



Carleton
UNIVERSITY

Biology Labs

Benchmarking Project

Presented to the Organizational Excellence Steering Committee

PURPOSE

The goals of this project are to (1) research the best practices associated with maximizing the number of students able to experience laboratories (labs) in their foundational biology courses and (2) research the best practices associated with engaging students in biology labs. We anticipate that the outcome of this project will indirectly lead to an increase in the recruitment and retention of students in Biology, Environmental, and Health-related science programs at Carleton University.

Executive Summary

The department of Biology is currently facing two challenges with respect to its laboratory (lab) sections:

- Biology lab space is at capacity because of increased student enrolment
- Student engagement in the labs needs to be improved

The Biology Labs Benchmarking Project was initiated by the Department of Biology with the support of the Dean of Science to assess these challenges. The objectives of this project are to gain an improved understanding of the needs of undergraduate students in first-year Biology labs and make recommendations aimed at improving student learning experience (engagement) in first-year Biology labs. The end goal is to not only increase the capacity of labs to meet the growing demand, but also to create a lab experience that best fits the needs of our students. Also of note is that any solutions put in place must address the requirements of students in programs other than Biology who also take Biology lab sections.

Research was conducted internally and externally with the aim of understanding the needs of undergraduate students (particularly in first year), identifying necessary, current and relevant learning outcomes from the perspective of Biology Faculty members, understanding the roles of Lab Coordinators and Teaching Assistants (TAs), and how Carleton compares to other universities offering labs. As a result of this investigation, the benchmarking team has identified such areas as lab scheduling, learning outcomes for the labs, adjustments to the roles of the TAs, modifications to the distribution of responsibilities across Lab Coordinators in first year labs and strategies for improved communication, all as distinct opportunities for improvement.

After completing internal and external data collection and evaluation, the benchmarking team has developed five comprehensive recommendations to both increase the lab capacity in first-year labs and improve the student learning experience.

Recommendation 1: Introduce additional lab sections, as needed.

Currently, first-year Biology labs are held Tuesday through Thursday between the hours of 8:30 a.m. and 4:30 p.m. It is recommended that two new lab sections be added on either the Monday or the Friday daytime slots and four evening labs be introduced Monday through Thursday, on an as needed basis. This will result in an increase of 70-140% over current capacity (depending on course).

Recommendation 2: Relocate first-year labs to new lab space.

It is recommended that the first-year labs be relocated to the new Health Sciences building currently under construction, or that a thorough upgrade of the Tory basement labs be conducted. After consultation, it became obvious that part of the problem with the current space is that the users were not sufficiently consulted as to their needs. Therefore, this move/upgrade should be completed in consultation with design specialists and users of the space to functionally and effectively maximize utilization of the space.

Recommendation 3: Reorganize Human Resources and improve communication.

First year biology labs consist of alternating weeks of wet lab sessions (hands on in the lab) and analytical sessions (data analysis in tutorial or computer rooms). Currently, the division of duties across lab coordinators for all lab sections in the first year biology course follows a lateral model (i.e., one person is responsible for administrative duties & TA duties/management, another for preparation/demonstration duties in the wet labs, another for tutorials/quizzes in the analytical sessions, etc.). TAs are responsible for both wet lab and analytical sessions. Currently there are a total of 30-40 TAs for first-year biology labs. Five TAs are assigned to a lab section of

approximately 60 students. TA training is in the form of weekly lab meetings with up to 20 TAs present at the same time.

Detailed in Parts A and B, below, we propose changes to the current division of duties, participation, and training that should streamline operations, and help to develop and foster a sense of community, team building and mentoring from Lab Coordinator to TA to student. It is our hope that these recommended changes contribute to improved employee, TA and student engagement.

Part A: Lab Coordinators

We recommend modifying the distribution of responsibilities for the lab coordinators to follow a vertical model where each lab coordinator is responsible for all aspects of running the labs but for a defined and unchanging set of lab sections, TAs and students, each term. The suggested change is a streamlining strategy that would provide more comprehensive running of labs by a given lab coordinator, better management of TAs and student groups by each coordinator, while at the same time reduce the number of students and TAs each coordinator has to manage/supervise/train. This would improve communication by having fewer and more direct points of contact between lab coordinators and TAs. For students, the points of contact for any lab concern beyond what the TA is responsible for would be reduced from 3 to 1, making communication much more direct. This recommendation would require a review of the division of duties for lab coordinators to ensure all are knowledgeable and completing duties in all areas.

Streamlining operations could free up time that may allow lab coordinators (perhaps in conjunction with TAs) to develop CUOL or YouTube instructional videos that could be used across lab sections. This would further free up lab time, for students to explore, for demonstration time for TAs and Coordinators and would improve the student learning experience by having an online resource that could be accessed at any time.

Further, the reorganization of lab coordinator responsibilities would ensure that each lab coordinator was fully informed about, immersed in, and capable of carrying out all duties associated with any lab section and as such, would be able to step in at any point should another coordinator for the course become unavailable.

Finally, lab coordinators should be encouraged to attend conferences for career development and to seek out innovative ideas to improve the student learning experience.

Part B: TAs

The recommended changes include assigning TAs to a smaller and defined cluster of students within a lab section (e.g., each TA could be assigned to approximately 12 students), which should improve consistency in communication between TA and student, develop stronger connections between a TA and the group of students he/she is responsible for and is expected to improve both the TA and the student learning experience.

It is also recommended that lab coordinators run training sessions for TAs that accommodate a trial run of each wet lab or analytical session. These training sessions should occur within the smaller groups created by implementing changes indicated above. These changes will introduce more direct and extensive hands-on training during these meetings. It is expected that this will better prepare TAs for their teaching role and support their desire to be strong mentors to students. Faculty should also be encouraged to attend weekly lab meetings with TAs and lab coordinators. This will improve communication between all involved and increase awareness if there are changes required. Scheduling of the courses of fourth-year TAs and Graduate TAs will be necessary to ensure that their classes do not conflict with the regular weekly meeting that would include a dry run of the lab.

Changes to the role of the TA should encourage them to develop teaching skills and be mentors to students. As such, focus should be taken away from TAs as markers, in part, achieved by the re-evaluation of learning outcomes outlined in Recommendation 4 below.

Recommendation 4: Reevaluate learning outcomes for foundational Biology labs.

First-year Biology labs must meet the needs of a wide range of students, including students from sister units such as other science and engineering departments. The learning outcomes of the first-year labs have traditionally included training in the writing of lab reports. A considerable amount of the students' time and effort goes in to writing lab reports in a format that is specific to Biology. We recommend re-evaluating lab report writing as a learning outcome of first-year labs for the following reasons: 1) students from sister units (e.g., Engineering) may never have to write a lab report again in their programs or careers, 2) a large number of students need ESL support, 3) we lack the resources to teach writing effectively (requires specially trained TAs who are themselves proficient at writing), 4) students are already overwhelmed by the many skills they are expected to master in first year Biology, 5) focus on writing lab reports fails to inspire the students' desire to explore science. Thus, it is recommended that less emphasis be put on the writing of lab reports and more be put on "doing science" (i.e., observations, hypothesis development and testing, interpretation/discussion of results). To this end, lab deliverables would shift to such activities as work sheets, bell-ringer quizzes, etc. instead of traditional lab reports. The intention would be to focus on both cognitive and technical skills (rather than writing) through well-designed lab activities. Further to this, a committee should be formed to investigate and implement "discovery-based learning" and labs based on the use of live organisms, as well as field trips and outdoor labs.

It is also recommended that the grading of labs be changed to a "pass/fail" format rather than a letter grade. This will reduce the students focus on the "correct" outcome of labs and consequent marks, reduce plagiarism, and free TAs from grading so that they can spend more time mentoring students.

Recommendation 5: Calendar change recommendations.

For calendar year 2017, we recommend merging courses 1003 with 1103 and 1004 with 1104. Several years ago, splitting these courses into an honours BSc stream and a non-honours/other stream seemed like a good way to serve the needs of a diverse range of students. However, in the interest of facilitating moving between degree programs, we recommend merging the courses back together.

In the longer term, we recommend that the Curriculum Committee investigate separating lecture from lab – a lab course [0.5 cr.] and lecture course [0.5 cr.].