Proposed BSc Freshman Program
Faculty of Science, McGill University

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This document outlines the current BSc freshman program and then proposes some modifications that are intended to provide more flexibility in the freshman year, enable students to better prepare for some majors than is currently possible, and to provide space for some elective courses.

The proposed changes are not major and should not change the freshman programs of many students, most notably those in the biomed majors.

However, the proposed changes are particularly important for students who are currently studying in areas such as Computer Science or Mathematics, which require more preparation in mathematics and computer science and do not rely on a complete set of biology, chemistry and physics courses for proper preparation for the major. Currently CS students in the current BSc freshman program cannot fit all of the existing freshman requirements, plus the courses that would best prepare them for their major. Furthermore, students who should be science students (and would be science students in many of our peer universities) are instead following a BA in computer science or mathematics, even though they are studying basically the same departmental programs as the BSc students. It would be much better to provide a way in which these students could be more easily integrated into the Faculty of Science.

1 Background

The Freshman program is intended for students admitted into the Faculty of Science from outside of Quebec. Students arriving from high schools with no advanced placement need to complete all of the freshman program. This is the case for the majority of high school students from Canadian or US high schools. Some students come with equivalent courses due to advanced placement exams or because they have completed courses in another system such as A-levels. In these cases students may be given credit and equivalence for some or all of the freshman courses.

All students admitted to the Faculty of Science must have completed at least two of Biology, Chemistry and Physics at the grade 12 level. It is important to keep in mind that this material is often similar to that taught in the introductory courses in CEGEP. Thus, students are coming into the Faculty of Science freshman program with some non-trivial science background. See for example, the grade 11 and 12 science curriculum for Ontario High Schools (http://www.edu.gov.on.ca/eng/curriculum/secondary/science1112curr.pdf).

2 The Existing Freshman Program

The current freshman program is 30 credits which must include 7 courses as follows:

- Calculus 1 (MATH 139,140 or 150), Calculus 2 (MATH 141 or 151),
* CHEM 110, CHEM 120
* PHYS 101/131, PHYS 102/142
* BIOL 111 or BIOL 112

These 7 courses cover the prerequisites for some majors (primarily the biomed majors), but many students must take more than the 7 required courses. For example, students in mathematics and physical sciences are asked to complete MATH 133, students in Psychology are asked to take PSYC 100, and students in Computer Science or Software Engineering are best served if they take both MATH 133 and COMP 202 in their freshman year.

Students intending on applying to medical school often take both Biology courses since some medical schools require 2 terms of biology as entry prerequisites.

Currently, our Science freshman complete:

**Life Sciences (7-8 courses):** Cal 1, Cal 2, CHEM 110, CHEM 120, PHYS 101, PHYS 102, BIOL 112, (many also take BIOL 111)

**Physical Sciences, Math and CS, Earth Sciences (8 courses):** Cal 1, Cal 2, CHEM 110, CHEM 120, PHYS 131, PHYS 142, BIOL 111/112, plus MATH 133. CS students should ideally also take COMP 202, but that takes them to 9 required freshman courses.

**Psychology (8 courses):** Cal 1, Cal 2, CHEM 110, CHEM 120, PHYS 101, PHYS 102, BIOL 111/112 plus PSYC 100

Freshman students can take a maximum of five courses each term, usually they take four courses in one term and four or five courses in the other. (Students may take fewer than five courses per term, and still get the required 30 credits because many freshman courses are 4 credits each.)

The analysis above shows that most freshman students fill up their entire freshman year with courses needed to satisfy both the freshman requirements and the prerequisites for their intended major program. There is little room for electives and in the case of CS, there are actually 9 required courses.

Furthermore, while the current 7 required freshman courses mesh nicely with the biological and biomed majors, other majors would be better served by a slightly different set of 7 courses.

3 **Suggested New Freshman Program**

The following suggested program balances the requirements so that students get both a breadth of general sciences, plus enough flexibility to both prepare for their major and have room in their program for some electives.

3.1 **Proposed official freshman requirements**

This would be the official rule that all freshman programs must obey. A student in U1 or above who had not completed these requirements would have their transcript flagged as missing a Science freshman requirement.

Students normally complete 30 credits which must include at least 7 courses from the list of Approved Freshman Science Courses as listed in Section [3.2](#) such that:

**General Math and Science Breadth:**
6 courses must be selected as follows:
(i) 2 courses from MATH and 4 courses from BIOL, CHEM or PHYS; or
(ii) 3 courses from MATH and 3 courses from BIOL, CHEM or PHYS.

**Science Complementary:**
1 additional course from the approved freshman science course list.

Students who have not studied all of Biology, Chemistry and Physics at the grade 12 level or equivalent are strongly advised to include at least one course in the missing discipline in their freshman program.

Many students will complete more than 7 courses from the Approved Science Courses list, particularly those who wish to leave several options open for their choice of major.

### 3.2 List of approved Freshman Science Courses

- ATOC 104/EPSC 104/GEOG 104 (3 credits) - The Earth System
- BIOL 111 (3 credits) - Principles: Organismal Biology
- BIOL 112 (3 credits) - Cell and Molecular Biology
- CHEM 110 (4 credits) - General Chemistry 1 (pre/coreq: college-level math and physics)
- CHEM 120 (4 credits) - General Chemistry 2 (pre/coreq: college-level math and physics, CHEM 110 is not a prereq)
- COMP 202 (3 credits) - Introduction to Computing 1
- MATH 133 (3 credits) - Vectors, Matrices and Geometry
- First calculus course, one of:
  - MATH 139 (4 credits) - Calculus
  - MATH 140 (3 credits) - Calculus 1
  - MATH 150 (4 credits) - Calculus A
- Second calculus course, one of:
  - MATH 141 (4 credits) - Calculus 2
  - MATH 151 (4 credits) - Calculus B
- First physics course, one of:
  - PHYS 101 (4 credits) - Introductory Physics - Mechanics
  - PHYS 131 (4 credits) - Mechanics and Waves (coreq: Cal 1)
- Second physics course, one of:
  - PHYS 102 (4 credits) - Introductory Physics - Electromagnetism (pre: PHYS 101, coreq: Cal 1)
  - PHYS 142 (4 credits) - Electromagnetism and Optics (pre: PHYS 131, coreq: Cal 2)
- PSYC 100 (3 credits) - Introduction to Psychology
3.3 List of Courses required for each Major

Just like with the current freshman program, students must also ensure that their freshman program includes all courses required for the courses in their intended majors.

Students should consider all the majors in which they might be interested and include the union of the prerequisite courses in their freshman program. The information in this section is intended for advising purposes only and may be further refined by discussions with the departments. Freshman students get very specific advising via the Student Affairs office whose advisors help students select the correct program (although with the following list, it should be fairly straightforward for students to do it themselves).

Anatomy and Cell Biology, Biochemistry, Microbiology and Immunology, Physiology:

- Cal 1, Cal 2, BIOL 112, CHEM 110, CHEM 120, PHYS 101/131, PHYS 102/142. (*Students thinking about Medicine may also take BIOL 111*

Biology: Cal 1, Cal 2, BIOL 111, BIOL 112, CHEM 110, CHEM 120, PHYS 101/131, PHYS 102/142 (*Note that this is 8 courses, biology students wondered if there could be any flexibility. For example, are both physics courses required? Some of the new faculty in biology are in areas that require more or different math. Should the math courses be rethought?*)

Atmospheric and Oceanic Sciences:

- MATH 133, Cal 1, Cal 2, PHYS 131 and PHYS 142, plus 2 out of CHEM 110, CHEM 120, ATOC/EPSC/GEOG 104.

Chemistry:

- MATH 133, Cal 1, Cal 2, PHYS 131, PHYS 142, CHEM 110, CHEM 120, BIOL 112 (especially for students who have not studied biology in grade 12 and for students in the bio-organic option).

Computer Science or Software Engineering:

- MATH 133, Cal 1, Cal 2, and COMP 202. (*Students who do not take COMP 202 in their freshman year may still enter a Computer Science or Software Engineering Major, but they will need to take COMP 202 in the first term of their U1 year and will not be able to proceed to the higher-level courses as quickly.*)

Earth and Planetary Sciences: Cal 1, Cal 2, BIOL 111, CHEM 110, PHYS 131, PHYS 142, plus 1 out of CHEM 120, MATH 133 or ATOC/EPS/GEOG 104.

Earth System Science: Cal 1, Cal 2, BIOL 111, CHEM 110, PHYS 131, PHYS 142, plus 1 out of CHEM 120, MATH 133 or ATOC/EPS/GEOG 104.

Environment: Cal 1, Cal 2, BIOL 111, CHEM 110, PHYS 101/131, ATOC/EPS/GEOG 104, (BIOL 112 for students planning on taking higher level Biology courses).

Geography: MATH 133, Cal 1, PHYS 101/131, CHEM 110, BIOL 111, ATOC/EPS/GEOG 104.

Mathematics and Statistics:

- MATH 133, MATH 140 (or MATH 139) and MATH 141.

Physics: MATH 133, Cal 1, Cal 2, PHYS 131, PHYS 142, CHEM 110, CHEM 120, (BIOL 111 or BIOL 112). (*It is not yet clear if both CHEM courses are prerequisites to physics courses. It is also not yet clear if the BIOL courses are actual prerequisites to any of the courses in the physics programs, and if so which BIOL course is needed.*)
Psychology: Cal 1, MATH 133 or Cal 2, PSYC 100, CHEM 110, BIOL 112.

4 Example Scenarios

Here are some typical scenarios and how the student would be advised. This should be considered a first draft and detailed advising notes can be developed in cooperation with the units and the Student Affairs Office advisors.

Students who want to leave the most options open: Cal 1, Cal 2, MATH 133, BIOL 112, CHEM 110, CHEM 120, PHYS 131, PHYS 142, plus one of PSYC 100, COMP 202, ATOC/EPSC/GEOG 104. (9 courses, 32 credits)

Students in Biology or Biomed students getting the prereqs for Medicine: Cal 1, Cal 2, CHEM 110, CHEM 120, PHYS 101/131, PHYS 102/142, BIOL 111, BIOL 112. (8 courses, 29 credits - students in this stream will take CHEM 212 in U1 which is 4 credits, so they can be short 1 credit here.) This option covers the majority of our incoming students.

Students interested in Physical Sciences (Physics, Chemistry, ATOC): MATH 133, Cal 1, Cal 2, PHYS 131, PHYS 142, CHEM 110, CHEM 120, plus one or two of BIOL 112, COMP 202 or ATOC/EPSC/GEOG 104 depending on their interests. For example, a student thinking about a joint Physics/CS degree might select COMP 202, a student intending on following a biological chemistry stream should take BIOL 112, and a student leaving open the option of ATOC should take ATOC/EPSC/GEOG 104.

Students interested in Math/Stats, CS/SE, or a joint Math&CS degree: MATH 133, Cal 1, Cal 2, COMP 202, plus at least 3 breadth courses from BIOL/CHEM/PHYS. Students should choose from the BIOL/CHEM/PHYS courses according to their background and other interests. Students who have not studied one of biology, chemistry or physics at the grade 12 level or equivalent should include at least one course in that discipline. Students interested in bioinformatics should include chemistry and biology courses. Students interested in robotics or a joint program with physics should include PHYS 131/142.

Students interested in Environment or Earth Sciences; MATH 133, Cal 1, Cal 2, PHYS 101/131, PHYS 102/142, CHEM 110, CHEM 120, BIOL 112, ATOC/EPSC/GEOG 104. (9 courses, 32 credits)

Students who are interested in ATOC or ESS should take PHYS 131/142. Students who are more interested in Environment or Geography could consider replacing one of the physics or chemistry courses with another biology course.

5 Discussion

This modified program still allows students to follow the old freshman program if that suits them, but also provides more flexibility. We expect that Biology and biomed majors will take exactly the same courses as with the current freshman program, although at the meeting of all student society reps some of these students expressed the desire for some flexibility. Students in the other disciplines will now have some flexibility to include courses more specific to their discipline, but will still have some breadth in Science.

Since most freshman students take a total of 8 or 9 courses, this also means that some students will have room for 1 or 2 elective courses (depending on how many prerequisites are required for the majors in which they are interested).
6 Future Considerations

When we change the freshman program, there are several future considerations.

• Many of our freshman courses do not have official pre- and co-requisites because we currently expect all of the students to be studying all of the courses. This is already problematic because of the BA&Sc students who do not know, for example, that it is better if they have taken one Chemistry course before taking Biology 112. Thus, the pre- and co-requisites for all of the freshman courses should be made clear.

• By making the freshman requirements slightly more flexible, we can also make our admissions requirements, for students entering U1, more flexible, along the same lines. The current admission requirements from CEGEP are actually stronger than our current Freshman program, and include Biology (NYA - General Biology 1), Chemistry (NYA - General Chemistry, NYB - Chemistry of Solutions), Math (NYA - Cal 1, NYB - Cal 2, NYC - Linear Algebra) and Physics (NYA - Mechanics, NYB - Electricity and Magnetism and NYC - Waves, Optics Modern Physics).

  This set of courses is reasonable for students coming from a Sciences DEC, but there are students interested in subjects like Computer Science, who may have a different background, such as a professional IT DEC. In this case, it is the math courses that are really required. We could admit students into specific majors and allow them to complete the other science courses as part of their 90 credit program.

• Biology/biomed students wondered if there might be a special two course math sequence that was not just calculus, but prepared them in other aspects of math as well (as was done for management students).