the work force (word, excel, graphics training) and gives some exposure to potential employers or at least their areas. Students felt the second year statistics course was too general and they had difficulty putting it into the context of their discipline. Based on student comments, the program might benefit from integrating more enquiry into the laboratories.

The Biology program relies on standard lectures with lots of visual content, class discussions and a great deal of laboratory exercises and demonstrations in the early years. The latter have always been a key part of Biology instruction, but their survival in current form is challenged in the face of growing class

enrolments and limited space and resources. The curriculum does not seem to include any field courses or field components. These are often as effective as laboratories in dramatically increasing students' comprehension of course materials. The Dean's office appears poised to explore non-standard alternatives to laboratory classrooms, in particular computer simulations.

d) Teaching and Assessment

A review of the material provided indicates that the program is using all of the assessment tools typical for Biology programs, and we are satisfied that basic learning outcomes are being assessed within the program. Information in the appendices of the self study suggests that senior courses generally lack assessments such as critiques, oral presentations and essays. These types of assessments are particularly useful in assessing learning outcomes/goals that involve science literacy, communication skills and critical thinking and analysis (Program Goals 6 and 7); the department may want to consider increasing those types of assessments, as is possible within the limitations of teaching resources and class size, to better align assessment with program outcomes.

e) Resources

There are an insufficient number of rooms for lab activities, as attested to the reviewers by students and staff, and described in the program's self-assessment document. This combines with an apparently growing number of students and a limited number of staff resulting in students having to conduct labs late in the evening. There are far too few microscopes and fume-hoods, and some rooms are in real need of updating and renovation. Collaboration and coordination with other programs such as Chemical Engineering, leveraging future resource allocation to programs such as Biomedical Engineering or accessing external partner facilities such as those at St. Michael's Hospital could help alleviate some of these concerns.

The reviewers feel that the Biology Program is making do with the financial resources allocated to it and shares the concern outlined in the Self Study that continued use of and "absolute reliance" on one-time-only hiring is not an appropriate long-term human resource staffing strategy.

The Library resources appear to be sufficient and inter-library loan services permit students to obtain literature from other schools, particularly medical schools with biology-related materials. Furthermore the Library's electronic resources, including web-based search engine and an e-book collection are competitive vis-à-vis other Canadian universities.

Computing resources are shared with other Ryerson programs. As is commonplace elsewhere, Ryerson's Campus Computing Services provides sufficient widespread and robust "bring your own device" support for students through wireless services, virtual applications, web access to teaching resources (Blackboard) that there is little need for dedicated computer labs.

Other campus resources include the student-focused Writing Centre and Access Centre for academic accommodations. In addition, faculty are supported by resources such as the Learning and Teaching Office and an Academic Integrity Office.

f) Quality Indicators

Neither the Ministry of Training, Colleges and University nor the Self Study provide data on graduation or employment rates specific to Ryerson's Biology program (or even the Chemistry and Biology Department). In the Self Study the lack of data was attributed to the fact that the first graduates would have been in 2009, and data only available from 2006.

The faculty members in the Department are well qualified and for the most part research active. The research output of faculty is variable but includes a significant number of individuals who are running

highly productive research operations and attracting diverse sources of funding. All but one faculty member are associated with the School of Graduate Studies. It is encouraging that many of these high output individuals are found amongst the Assistant Professor pool. One concern is the demographic structure of the Department – there appears not to be enough Assistant Professors to support the planned increase in program enrolments.

The program “currently” requires the support of Limited Term Faculty and Sessional Instructors in order to run efficiently. Student to faculty ratios are increasing. It is our understanding that Limited Term Faculty, while highly valued for their teaching support, cannot be made permanent. This would seem to be a waste of the investment of training and preparation time for both the permanent faculty and the LTF's. Other institutions have the option of hiring full time Lecturers, members of faculty who are hired primarily for teaching who can be granted tenure and rise up promotional ranks. At UTSC, in both Physical and Environmental Sciences and in the Biology Department, lecturers are critical members of the teaching staff without whom our programs would be seriously cut back. It is curious these kinds of positions are not used at Ryerson, and we encourage the institution to explore this option.

Many concerns surrounding the statistics that reveal student quality appear to have been resolved by the recent introduction of a Biomedical option. The program has also seen an overall increase in the average GPA (up from 76 to 80%). Retention has improved since retakes of first year courses has been allowed. There is a clear concern that the enrolments in Biomedical will overshadow those in Biology. This reveals a need to review the current Biology options carefully with a view to improving course offerings, content and marketing.

g) Quality Enhancement

Innovative and non-traditional approaches are being conducted within the program. Dean Coe pointed out that there is an explicit focus on improving the quality of the program while deliberately not growing the program. With this in mind, the Biology Program is taking advantage of the student-centric “Zone Learning”, successfully pioneered in the Digital Media Zone, to develop a “Biology Zone” at the nearby MaRS centre.

The continued emphasis on practical skill development in laboratory settings has a positive impact on learning. The conversion of CPS 118 from a C-programming oriented course to one based on Matlab leads in the correct direction. The initiative to conduct makeup exams on Mondays at 7am, while unconventional, appears to have countered the recent growth in missed midterm examinations seen in other departments at Ryerson. Continuing education (Chang School) resources appear to be used effectively, permitting students to take core and elective classes outside of the standard schedule, thereby using available resources efficiently.

iv) SUMMARY AND RECOMMENDATIONS

Overall the Ryerson Program in Biology is doing an admirable job of training general Biologists. It provides students the background for moving on to more specialized training in biology related discipline. It produces generally high quality graduates with good hands-on skills. The Biology faculty are of high quality and the program meets quality expectations set by Ryerson. We expect the program will need to continually evolve and adapt to accelerations in the sciences over the years to come, but there is strong evidence the Faculty are collegial and already engaging in a process of adaptive change. We recommend the University and Department keep the following recommendations in mind as they proceed.

- The organization of the curriculum with essentially all senior disciplinary courses referred to as “professional courses”, and with an unfathomable course numbering system, is atypical for university curricula.

- Needing immediate attention is planning for handling increasing enrolments, in terms of full time faculty, laboratory and classroom space, and support staff. Possible options regarding limited lab resources include obtaining additional facilities and staff, carefully controlling and limiting enrolments, or revisiting current lab space and delivery with an eye to optimizing efficiency through creativity and innovation, changes to course scheduling, etc. While administrators always advocate replacing hands on activity with online simulations, we feel that hands on is always best.
- Some of the existing lab space seemed to be in great need of renovation and updating.
- In spite of the restrictive lab space and the emphasis the program places on hands-on practical experience, it seemed to us there were few or no senior lab courses. There should be sufficient lab offerings in fourth year courses to provide all students with the opportunity to have a senior laboratory opportunity.
- As the program grows, pressure will increase to move away from some of the aspects of the program students seemed to like best and the department feels distinguishes it from local competitors such as lots of hands-on experience, small classes, and the opportunity to develop personal relationships with professors. The department will have to seriously consider the implications of such changes.
- We recommend the program continue to revisit fourth year course assessments, to ensure assessments are constructively aligned with program learning goals – i.e. that they are assessing the key skills/knowledge they want their graduates to have.

11. PROGRAM RESPONSE TO PEER REVIEW REPORT

a) Introduction

Overall, the PRT found the Biology Program to uphold the institution's mission statement by providing applied knowledge and research with a balance between theory and application. They found the curriculum to provide a solid foundation in the biological sciences and that the program satisfied all the criteria for university level education. However, the PRT did note that the mapping of program goals 6 and 7 to learning outcomes and knowledge/skills and values were vague and the means of assessment difficult. These issues will be re-visited by the Biology Curriculum Committee and the language changed to better express the intention of these goals.

The PRT noted that the curriculum was strong and well-balanced. The current curriculum was achieved through well-planned progressive changes over the last several years. We will continue to monitor our curriculum to ensure its appropriateness to current societal need and continue to uphold the necessary teaching and delivery methods to foster high quality education in biology. The PRT, however, did find that the infrastructure of our department was being stretched and that the program was weak in terms of senior level lab course offerings to our students. Given the limited space available and continued enrolment growth in Biomedical Sciences, there is no current prospect for addressing either of these concerns.

The PRT also commented on the low enrolment in two of the options, Biophysics, and Bioinformatics and Computational Biology. This results, in part, from the difficulty students in these options face in accessing courses outside the Department: these courses often create scheduling conflicts and may not even be offered by the other department. We continue each year to improve the options by working with the other departments to promote student access, but ultimately we do not have control over the availability of these required courses. As suggested by the PRT, programming tools such as Python and Perl are not taught in the current courses of the Bioinformatics and Computational Biology option and should be. The recent faculty hire in spatial ecology/big data may be able to help us launch a course that addresses this issue.

The Program Review determined that approximately 50% of Biology students do not have Clear standing at the end of their first year and this was seen as a concern by the PRT. With the introduction of the Biomedical Sciences Program, and reduction of Biology program admissions by almost 25%, the

admission averages have significantly risen over the last 2 years. Attracting better students should help us to increase our retention. Unverified data from last year shows that the percentage of students with Clear standing at the end of first year had risen to almost 70%. This result may also be due in part to a change last year in the Ryerson G.P.A. policy that lowered the requirement for Clear standing to a cGPA of 1.67 from 2.00.

b) Details

While the PRT felt that the program delivered a good basic education in the foundational biological sciences, they also noted that upper level biology course offerings in the elective package were very limited and lacked laboratory components. We are aware of this weakness in the curriculum but, due to space and financial resource limitations, it is not currently possible to offer laboratory-based upper year electives to our students. The addition of a Faculty of Science building at some point in the future may help to eliminate this shortcoming. Additionally, the PRT suggested that the program introduce field study labs, a suggestion that we also feel would be exciting for our students, especially those in the environmental biology option. Although more resources will be necessary to implement such a project, it should be achievable.

Furthermore, the PRT noted that liberal bands negatively impacted on the delivery of Biology labs. Although the Department is well aware of this fact, it is a university issue and beyond the scope of this exercise.

The PRT noted the challenge we face in trying to retain labs as curricular components with the growing number of admissions, especially the substantial enrolment increases associated with the Biomedical Sciences Program. Some curricular changes proposed to go into effect next year will reduce the delivery requirements of some lab courses. This will help to reduce the number of lab sections required and provide increased scheduling flexibility. Although it allows us to continue to deliver all of the fundamental lab skills as part of our curriculum, it also removes required lab hours from the Biology Program curriculum. This is a concern, shared by the PRT.

Overall, we concur with the laboratory space limitation concerns expressed by the PRT and have lobbied for more and better facilities for our students. Although neither the PRT nor the Department has the power to improve or acquire space, we implore the university to help us resolve this serious issue in curriculum delivery.

The other issue raised by the PRT is the number of faculty available to teach the growing number of students. The PRT notes the growth in both the faculty and student numbers although the rate of increase in student numbers is far higher. With additional students coming from other programs first year biology course numbers are over 600. The delivery of the program has gone from classrooms to theatre halls. The unique teaching and learning experience that students received in this program are being seriously eroded. Although we attempt to retain a friendly, welcoming environment, our program can no longer boast of small classroom experiences as a point of differentiation with local competitors with large science programs. More faculty, staff and technical support is one way to ensure that the educational experience of the students remains commendable and allows them to succeed and pursue their careers post-graduation.

The PRT's meeting with current senior Biology students suggested that they were disinterested in the Orientation course. However, we continue to believe that the course is a valuable asset to new students. Due to student dissatisfaction, the course was recently re-vamped (2013-2014) so it can be delivered almost exclusively on-line. The new format has been well received by the newer students.

c) Summary

The Department agrees that there should be a rational course numbering scheme implemented, but it is outside the context of this study.

- The PRT would like to see more planning in regard to lab and classroom space requirements, and the faculty and staff complement needed for the growing number of students in the program. The Department agrees. Planning at the local level is frustrated by limited options and a notable lack of institutional clarity in how additional resources are allocated for growing programs. Ryerson's current inability to deliver promised new laboratory teaching space for Biomedical Sciences has seriously impacted students in the Biology program. These problems can only be addressed at the institutional level.
- The PRT noted that renovations were in order for some of the older lab spaces. A number of lab spaces have not been renovated since originally built. The Department agrees that running up-to-date experiments in antiquated facilities is not ideal for high quality student training. The construction of a new Faculty of Science building in the future will eventually resolve this issue. In the meantime, the high costs of renovating a building not expected to house Science for more than 8-10 years undermines institutional willingness to address this problem.
- The PRT noted that upper year courses do not contain any lab experience component, which they felt would increase the student learning aspect and train them for additional career opportunities. We agree with this assessment but currently there is no space in the Department available for additional upper year course lab components. All available space is needed to run required lower level courses.
- The PRT cautioned that as we grow away from the small intimate classes and take on larger and a more comprehensive program, we should consider the implications this will have on our reputation, both as a Program and for the Department at large. We are excited by the growth in the enrolment in Biology but we also worry that our standards for teaching and learning are being impacted. We would like to be assured that renewed support for this popular program will be forthcoming in terms of spaces, staff and teaching capacity as we can continue to graduate sought after biologists.
- The last recommendation of the PRT was to ensure we re-visit our fourth year student assessments ensure they are aligned with our program goals. The program is very grateful for this comment and we will certainly work on this issue. With the strong foundational courses in our program being well established now, we can turn our focus to the upper year elective biology courses to improve implementation and assessment of skills the students will need post-graduation.

12. DEAN'S RESPONSE (Dr. I. Coe)

a) Overall state of the program based on the data and analysis contained in the self-study

The time frame of the current PPR (2005-2012) covers a time of enormous change and growth in the sciences at Ryerson, including (but not limited to the Biology program) and culminates in the formation of the new Faculty of Science in 2012. This is the first review for the Biology program, which is one of the most popular programs within the sciences. The faculty and staff involved in the program are continually monitoring outcomes in order to improve and further develop the program to meet increasing demands and to deal with the enormous increase in new knowledge regarding the life sciences. Overall, the program is rigorous, has a solid curricular structure, experiences strong enrolment pressure and a gradually increasing quality of student coming into the program.

b) Plans and recommendations proposed in the self-study report

The self-study is an extremely comprehensive and thorough document that clearly describes the program and highlights a number of strengths, weaknesses, opportunities and threats. The Department is well aware of areas that need attention while continuing to build on established strengths. For the most part,

the plans and recommendations proposed in the self-study are echoed by the reviewers and the departmental response is appropriate.

c) Recommendations of the PRT and the response by Department

i) Rational course numbering

Rational course numbering is a long-standing recommendation across the university. In consultation with the Department (and others within the Faculty) we will investigate options so as to provide more clarity for students in terms of planning their programming.

ii) Planning for growing enrolments

Since I became Dean in 2012, improved enrolment management has been an area of priority. There are several approaches that I advocate and which are already in development a) enrolment management through reduced intake and enhanced retention, b) curricular innovation allowing strategic and directed use of resources and c) transparent and empowered budgeting

Enrolment management – in consultation with the Chair of the Department, the first year intakes into the life science will be reduced with a concomitant increased focus on improved retention to off-set a potential overall drop in revenues to the program as a consequence of decreased intake. This modification of targets represents a first step towards rational enrolment management, and this is possible because of the opportunity presented by strong enrolment pressures.

Innovation in pedagogy – Supporting and promoting innovation in the content and delivery of laboratory courses, while costly and time-intensive up front, can pay off later in both improved learning outcomes, better retention rates and more effective use of resources. This is the approach I encourage, in full recognition that it may not lead to cost savings overall – but it may certainly lead to better use of the overall budget with, most importantly, improved outcomes.

Being proactive about the challenges ahead, Department has already made some adjustments in programming to split labs from lectures and create a stand-alone course (BCH880). There are both pedagogical and resource reasons for doing this. An extension of this approach is the development of a “mega-lab” course, which, if well designed, has solid pedagogical value and which can mimic more closely the nature of scientific inquiry. This approach also allows technical staff and resources to be used in a more directed and strategic manner and reduces the sense that both are being spread ever more and more thinly. There is also some evidence that students have a higher level of satisfaction and improved learning through these approaches. I encourage the program to consider the approach and will support initiatives in this direction as required/requested.

Enhanced clarity in revenues and budgets – to assist Departments planning for their programs, all Chairs in the Faculty of Science are now provided with detailed budgets at the beginning of every financial year, which outline income/revenues into dedicated cost centres associated with different activities - along with anticipated costs (based on the previous year’s data). This enhanced and detailed budgeting process provides increased clarity as to the actual costs of all aspects of program and helps to identify to both the Chair and the Dean, the specific areas that require remediation, additional investment or attention. Chairs now have increased clarity regarding their resources and more autonomy than in the past in terms of how those funds are to be used in support of their programming. One benefit to the program of growth in the life sciences is the acquisition of new faculty positions and the Department has gained 2 new biology positions as well as two new positions as a result of the growth in the Biomedical Sciences program. These four new hires represent a significant injection of expertise, enthusiasm and, in one case, experience in internationally recognized research, which will provide a strong positive boost to the program in many ways.

iii) *Existing lab space – some of it seemed to be in great need of renovation and updating*

Since I arrived as Dean in 2012, I have been advocating vigorously for new and improved space for science and this is recognized as a top priority for the institution. Ryerson University recently submitted a proposal for a Science and Innovation Zone in response to the provincial call for Major Capacity Expansion in the Post-Secondary Sector (PSE). This provides some hope for longer term but in the short term, there are no obvious or easy solutions. Curricular innovation may allow for ingenious solutions for making more use of current space – as may changes to the currently assigned shifts of technical support staff. However, there is no single or simple answer to the space crisis and it will be an on-going challenge for all the laboratory sciences that are based in Kerr Hall. We will continue to regularly assess space needs and space use to ensure that it is being used as efficiently as possible and to look for short-term solutions through partnerships with other programs or for under-used space in other areas outside of science.

iv) *Few or no senior lab courses*

The research project honours thesis course provides a good number of students with high quality opportunities in research labs under the guidance of highly engaged and supportive faculty members. In addition, many undergraduate students are involved in volunteer activities within research labs. While these types of more advanced laboratory experiential opportunities do not replace formal, traditional laboratory courses, they do provide upper level students with high quality laboratory experiences for the most part.

Addition of upper level courses may be possible as lower level lab programming is addressed. To address both the limited options in Environmental Biology (as mentioned by the reviewers) and provide hands-on experience in a wide variety of field type settings, I strongly encourage the Department to join the Ontario University Program <http://www.oupfb.ca/>. This program will provide Ryerson students with access to a very wide range of field biology/ecology courses offered by other universities in Ontario. The Dean's office can facilitate interactions and development of offerings, particularly given my direct experience with the OUPFB within the context of an active and diverse biology program.

v) *As program grows pressure will increase to move away from some of the aspects of the program students seemed to like best and the department feels distinguishes it from local competitors: lots of hands-on experience, small classes, and the opportunity to develop personal relationships with professors. The department will have to seriously consider the implications of such changes.*

This is a valid concern for any program undergoing the rapid transformation that the life science programming has experienced at Ryerson University. The program has managed to increase its faculty complement by an additional four new hires in the last 2 years, representing diversity in disciplinary areas, molecular and cellular biology, microbiology, to community ecology and eco-toxicology. Enrolment targets for first year have been held constant or decreased, with the aim of increasing retention and improving the quality of the experience for the more senior students. New programming and initiatives are underway to optimize and promote faculty: student interactions and to maintain the close connection between faculty and students. As discussed with all Chairs within the Faculty, I am willing to provide supports for events and initiatives that the program feels will help to maintain, support and promote the community feeling that we hear is so highly valued by undergraduates. Moreover, efforts to improve enrolment management and increase resources are on-going and will continue.

vi) *The PRT recommends that the program continue to revisit fourth year course assessments, to ensure assessment is constructively aligned with program learning goals – i.e. that they are assessing the key skills/knowledge they want their graduates to have.*

The Department is appropriately addressing this recommendation, as outlined in their response, part of the on-going curriculum review and as a standard part of academic planning going forward.

d) Additional Comments

While not specific recommendations, both the department and the reviewers noted the challenges associated with scheduling “across the liberal bands”. One of these issues was the “protection” of the Liberal Bands, in the middle of the day, at peak time when laboratory sections needed to be offered. With small numbers of students (as the program experienced in the early days), it was possible to accommodate this “protected” status. It is no longer possible and this challenge to the effective delivery of the Biology program was noted as a major weakness, in the self-study, by the external reviewers, and in the response from the Department to the reviewers.

Consequently, in Fall 2014, positive discussions with the VP-Students and the Manager of University Scheduling about the pressing needs of science programming and the reality of how science students actually access liberal studies courses resulted in an agreement that science could request and be accommodated in the scheduling of lab sections as required across this time slot. Program requirements for science students at Ryerson exceed requirements of our comparators (noted for the Biology program by the external reviewers and by Medical Physics as part of their self-study in advance of their own PPR). Given that our students tend to take whatever courses they can access towards the end of their program – simply as a means of completion – begs the question of the real value of this programming requirement for science students (especially compared against our competitors). While the principle of enforced breadth within a program through mandatory courses outside the discipline is a noble one, the reality, from my perspective, is that the current approach fails to meet the overall learning goals or mission of either the faculty or the university as a whole. We need to find other ways, perhaps in parallel with the current approach, or with a modified version of the current approach, to achieve the aims of the breadth requirements.

Similarly, the challenges associated with students being able to meet the “professionally related” course requirements were noted in this review and continue to plague many programs in the sciences. The institution is well aware, this programmatic structure for our majors needs overhaul or review since it no longer serves the students (at least those in science) well and this will need to be addressed in a larger forum.

Curricular innovation and development continues to be discussed institutionally and, no doubt, new and different approaches may be proposed and adopted. The Faculty of Science is committed to producing well-rounded global citizens who possess a solid and rigorous foundational knowledge in science with an understanding of the way that science permeates every aspect of life and the recognition of the natural and power synergies between the sciences and the arts and humanities.

13. ASC EVALUATION

The Academic Standards Committee assessment of the Periodic Program Review for Biology (Bachelor of Science) indicated that the review provided a well-written, informative evaluation of the program. The ASC also noted the curriculum revisions that have been undertaken since the launch of the program in 2005 to produce high quality, competitive graduates.

The Academic Standards Committee recommends that the program provide a follow-up report on the status of the initiatives outlined in the Developmental Plan. The follow-up should also include (1) an update on discussions regarding a biochemistry option and an option in biological chemistry, (2) updated faculty CVs, (3) a statement on the outcomes of the plan to promote the three Options: Bioinformatics and Computational Biology, Biophysics, and Environmental Biology, and (4) any update on initiatives that have been started to engage the students and to deliver the curriculum in innovative ways, as outlined in the developmental plan.

Follow-up Report

In keeping with usual practice, the follow-up report which addresses the recommendation stated in the ASC Evaluation Section is to be submitted to the Dean of the Faculty of Science, the Provost and Vice President Academic, and the Vice Provost Academic by the end of June, 2016.

14. IMPLEMENTATION PLAN

- i. Approval of the recommendations set out in the Final Assessment Report:
The recommendations have been approved by the Dean and by Senate. Ryerson University's IQAP Policy 126 states: "Senate is charged with final academic approval of the Program Review."
- ii. Responsibility for providing any resources made necessary by those recommendations:
Ryerson University's IQAP Policy 126 states: "The Chair/Director and Dean are responsible for requesting any additional resources identified in the report through the annual academic planning process. The relevant Dean(s) is responsible for providing identified resources, and Provost is responsible for final approval of requests for extraordinary funding. Requests should normally be addressed, with a decision to either fund or not fund, within 2 budget years of the Senate approval. The follow-up report to Senate will include an indication of the resources that have been provided."
- iii. Responsibility for acting on those recommendations:
Ryerson University's IQAP Policy 126 states: "If the report includes a recommendation for approval of the program review, it will include a date for a required follow-up report to be submitted to the Dean and Provost on the progress of the developmental plan and any recommendations or conditions attached to the approval."
- iv. Timelines for acting on and monitoring the implementation of those recommendations:
Ryerson University's IQAP Policy 126 states: "The initial follow-up report is normally due by June 30 of the academic year following Senate's resolution. The Provost may require additional follow-up reports."

15. REPORTING

- i. The distribution of the Final Assessment Report (excluding all confidential information) and the associated Implementation Plan to the program, Senate and the Quality Council:
The Office of the Vice Provost Academic is responsible for distribution of the Final Assessment Report to all relevant parties.
- ii. The institutional Executive Summary and the associated Implementation Plan be posted on the institution's website and copies provided to both the Quality Council and the institution's governing body:
The Office of the Vice Provost Academic is responsible for posting the information on the Curriculum Quality Assurance website at www.ryerson.ca/curriculumquality. The information is provided to the Board of Governors on an annual basis.
- iii. The timely monitoring of the implementation of the recommendations, and the appropriate distribution, including web postings, of the scheduled monitoring reports:
The Office of the Vice Provost Academic is responsible for following up with the programs and their respective Deans to ensure the recommendations are implemented. The follow-up report is submitted to the relevant Dean(s) and the Vice Provost Academic for review.
- iv. The extent of public access to the information made available to the public for the self-study:
Ryerson University's Senate Policies are available to the public through the Senate website at www.ryerson.ca/senate. This includes Policy 110 Institutional Quality Assurance Process and

Policy 126 Periodic Program Review of Graduate and Undergraduate Programs. The Final Assessment Report (excluding all confidential information) and the associated Implementation Plan is available on the Curriculum Quality Assurance website at www.ryerson.ca/curriculumquality. A summary of the Report of the Review Committee is contained within the Final Assessment Report. A summary of the responses provided by the Dean and the program to the Report of the Review Committee is contained within the Final Assessment Report.

16. SCHEDULE

The next periodic program review for the Bachelor of Science in Biology is scheduled for 2022 - 2023.