

## FINAL ASSESSMENT REPORT - DRAFT

### Institutional Quality Assurance Program (IQAP) Review

#### Biology Undergraduate Programs

**Date of Review:** March 27 - 28, 2017

*In accordance with the University Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response and assessments of the **Biology** undergraduate program delivered by The Department of Biology. This report identifies the significant strengths of the programs, together with opportunities for program improvement and enhancement, and it sets out and prioritizes the recommendations that have been selected for implementation.*

*The report includes an Implementation Plan that identifies who will be responsible for approving the recommendations set out in the Final Assessment Report; who will be responsible for providing any resources entailed by those recommendations; any changes in organization, policy or governance that will be necessary to meet the recommendations and who will be responsible for acting on those recommendations; and timelines for acting on and monitoring the implementation of those recommendations.*

#### **Executive Summary of the Cyclical Program Review of the Undergraduate Biology Program**

In accordance with the Institutional Quality Assurance Process (IQAP), the Biology program submitted a self-study in February 2017 to the Associate Vice-President, Faculty to initiate the cyclical program review of its undergraduate programs. The approved self-study presented program descriptions, learning outcomes, and analyses of data provided by the Office of Institutional Research and Analysis. Appendices to the self-study contained all course outlines associated with the program and the CVs for each full-time member in the department.

Two arm's length external reviewers, both from Ontario and one internal reviewer were endorsed by the Dean, Faculty of Science, and selected by the Associate Vice-President, Faculty. The review team reviewed the self-study documentation and then conducted a site visit to McMaster University on March 27 - 28, 2017. The visit included interviews with the Provost and Vice-President (Academic); ViceProvost, Faculty, Dean of Science and Chair of the department and meetings with groups of current undergraduate students, full-time faculty and support staff.

The Chair of the department and the Dean of the Faculty of Science submitted responses to the Reviewers' Report (June 2018). Specific recommendations were discussed, and clarifications and corrections were presented. Follow-up actions and timelines were included.

## Strengths

In their report (May 2017), the Review team noted that The Department of Biology delivers a top quality, lab-based undergraduate program on a minimal budget. The Department has done an impressive job with their recent innovative redesign of Bio1A03 (including the lab component), which incorporates many facets of evidence-based teaching that have been shown to improve learning in STEM courses. Indeed, the department utilizes multiple approaches to teaching in their Biology and Molecular Biology courses. While all courses except the research and co-op courses use lectures, the majority also incorporate innovative and creative approaches that include: clickers, class-based discussions, case studies, group work, collaborative learning, PBL, labs, field work, tutorials, and podcasts, just to name a few. In addition, these multiple approaches to student learning are key to developing student proficiency in many of the Biology department's PLOs that are aimed at higher levels of learning (e.g. PLOs 14 & 23), meeting undergraduate degree level expectations (e.g. PLOs 22-24 & 40) and prioritizes accessibility and removal of barriers to learning. Students are assessed through a variety of methods, including tests, exams, term papers, oral presentations, group projects, case studies, critical reviews, and experiential learning. All of these assessments are effective ways of measuring student learning and the wide variety of types of assessments used represent best pedagogical practice. These methods of assessment of student achievement of PLOs are thorough, appropriate and effective.

The Biology programs are doing an excellent job of meeting or exceeding departmental PLOs and helping the university meet its undergraduate degree learning expectations and overall mission. As part of the self-study, the department has performed a thorough critical analysis of PLO achievement in its programs, and has already identified areas for improvement along with strategies for doing so. The reviewers agree with the department's self-study and areas targeted for improvement include: encouraging more students to enroll in existing laboratory and field courses thereby increasing proficiency in PLOs 25-28 and 33-35, increasing the number of opportunities for students to work with statistics in biology, as well as opportunities for increased exposure to programming as it relates to the modern study of biology. All of these target areas came up in our discussions with students and faculty. The department has already been extremely proactive in implementing new cell biology labs in several key courses as well as securing funding for equipment for a new course in Experimental Approaches in Cell Biology (3D03). These laboratory and equipment improvements will certainly help to increase proficiency in microscopy and cell biology-related PLOs as well as experimental design and lab skill PLOs for the next cohort of biology graduates. A final area of improvement identified involves ethics (PLO 41). Ethical thinking is embedded within several program courses, but it may be that it needs to be made more explicit to students.

Further highlights identified in the report include:

- top-quality, lab-based undergraduate programs on a minimal budget
- courses incorporate many facets of evidence-based teaching that improve learning in STEM courses
- many courses use innovative approaches including blended learning (Bio1A03, Bio2B03) clicker, case-studies, in-class discussions, group work, PBL, labs, field work, podcasts, etc

- Biology is doing an excellent job at meeting or exceeding departmental PLOs that align with Ontario's Undergraduate Degree Level Expectations
- Biology has been very successful in obtaining FWI, ASF and other funding to improve undergraduate education

### **Areas of Improvement**

In their report, the Review Team identified some recommendations for areas of improvement. As in many Departments across the University system, there is an aging faculty and an uneven demographic across sub-disciplines. There has been considerable reduction in Plant Biology, Microbiology and Physiology faculty in recent years, to the point where these major areas of Biology are only poorly represented. This erosion of expertise in some core areas of Biology is a concern that cannot be left unaddressed for long before it will impact program quality.

A recurring theme amongst nearly all our discussions was the Life Sciences undergraduate program. A common perception is that this program, which currently does not reside within an academic unit (department), is a "pre-med" program. However, the LSP did not see itself as a pre-med program, but rather as a program with emphasis on basic science application to human health and Community Engagement Learning. In other words, the LSP wants to differentiate itself as an applied human biology program, while the Department of Biology has a strong emphasis on traditional Biology sub disciplines. The delineation of the roles of these two programs needs to be clearer.

The Department does not appear to have a clear plan regarding faculty complement renewal (beyond replacement in areas required to cover undergraduate courses), and this may hinder developing cogent arguments for faculty replacement/renewal when resources allow.

Faculty do not receive credit for teaching intensive field courses. Field courses are a substantial amount of work to organize and operate and require adequate support to ensure safety of all participants, including appropriate TA resource allocation. Other recommendations are outlined below.

- develop a plan for faculty renewal, especially in areas with poor representation (plant biology, microbiology, physiology)
- delineate and differentiate the roles of Biology programs from Life Science programs
- provide teaching credit to faculty teaching field courses
- improved TA resources to maintain high quality of lab and tutorials in biology courses

The Dean of the Faculty of Science, in consultation with the Chair of the program shall be responsible for monitoring the recommendations implementation plan. The details of the progress made will be presented in the progress report and filed in the Vice-Provost, Faculty's office.

**Summary of the Reviewers' Recommendations with the Department's and Dean's Responses**

| <b>Recommendation</b>  | <b>Proposed Follow-Up</b>   | <b>Responsibility for Leading Follow-Up</b>  | <b>Timeline for Addressing Recommendation</b> |
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| R1.1. Continue to strive to provide enriching, experiential learning throughout their  | Continue to provide a lab-based biology experience to our students by advocating for the resources to maintain 13 lab/field courses, and  | Associate Chair (undergrad), Chair   | Ongoing                                       |
| undergraduate program  | experiential/independent research courses (Bio3EP3,3IR3, MolBio3I03, Bio4F06, 4C12, MolBio4G12). TA support is currently a limiting variable for this.  |  |   |
| R2.1 Maintain dualentry to Honours Biology program and continue to strive to make the differences between Discovery Subplan and regular Honours Biology program more visible to students earlier in their studies. | Agreed, maintain Biology core and Biology + Discovery subplan<br><br>Look into additional ways to advertise our program options to Level I students (more info on Bio web site & Bio1A03, Bio1M03 Avenue pages), use social media (twitter, snapchat), engage the BioSociety to help with this.                   | Associate Chair and Biology Undergraduate Committee (BUGs), Biology Undergraduate Society (BioSociety) | 2017-18                                       |
| R2.2. Consider including a Level 2 course or extracurricular activities aimed at Discovery Subplan students that would build a student learning community or more closelylinked cohort.                            | Level 2 is full with courses, cannot introduce another. Instead consider recommending or requiring that Bio+Discovery students take Bio2L06 (Experimental Biology).<br><br>Already considering how to provide a better cohort experience for all programs, perhaps by following our Welcome to Biology Night with | Associate Chair and BUGs, BioSociety   | 2017-18                                       |

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|   | additional get-to-know your faculty & fellow student events                                      |                                   |         |
| R2.3. Adopt recruitment activities to maximize the visibility and enrolment in the Honours Biology Discovery Subplan. | See proposed follow-up above   | Associate Chair, BUGs, BioSociety | 2017-18 |
| R3.1. Faculty be made more aware of   | The Associate Chair participated in a workshop that introduced Forward with Flexibility, the new | Associate Chair and Chair,        | 2017-18 |

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| <p>(or be given more access to) institutionally supported closecaptioning video services so that individual faculty do not perceive this accessibility requirement as a barrier to producing learning materials for all types of learning styles.</p> | <p>teaching and learning resource on accessibility and inclusion. This resource will be available sometime this summer to aid faculty in making their teaching more accessible to all. All faculty will be expected to do the online modules and take a quiz as part of our obligation to the Accessibility for Ontarians with Disabilities Act. Representatives from the Forward with Flexibility resource will visit the department to explain use and benefits of the resource.</p> <p>During the workshop the Associate Chair learned that close-captioning and other resources are available for courses that have students with these needs.</p> | <p>Forward with Flexibility team</p>   |                |
| <p>R3.2. Faculty be encouraged to continue to develop and adopt innovative and creative approaches to their teaching.</p>   | <p>Work with the MacPherson Institute to encourage continued innovative ways to improve teaching in Biology. Invite MacPherson to provide a 1 hour information session to the faculty. Ask Biology Teaching Profs to provide 1 hour information sessions on different ways to enhance student engagement during lectures</p>   | <p>Associate Chair, MacPherson Inst, Biology Teaching Profs, Biology faculty</p> | <p>Ongoing</p> |
| <p>R4.1. Continue to articulate value of laboratory and field courses to students and explore mechanisms to encourage more students to choose these courses in Levels 3 or 4.</p>   | <p>Continue to do this at various Biology information events for our students.</p> <p>More promotion of our lab/field courses in all level 2 Biology courses and if possible on social media (see R9.1)</p>  | <p>Associate Chair, Level 2 Biology faculty</p>                                  | <p>Ongoing</p> |

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| R4.2. Depending on availability of adequate resources, | Can't add a new lab/field course due to resource issues & already have many lab/field options. | Associate Chair and BUGs | Put this curriculum change through APPC this fall for the 2018-19 calendar. |
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| consider introducing a required Level 3 laboratory or field course for program students not doing co-op or not intending to do a thesis project course. Perhaps Honours Biology Discovery Subplan might be a good place to introduce this. | Instead, considering adding a requirement that all Biology program students take at least 3 units from: 3 <sup>rd</sup> year lab/field courses, 3 <sup>rd</sup> year experiential or research courses (Bio3EP3, Bio3IR3, MolBio3I03), 4 <sup>th</sup> year project (Bio4F06) or thesis (Bio4C12, MolBio4G12)   |   |         |
| R4.3. Continue with its plans to offer a new Level 3 course developed by the computational and quantitative biologists.  | Bio3SA3 (Biological Statistics) was approved in fall 2016 and will be offered in winter of 2018  |   | Done    |
| R4.4. Consider where more biostatistical analysis and critical analysis of published biostatistics could be reinforced in existing courses.  | This was discussed at a departmental meeting in in 2017 after examining the 2015 IQAP survey of graduating students. A number of faculty have added statistical analysis of biological data to their courses (Bio2L06Experimental Bio, Bio3SS3-Pop Eco, Bio3JJ3-Field Eco, MolBio3D03-Experimental Cell Bio, MolBio3Y03-Plant responses to the environment.<br><br>Monthly Data Lunch run by Bolker & Dushoff to help 4 <sup>th</sup> year students, grad students & faculty | Associate Chair will survey faculty and then if necessary encourage more faculty to add biostats analysis to their courses. | 2017-18 |

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|  | with statistical analysis of their data.   |   |  |
| R5.1. Establish clear guidelines to outline reasonable expectations for newly defined technical roles.   | Chair, Associate Chair, Dept. Administrator and staff will work together to outline guidelines and roles. A comprehensive review is scheduled for the spring of 2018.  | Chair   | 2017   |
| R5.2. Consider distributing technical support staff responsibilities according to expertise, rather than course level, to more fully utilize expertise of incumbent staff. | We realize that the new model of one Undergrad Coordinator (UC) + 1 tech for each level, may not be the best way to run our undergrad labs and tutorials. We will work together to find the best way to deliver our labs & tutorials with 3 UCs and 3 techs. | Chair, Associate Chair, Dept. Manager, Staff, | 1 <sup>st</sup> formal meeting – Aug, 2017 to prepare for upcoming 2017-18 academic year<br><br>2 <sup>nd</sup> formal meeting – May 2018 to discuss how the first year went, brainstorm to improve for subsequent years |



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| R5.3. Insofar as resources allow, the allocation of TA resource to Biology be adjusted to meet the demand on programs to deliver high quality, experiential learning opportunities. | We will work with the Dean to maintain the high quality of our undergraduate courses.  | Chair, Associate Chair, Manager, staff | Ongoing |
| R5.4. Faculty of Science consider allowing select appointment of sessional instructors in areas of Biology with limited capacity to deliver necessary curriculum.                   | Hiring sessionals will not serve the long-term need for subject expertise that is not being met by current faculty complement. We will work with the Dean to explore solutions.  | Chair, Dean                            | Ongoing |
| R5.5. Field courses be recognized as bona fide courses, and faculty who teach them be afforded teaching credit and TA resources to operate them.                                    | Faculty spend 160-180 hours for each field course, this is often higher than for a regular already developed course offered during the academic year. Biology faculty currently teach 2 to 3 field courses per year, along with a full regular course load in most years. We need to maintain this level of field course teaching to remain in OUPFB (Ontario Universities Program in Field Biology) & provide McMaster students access to these field opportunities. We will work with the Dean to explore solutions to | Chair, Dean                            | 2017-18 |
|   | continue to offer field courses while maintaining our regular curriculum.  |  |         |

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| <p>R5.6. Department should prepare an updated Strategic Plan, with emphasis on growing strengths and identifying core faculty complement required to continue to deliver their strong undergraduate programs.</p> | <p>Agreed. Chair will organize a retreat to discuss this in spring 2018.</p>   | <p>Chair, faculty</p>                            | <p>2018</p>    |
| <p>R5.7. Renovation of greenhouse space be made a priority.</p>   | <p>We agree that the greenhouse is a priority, but renovations are not the answer. A new modern energy-efficient greenhouse is required. The importance of the Biodiversity collection was recently recognized by a Sustainable Design in Heritage Award from the Hamilton Municipal Heritage Committee. It is not generally appreciated that the Biodiversity collection is a core component of our undergraduate teaching and community outreach. The biodiversity collection receives 500 student visits yearly as part of lecture, lab, outreach, as well as loaning plants for lab study almost weekly. We will work with the Dean and Advancement to fundraise for a new greenhouse.</p> | <p>Chair, plant biology faculty, Advancement</p> | <p>2017-18</p> |
| <p>R7.1 Ensure that faculty, TA, and laboratory resources in Level 2 Bio courses required by both LSP and Bio students are provided at the level required to maintain the pedagogical</p>                         | <p>Agreed, will advocate for the TA and lab resources to maintain these courses.</p>   | <p>Chair, Associate Chair</p>                    | <p>Ongoing</p> |

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| excellence developed by Biology.   |   |   |   |
| R7.2 To enable better communication among stakeholders in Life Sciences Programs, an ongoing Life Sciences Program curriculum committee be struck to allow consultation with cognate units prior to decanal approval of new LS courses and programs. Care should be taken to ensure that representation by Biology faculty with 100% appointments is provided. | Agreed. Biology's Associate Chair has suggested this on a number of occasions at APPC.  | SIS Director, Associate Dean, Associate Chair                             | 2017  |
| R9.1. Biology make a concerted effort to reach out to undergraduate students through a variety of means, including social media (Twitter, Facebook, etc.).   | Agreed. We have been thinking about this as discussed in our Self-Study, as our Information Events, website and emails are not informing enough of our students. We will look into using Twitter, snapchat, TVs outside first year labs in BSB, announcements on Course Avenue sites. We will also consider providing small group mentorship to Biology students, perhaps with the help of the BioSociety. A retreat to discuss these issues will be organized, and funding sought. | Associate Chair, Academic Administrator, BUGs, BioSociety, faculty, staff | IQAP implementation Retreat in Midterm Break in October 2017. |

**Dean's Response, Faculty of Science:**

Due to some turnover in the Office of the Dean of Science, the response of the Dean has been delayed. The Dean noted that the reviewers report highlighted several areas of strength in the undergraduate programs in Biology. In particular, the report highlighted the commitment to comprehensive Biology

undergraduate programs that reflect the breadth of the Discipline, while also providing capacity for students to specialize in areas of interest. It is clear that the program learning objectives are well defined and integrated into the curriculum with many points of evidence indicating that graduating students in all programs should meet or exceed the degree requirements. The recent changes to Biology 1A03 were highlighted as an example of innovation in curriculum design that reflects the excellence of the programs, the staff and the faculty. The review team recommendations have provided areas for continued improvement and consideration and have all been incorporated into a plan for moving forward. The Dean supports all of the proposed actions highlighted in the program response but feel that some of the interpretations and recommendations and subsequent program responses do require some explanation and refinement with the broader lens available at the Decanal level. In addition, due to the considerable delay between the development of the Program response and the submission of the Dean's response, the Dean is now able to provide more context for some of the specific recommendations.

Recommendation R2.3: *“Adopt recruitment activities to maximize the visibility and enrolment in the Honors Biology Discovery Subplan.”*

Recommendation R9.1: *“Biology make a concerted effort to reach out to undergraduate students through a variety of means including social media”.*

The Dean grouped these recommendations together to highlight action on these items. The Office of the Dean of Science is taking a number of steps to address communication with undergraduate students in the Faculty of Science. We will be supporting enhancement of communication at several levels including the hiring of a communications officer for central facilitation of both internal and external communications. We are also initiating a variety of projects aimed at supporting and informing students with respect to academic, career and co-curricular opportunities and events.

#### Resource related recommendations (Section 5)

Overall, I believe that many of the resource related recommendations in section 5 could be addressed in a variety of ways in the near future, however a strong Departmental Strategic plan will be crucial to the ability of the Office of the Dean to support requests and initiatives from the Department of Biology.

Recommendation R5.1: *“Establish clear guidelines to outline reasonable expectations for newly defined technical roles.”*

The review team correctly noted that a significant re-structuring of the instructional and technical roles had been undertaken just prior to the site review. It is expected that any significant change in organizational structure will result in a period of adjustment and accommodation. While that restructuring

was conducted with the oversight of the Office of the Dean, the actual structure was developed and implemented from within the Department of Biology. During the 2017/2018 academic year the Dean met on a regular and frequent basis with the Chair of the Department and the staffing plans were a common focus of those meetings. Substantial information was gathered including detailed responsibility and task lists, and time estimates. Reporting structures were altered such that laboratory and technical staff now report to the Department Chair rather than the Department Administrator. A review of the new staffing structure revealed that some adjustments should be made and we have now moved one additional instructional staff to 12 month rather than 10 month and adjusted the activities and expectations of several positions.

Recommendation 5.3: *“Insofar as resources allow the allocation of TA resource to Biology be adjusted to meet the demand on programs to deliver high quality, experiential learning opportunities.”*

The Department of Biology has had and will continue to have the capacity to request additional resources in all areas as part of comprehensive and justified planning. Efforts have been made to clarify the financial supports available to units for their graduate programs (TA and Scholarship) in an effort to assist them in both fiscal management and effective utilization of resources for their academic mission.

Recommendation 5.4: *“The Faculty of Science consider allowing selection appointment of sessional instructors in areas of Biology with limited capacity to delivery necessary curriculum.”*

Similar to recommendation 5.3, the unit already had, and will continue to have, capacity to request sessional faculty, however those requests must be justified both in terms of rationale and resource allocation and be part of a comprehensive strategic plan for the unit. One specific area of concern identified in the report was the heavy reliance on sessional instructors for the Biology/ Pharmacology Program. For this reason and others, this program has now been administratively moved to the Faculty of Health Sciences.

Recommendation 5.5: *“The field courses be recognized as bona fide courses, and faculty who teach them be afforded teaching credit and TA resources to operate them.”*

As this recommendation links specifically to the courses offered through the Ontario Field Biology program which has a separate administrative and enrollment system from McMaster, the dean recently requested and received a report from the Chair of Biology on how the program runs and how it is currently resourced by McMaster. It is clear that the teaching of field courses in this program have been resourced by both faculty and staff and that credit for teaching courses by faculty has been provided on an ad hoc basis in the past. This report will provide the foundation to establish a more stable mechanism of resourcing that also takes the funding of the program into consideration.

Recommendation 5.7 *“Renovation of the greenhouse space be made a priority.”*

The Faculty of Science submitted a successful proposal to the McMaster University Strategic Alignment Fund to assist the Faculty of Science with the costs of building a new greenhouse addition to the Life Sciences Building, where the Department of Biology is housed.

*Recommendation 7.2 “To enable better communication among stakeholders in Life Sciences Programs, an ongoing Life Sciences Program curriculum committee be struck to allow consultation with cognate units prior to decanal approval of new LS courses and programs. Care should be taken to ensure that representation by Biology faculty with 100% appointments is provided.”*

The Dean has substantial concerns with this recommendation as is not sure that the review team was provided with the full context of the information related to the development of the Life Sciences Program or the curriculum governance process that is already in place. In recognition of the issues of academic planning and resourcing, former Dean of Science, Rob Baker, formed an *ad hoc* committee in 2014 (The Life Sciences Working Group) and that group included representation from faculty, staff and students from many units in Science, including Biology. In their report of March 2015, the working group proposed a variety of revisions to the Life Sciences Curriculum to address a variety of concerns. Those revisions have now been adopted, and as noted by the reviewers have transformed the Honours Life Sciences Program into a distinct and excellent program. In January 2016, the School of Interdisciplinary Sciences was established and the Life Sciences program was moved to that new academic unit. The School of Interdisciplinary Sciences has its own curriculum committee for managing curriculum issues for all programs in the School, and as such, it would not be appropriate to layer on an additional curriculum committee with faculty representation from outside the unit. For this program, as with all other programs in the Faculty of Science, the mechanism for other units, such as Biology, to provide input on the curriculum proposals from another unit occurs at the Faculty of Science Academic Policy and Planning Committee. It will perhaps take some time for all members of the Faculty of Science to become aware of all of the recent changes, but in light of this information, the Dean does not support any action with respect to recommendation 7.2.

As the Faculty of Science moves forward with its commitment to excellence in undergraduate education, it will monitor its progress with respect to the individual recommendations of the review team and engage in its highly valued partnerships in refining and delivering these excellent undergraduate programs in Biology.

### **Quality Assurance Committee Recommendation**

McMaster’s Quality Assurance Committee (QAC) reviewed the above documentation and the committee recommends that the program should follow the regular course of action with a progress report and subsequent full external cyclical review to be conducted no later than 8 years after the start of the last review.

