Faculty of Science – McGill University

Program Review:

An Overall Review of the B.Sc. Programs

Third Draft – May 18, 2007

This document was created as a collaborative effort of the Faculty Review Group (FRG) and the three Program Review Groups (PRGs) for the Faculty, Major and Honours Programs. Many thanks to Victor Chisholm (Faculty of Science Undergraduate Research Officer) and Christopher Johns for their help in preparing this document.

Faculty Review Group (FRG)	**Faculty Programs PRG**
Laurie Hendren, Associate Dean (Academic), Faculty of Science (Chair) Jennifer Hunter, Faculty of Science Craig Mandato, Department of Anatomy & Cell Biology Ann Wechsler, Department of Physiology Bettina Kemme, School of Computer Science Dik Harris, Department of Physics Don Baker, Department of Earth & Planetary Sciences Robert Levine, Department of Biology Dorothy Durnford, Graduate Student, Department of Atmospheric & Oceanic Sciences Marina Lagodich, VP Academic, Science Undergraduate Society	Laurie Hendren (Chair) Louis Hermo, Department of Anatomy & Cell Biology Christopher Barrett, Department of Chemistry Bill Anderson, Department of Mathematics & Statistics Jennifer Di Massimo, Staff; Department of Microbiology & Immunology Tanya Skamene, Student; Department of Physiology
Major Programs PRG	**Honours Programs PRG**
Laura Nilson, Department of Biology, (Chair) Kathleen Cullen, Department of Physiology Jim Gleason, Department of Chemistry Jim McGilvray, Program Director, Cognitive Science / Department of Philosophy Raffaella Bruno, Staff; Department of Mathematics & Statistics Dena O'Hara, Student; Department of Biochemistry	Charles Lin, Department of Atmospheric & Oceanic Sciences (Chair) Julie Desbarats, Department of Physiology Brigitte Vachon, Department of Physics Patrick Hayden, School of Computer Science Terry Wheeler, Department of Natural Resource Sciences Anne Comeau, Staff; Department of Biology Elizabeth Munro, Student; Departments of Physics and Mathematics & Statistics

Table of Contents

Faculty of Science – McGill University

An Overall Review of the B.Sc. Programs

1 Introduction and Overview

The Faculty of Science offers a wide variety of B.Sc. programs ranging over many disciplines and including three main types of programs (Honours, Major and Faculty). The purpose of this document is to review all these programs, providing both an overview and analysis of the programs as well as recommending the steps required for further improvements.

1.1 Review Process

The review process started in the academic year 2004-2005 with the formation of the Faculty Review Group (FRG) and three Program Review Groups (PRGs), one PRG for each of the Honours, Major and Faculty programs. The FRG provides acts as a top-level group to which the three PRG groups report. The review groups were set up so as to ensure representation from all discipline, as well as representation from professors, academic administrative staff and students. An initial list of topics to address was created at the end of 2004-2005. At the beginning of 2005-06 former Associate Dean of Science (Academic) Morton Mendelson handed over the responsibilities of heading the review process to the current Associate Dean (Academic), Laurie Hendren.

The main bulk of the review took place in the winter term of 2005-2006. Each PRG focused on specific questions most relevant to their program (Honours, Major or Faculty) and the FRG examined topics that were common to all B.Sc. programs. The review was not meant to be a detailed examination of each individual B.Sc. program, but rather an examination of the more general aspects of the groups of programs. Our intent was to document the current state of the B.Sc. program structure, to analyze what is working well, and to suggest what could be improved so that we could provide meaningful recommendations which could be used as a roadmap for improvements that could implemented over the next several years.

During the 2006-07 academic year some program changes were introduced in response to the review process, the most important one being replacing the Faculty programs with a more general and modular system called the B.Sc. Liberal programs. A short overview of that new program is also included in this document.

1.2 Document Roadmap

The structure of this document follows very much the structure of the review process. In Section 1.3 we provide a short summary and overview of the B.Sc. programs offered by the Faculty of Sciences. Sections 2, 3 and 4 contain the reports from the Honours, Major and Faculty Program Review Groups. Each program review group section contains some recommendations that are specific to the program group it was reviewing. However, one major outcome of this exercise was the proposal of a new kind of B.Sc. program that we call the B.Sc. Liberal program and this new program is outlined in Section 4.6. A discussion of the three "I"s, Internationality, Interdisciplinarity and Inquiry-based learning is given in Section 5. Finally, some conclusions are given in Section 6.

1.3 Summary of B.Sc. Programs offered by the Faculty of Science

The Faculty of Science offers B.Sc. degrees through the departments and Schools in the Faculty of Science (Atmospheric and Oceanic Sciences, Biology, Chemistry, Computer Science, Earth and Planetary Sciences, Geography, Mathematics and Statistics, Physics and Psychology) as well as administering and awarding degrees in four biomedical areas where the actual departmental units are part of the Faculty of Medicine (Anatomy and Cell Biology, Biochemistry, Microbiology and Immunology, and Physiology).

1.3.1 B.A. and B.A.&Sc Programs offered by Units in the Faculty of Science

Although this review focuses only on the B.Sc. degrees, it is important to point out that the Faculty of Science offers a significant number of programs in the B.A. and B.A.&Sc. Degrees as well.

The B.A. programs include those in Computer Science, Geography, Mathematics and Statistics, and Psychology. In the case of Geography and Psychology, the majority of students in those departments follow B.A. programs. The B.A. programs offered by units in the Faculty of Science were reviewed in the Faculty of Arts review process. The B.A.&Sc degree programs are jointly offered by the Faculty of Science and the Faculty of Arts and students follow a program from both faculties. Each unit in Science has a 36-credit major concentration available in the B.A.&Sc. Degree. As the B.A.&Sc. Programs just began at the time of this review process, they will not be formally reviewed until the next cyclical review exercise.

There are two major differences between the B.Sc. and B.A. programs. First, the entrance requirements are different. Entry into the B.Sc. programs requires a Science CEGEP DEC or the completion of the Science Freshman Program. Second, most of the B.A. programs are multi-track ones, consisting of a 36-credit major concentration, plus a minor or a second major. In contrast, the existing B.Sc. programs are significantly larger, requiring at least 54 credits, but do not require a second program.

1.4 The three kinds of B.Sc. degrees

There are three main kinds of degrees offered: Honours, Major and Faculty. The current definitions of these programs, as currently given in the 2006-2007 Undergraduate Calendar, are as follows.

A *Faculty program* is an approved coherent selection of courses giving students a useful concentration in a recognized area. Students in a Faculty program may choose a pattern of study that can range from one yielding a broad education to one specializing in particular areas.

Major programs are more specialized than Faculty programs and are usually centered on a specific discipline or department.

Honours programs typically involve an even higher degree of specialization, often include supervised research, and require students to maintain a high academic standard. Although Honours programs are specially designed to prepare students for graduate studies, graduates of the other degree programs are also normally admissible to most graduate schools. Students who intend to pursue graduate studies in their discipline should consult a departmental adviser regarding the appropriate selection of courses in their field.

Although these definitions give the general flavour of the different kinds of programs, part of this review exercise is to revisit the definitions and to clarify the purpose and goals of each kind of program and to evaluate if our current programs are achieving those goals.

1.5 The structure of a B.Sc.

A B.Sc. degree at McGill consists of four years of study with a total of 120 credits. A normal course load is five 3-credit courses per term and each year has two terms, Fall and Winter. Students entering McGill from a high school outside of Quebec complete a special 30-credit Freshman program and then a 90-credit departmental program. Students entering McGill from the Quebec CEGEP system receive 30 credits and start directly into the 90-credit departmental program. Students entering with advanced placement credits are evaluated on an individual basis and can receive up to 30 credits towards the Freshman program. Students in the Freshman program are said to be in their U0 year, whereas the three years of the departmental programs are called U1, U2 and U3.

All programs are expressed in terms of *required* and *complementary* courses. Required courses must be taken by all students in the program, whereas the complementary courses offer some choice and allow students to specialize within their program. Usually, but not always, the complementary courses are in the same discipline as the program. We will see the exceptions to this rule in Section 4 which contains the review of the Faculty programs.

The number of *program credits* is the sum of the number of credits of required courses and the number of credits of complementary courses. A typical Major Program requires around 60 credits. Normally Faculty programs require fewer program credits than Major programs, and Honours programs require more program credits than Major programs. All students must complete 90 credits and the credits that remain after the required and complementary courses have been accounted for are called *elective* courses. For example, if a program specifies 60 credits of required/complementary courses, then a student has 30 credits of electives (for students starting in the freshman program, they may have additional elective credits in their freshman (U0) year). There are currently very few restrictions on which elective courses may be taken. Any course offered by the Faculty of Science of the Faculty of Arts is an acceptable elective course and many courses from other faculties are also allowed. Some students use their elective courses to complete a second program such as a minor.

1.5.1 Course Levels and Numbering

The freshman courses (those taken by students coming from outside of Quebec, directly from high school) and some basic general interest courses, have 100-level numbers. Courses with 200-level numbers correspond to courses normally taken in the U1 year (i.e. the first year of studies for CEGEP graduates). Most 200-level courses are foundational courses in a program, although there are some 200-level courses that are general interest courses, and not part of any program. Courses at the 300-level and above are almost always foundational courses that are part of a program. 300-level courses are normally taken in U2, and 400-level courses are normally taken in U3. 500-level courses are available for both undergraduates and graduate students and tend to cover relatively advanced material. The expectation is that students will take a "reasonable number" of upper-level courses (i.e. those at the 300-level or above).

1.6 Program Statistics

1.6.1 Enrolment and part-time/full-time breakdown

Table 1 gives a summary of enrolment for the years 2002, 2003 and 2004. These figures, as well as all subsequent data in this report, do not include students in the freshman program. There are approximately 500-600 students in the freshman program each year. These students have not yet declared a major and they are enrolled mostly in basic science courses. The Faculty of Science has the second largest undergraduate enrolment at McGill, second to the Faculty of Arts.

Note that over 95% of students are studying full-time, enrolment has slowly risen over the time period, and the majority of students are registered in a Major program (around 79%). More detailed tables are also given in the section devoted to each of the Honours, Major and Faculty programs. (NOTE: Most of the data given in this report is for the years 2002 through 2004, as this data was provided to the faculties for the purposes of the program reviews. In some cases, the individual review groups collected additional data which is often for the 2005-2006 academic year. There is currently a new enrolment tracking tool being built at McGill that, in the future, will provide more detailed data and allow better tracking of students both within and between programs.)

	Fall 2002			Fall 2003			Fall 2004				
Summary by Type of Program	Full-Time	Part-Time	Total	Full-Time	Part-Time	Total	Full-Time	Part-Time	Total	%Full-Time	%Total
Faculty Program Total	309	21	330	357	27	384	362	18	380	95.3%	11.8%
Major Program Total	2293	118	2411	2337	138	2475	2408	121	2529	95.2%	78.7%
Honours Program Total	325	11	336	308	21	329	305	13	318	95.9%	9.5%
All Programs Total	2927	150	3077	3002	186	3188	3075	152	3227	95.3%	100.0%

Table 1: Enrolment Summary (2002-2004)

1.6.2 Graduation

Table 2 summarizes the data on students graduating in the period 2000-2004. Note that compared to the enrolment numbers we see a lower fraction of students in the Major program

(64% versus 79%) and corresponding increases in the Faculty and Honours programs. This indicates that most students tend to start in the Major program and then some switch into the Faculty or Honours program as their studies progress. Thus, in designing our programs, we should make it easy to switch between programs, especially during the U1 year of study.

Table 2 also gives the average GPA for the graduates of 2003 and 2004. Note that, as expected, the GPA of students in the Honours programs is higher by a significant margin. If we look at the percentage of students who graduate on the Dean's Honours List (DHL), we again see a larger percentage of Honours students than Major students. Note that each year at most 10% of graduating students are nominated for the DHL and the GPA cutoff is very high, 3.82 in 2003 and 3.84 in 2004. It is somewhat surprising that a higher percentage of Faculty program students are on the DHL than Major program students (8.1% versus 5.5%). This may be, in part, due to the fact that some "medical school hopefuls" enroll in the Faculty program for the express purpose of raising their GPA (in the Faculty program they have more flexibility to choose lower-level courses and electives).

				2003		2004		2003 & 2004	
Summary by Program	2000	2001	2002	# of Deg.	GPA	# of Deg.	GPA	% on Dean's Honor List	% of Total Graduates
TOTAL (Faculty Program)	99	140	143	141	3.15	156	3.22	8.1%	18.2%
TOTAL (Major Program)	519	454	506	496	3.19	548	3.20	5.5%	64.1%
TOTAL (Honours Program)	149	150	148	152	3.65	136	3.65	25.0%	17.7%
TOTAL	767	744	797	789	3.27	840	3.28	9.4%	100.0%

Table 2: Graduation Data(2000-2004)

If all students who registered eventually graduated with a B.Sc. degree from the Faculty of Science, then we would expect about one third of the currently registered students to graduate each year, which would be just over 1000 students. As shown in Table 2, we actually graduate about 800 students. We do not have access to an exact tracking mechanism to determine what causes this difference. However, using a recently developed prototype for tracking enrolment over all programs at McGill, it appears that there are 3 causes. First, some students take more than three years to finish their 90-credit degree program. This may because they arrived with a partial year due to advanced placement credits or did not complete a full course load each term., because they add second program which requires extra courses, or because for academic or non-academic reasons they may have chosen to take a reduced load. Second, it is reasonably easy for students to switch between faculties and some students switch to Management, Engineering and Arts. Since B.Sc. students tend to have the prerequisites for all of these programs (and the opposite is not necessarily true), we see a net loss due to such transfers. This should not be considered a problem since the overall goal of the University is to provide a program that is suitable for each student. Third, a certain number of students leave McGill early, either because of poor academic performance or to transfer to another institution. Initial studies seem to show that each year about 5% of the B.Sc. students leave without finishing their program.

1.6.3 Biomedical versus other science disciplines

Table 3 shows the breakdown of 2003 and 2004 graduates by kind of program (i.e. Faculty, Major or Honours) and by whether the discipline of the degree corresponds to a departmental unit in the Faculty of Science (column labeled "Science") or to a Biomedical departmental unit from the Faculty of Medicine. Overall about 58% percent of the graduates come from Science units and 42% of the graduates come from Biomedical units.

Table 3 also demonstrates that the distribution between Faculty, Major and Honours programs differs between the Science and Biomedical units. In both the Science and Biomedical units the Major programs are the most popular. However, a significantly higher proportion of the Science students choose an Honours program as compared to the Faculty program, whereas the opposite is true for the Biomedical students, where the proportion of students choosing the Faculty program is noticeably higher. This may be, in part, due to the fact that many students in the Biomedical disciplines are aiming for Medical School, whereas many Science students are preparing for graduate programs. Another factor that affects the number of Honours students in Biomedical programs is that some Honours programs, such as the Physiology Honours program, limit the number of students in order to ensure space in the Honours Lab and to allow for active participation in the Seminar course.

Summary 2003 and 2004 (% of graduated students)	Science	Biomed	Total for Program
Faculty Programs	5.2%	13.1%	18.2%
Major Programs	41.7%	22.4%	64.1%
Honours Programs	11.4%	6.3%	17.7%
Total for Faculty	58.2%	41.8%	100.0%

Table 3 - Breakdown of graduates by program

Table 4 provides a more detailed breakdown of the enrolment in all three types of programs for the Science departments. Faculty programs are indicated by the suffix "FP" and Honours programs are indicated by the suffix "Hon". Note that not all units offer a Faculty program (the Psychology Faculty program was closed in 2006). Except for Biology, the proportion of students in the Faculty programs is quite low.

Table 5 provides a similar breakdown, by department, for the programs offered by Medical units. Although all Faculty programs offered by these units attract a significant proportion of students, the Anatomy & Cell Biology Faculty program attracts a significantly higher proportion of students and the Honours programs in Anatomy&Cell Biology attracts a significantly lower proportion of students.

Programs	Fall 2002 Male	Fall 2002 Female	Fall 2002 Total	Fall 2003 Male	Fall 2003 Female	Fall 2003 Total	Fall 2004 Male	Fall 2004 Female	Fall 2004 Total	Total 2002-2004 %Male	Total 2002-2004 %Female	Total 2002-2004 Total	Dist. within Discipline
Atmospheric Sciences	9	12	21	9	12	21	7	15	22	39.1%	60.9%	64	80.0%
Atmospheric Science - Hon	2	2	4		4	4	3	5	8	31.3%	68.8%	16	20.0%
Biology FP	15	38	53	16	37	53	15	33	48	29.9%	70.1%	154	12.3%
Biology	106	237	343	118	213	331	128	240	368	33.8%	66.2%	1042	83.0%
Biology - Hon	8	10	18	7	16	23	11	8	19	43.3%	56.7%	60	4.8%
Chemistry - FP	1	2	3	2	5	7		4	4	21.4%	78.6%	14	3.8%
Chemistry	37	46	83	39	48	87	50	59	109	45.2%	54.8%	279	76.6%
Chemistry - Hon	15	9	24	12	11	23	13	11	24	56.3%	43.7%	71	19.5%
Math & Comp Sci - FP *	3	1	4	1	1	2	1		1	71.4%	28.6%	7	0.9%
Math, Stats & Comp Sci - FP *	4	2	6	1		1	1	1	2	66.7%	33.3%	9	1.1%
Math & Computer Science *	25	4	29	17	1	18	16	4	20	86.6%	13.4%	67	8.5%
Software Engineering	14	5	19	23	5	28	24	12	36	73.5%	26.5%	83	10.5%
Computer Science	198	70	268	126	42	168	81	19	100	75.6%	24.4%	536	68.0%
Computer Science - Hon	33	8	41	24	5	29	16		16	84.9%	15.1%	86	10.9%
Earth & Planetary Sciences	15	14	29	17	9	26	14	13	27	56.1%	43.9%	82	82.8%
Earth Sciences - Hon	2	4	6	1	5	6	3	2	5	35.3%	64.7%	17	17.2%
Geography	12	10	22	7	10	17	2	13	15	38.9%	61.1%	54	90.0%
Geography - Hon	1	1	2	1	1	2	1	1	2	50.0%	50.0%	6	10.0%
Math & Comp Sci - FP *	3	1	4	1	1	2	1		1	71.4%	28.6%	7	1.5%
Math, Stats & Comp Sci - FP *	4	2	6	1		1	1	1	2	66.7%	33.3%	9	2.0%
Math & Computer Science *	25	4	29	17	1	18	16	4	20	86.6%	13.4%	67	14.5%
Mathematics	27	30	57	29	29	58	42	31	73	52.1%	47.9%	188	40.8%
Mathematics - Hon	17	6	23	16	4	20	13	3	16	78.0%	22.0%	59	15.6%
Probability & Statistics - Hon	1		1	1	1	2	4	2	6	66.7%	33.3%	9	2.0%
Applied Mathematics - Hon	2	1	3	4	1	5	2	2	4	66.7%	33.3%	12	2.6%
Math and Physics - Hon*	40	2	42	30	5	35	30	3	33	90.9%	9.1%	110	23.9%
Physics - FP	3	2	5	3		3	2		2	80.0%	20.0%	10	2.3%
Physics	45	22	67	50	24	74	61	21	82	70.0%	30.0%	223	50.7%
Physics - Hon	28	9	37	26	3	29	28	3	31	84.5%	15.5%	97	22.0%
Math and Physics - Hon*	40	2	42	30	5	35	30	3	33	90.9%	9.1%	110	25.0%
Psychology - FP	1	12	13	5	12	17	8	10	18	29.2%	70.8%	48	6.2%
Psychology	45	147	192	50	157	207	49	194	243	22.4%	77.6%	642	82.3%
Psychology - Hon	8	29	37	7	24	31	5	17	22	22.2%	77.8%	90	11.5%

*** students counted twice - once in Math and once in other discipline**

Table 4 - Breadkdown of Enrolment by type of Program (Science Departments)

Programs	Fall 2002 Male	Fall 2002 Female	Fall 2002 Total	Fall 2003 Male	Fall 2003 Female	Fall 2003 Total	Fall 2004 Male	Fall 2004 Female	Fall 2004 Total	Total 2002-2004 %Male	Total 2002-2004 %Female	Total 2002-2004 Total	Dist. within Discipline
Anatomy and Cell Biology - FP	31	88	119	32	102	134	40	109	149	25.6%	74.4%	402	46.9%
Anatomy and Cell Biology	37	96	133	40	105	145	51	114	165	28.9%	71.1%	443	51.7%
Anatomy and Cell Biology - Hon	2	2	4	1	2	3		5	5	25.0%	75.0%	12	1.4%
Biochemistry -FP	9	23	32	20	31	51	20	21	41	39.5%	60.5%	124	11.2%
Biochemistry	123	169	292	106	157	263	117	187	304	40.3%	59.7%	859	77.2%
Biochemistry -Hon	13	20	33	26	21	47	29	20	49	52.7%	47.3%	129	11.6%
Micro & Immunology -FP	9	19	28	10	17	27	7	14	21	34.2%	65.8%	76	7.0%
Micro & Immunology	94	194	288	110	206	316	126	187	313	36.0%	64.0%	917	84.1%
Micro & Immunology -Hon	5	13	18	2	14	16	9	12	21	29.1%	70.9%	55	5.0%
Immunology (Interdept) - Hon	9	4	13	7	7	14	3	13	16	44.2%	55.8%	43	3.9%
Physiology -FP	16	28	44	21	51	72	21	52	73	30.7%	69.3%	189	15.7%
Physiology	101	171	272	114	178	292	155	240	395	38.6%	61.4%	959	79.8%
Physiology -Hon	5	8	13	8	12	20	9	12	21	40.7%	59.3%	54	4.5%

Table 5 - Breakdown of Enrolment by type of Program (Medical Departments)

We do not have good data to measure exactly what proportion of B.Sc. students are intending to continue to Medical School or graduate programs. However, the feeling is that those intending to go to Medical School are more likely to choose either Biology or one of the Biomedical disciplines. Table 6 would seem to support this observation. Of the 219 Quebec applicants for admission into McGill Medicine for September 2006, 74 of them were completing the last year of their undergraduate degree at McGill (there are additional applicants who have previously graduated from McGill). Of those 74 applicants, 65 of them are from the Faculty of Science B.Sc. programs and of those 63 are from Biology or one of the biomedical disciplines. The Faculty of Medicine would welcome a more diverse applicant pool, and so it would be interesting to see how we can package our programs so that students can get both a solid background for admission to Medicine and study any discipline, not just the biomedical ones.

Other Faculties		
BEng	2	
Physical Therapy	2	
BA Sociology	1	
Nutrition and Psychology	1	
Nutritional Science	2	
BSc/Bed	1	9

Faculty of Science		
Biology	13	
Psychology	2	
Anatomy and Cell Biology	9	
Biochemistry	3	
Microbiology and Immunology	15	
Physiology	23	65

Table 6: Applications to McGill Medicine from McGill Undergraduates graduating in June 2006 (Quebec Resident,total Quebec applicants 219)

1.6.4 Gender

Over time there has been a noticeable trend that a greater proportion of undergraduates are female. As demonstrated in Table 7, about 58% of the B.Sc. students in the Faculty of Science are female. However, the breakdown by program type shows a somewhat surprising results, which is the proportion of females in the Faculty programs is even higher (68.5%) and the proportion of females in the Honours programs is substantially lower (39%). One might assume that this difference is due to fact the female students are more likely aiming for medical school than graduate studies, and hence are in disciplines where the Faculty program is more popular. However, this is not the only cause for this difference, as is shown below.

Program Type	Fall 2002			Fall 2003			Fall 2004			Total 2002-2004		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	%Male	%Female	Total
Faculty	103	227	330	119	265	384	123	257	380	31.5%	68.5%	1094
Major	961	1,361	2,322	927	1,324	2,251	985	1,464	2,449	40.9%	59.1%	7022
Honours	208	128	336	193	136	329	197	121	318	60.8%	39.2%	983
Total	1,272	1,716	2,988	1,239	1,725	2,964	1,305	1,842	3,147	41.9%	58.1%	9099

Table 7: Breakdown of enrolment by gender (2002-2004)

Figure 1 shows the percentage of male/female students by individual program. As was expected the biomedical, biology and psychology disciplines have the highest proportion of female students and the physical sciences, mathematics and computer science disciplines have the lowest proportion of female students. However, from this figure one can also see that in most cases the bar representing the Honours program in a discipline is to the right (lower proportion of female students) of the Major bar. For example, Honours physics has only about 17% female students, whereas the Major program in physics has about 30%. There are similar trends for most of the other disciplines.

As the Honours programs are intended for students intending to continue to graduate studies, this small proportion of females in the Honours program is potentially once source of the "shrinking pipeline" problem, where the proportion of females goes down at each level in the academic chain. This ultimately leads to a very small pool of female applicants for academic jobs. It is somewhat disturbing to see that either by choice, or by accident, many female students are restricting their opportunities for graduate school by their choice of undergraduate program. Thus, this might be one area where better advising and mentoring could help.

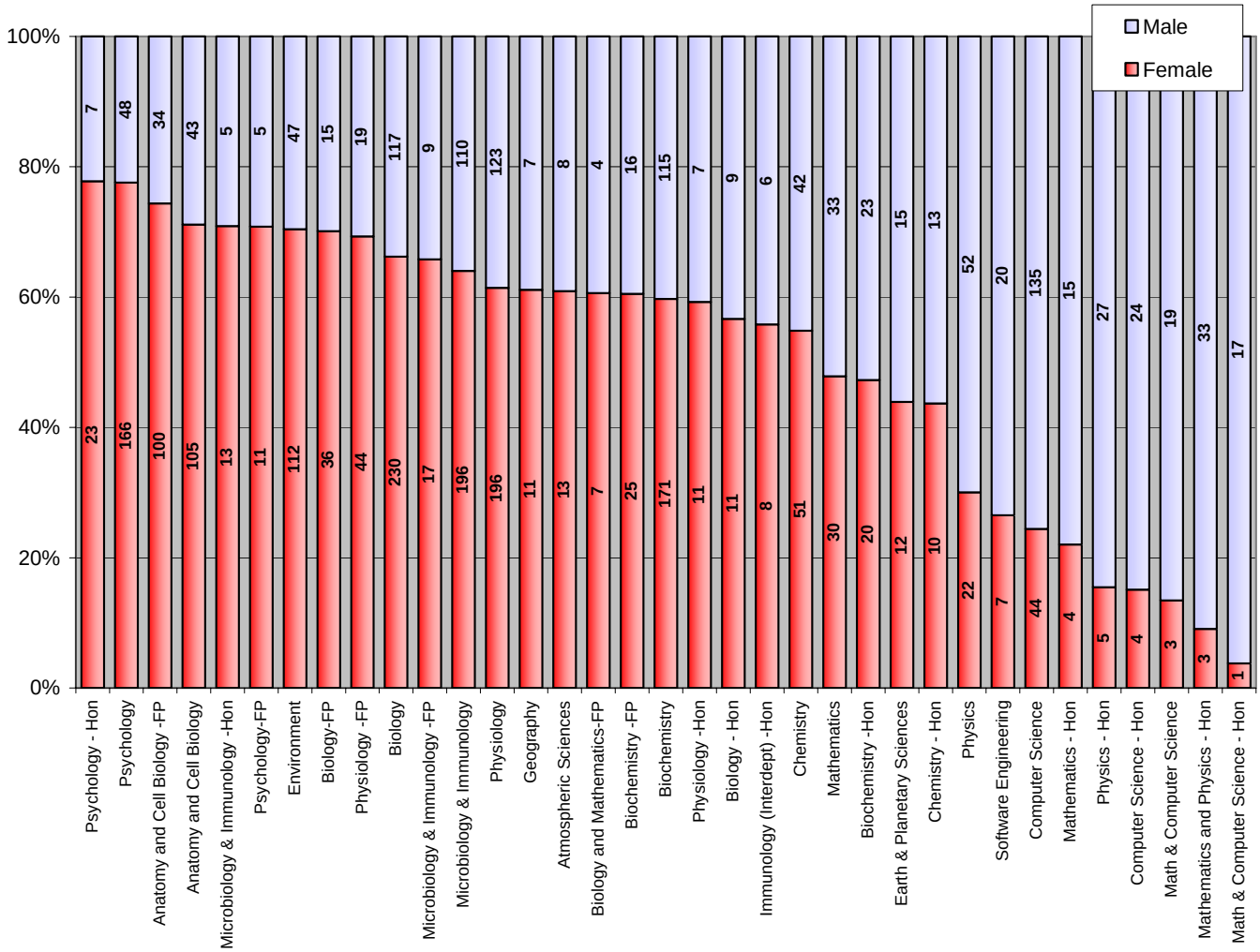


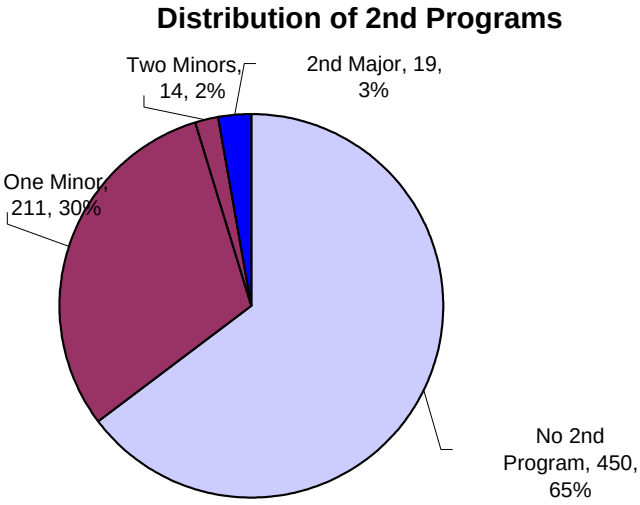
Figure 1 - Gender Distribution of Enrolment by Individual Program (average over 2002,2003,2004). Note that programs with fewer than 10 students enrolled have been omitted).

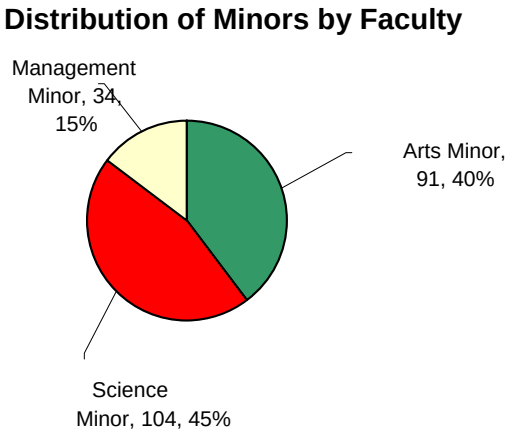
1.6.5 Second Programs

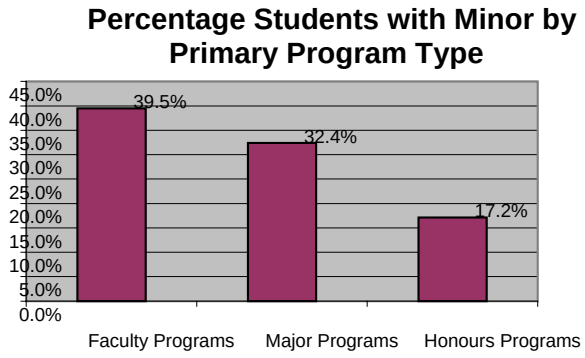
The Faculty of Science is increasingly committed to inter- and multi-disciplinary undergraduate programs. We already have historically offered several Joint Majors and Joint Honours programs and more recently also have three interdepartmental/interfaculty Majors (Environment, Earth System Science and Neuroscience). The Environment program is well established, the Earth System Science program is in the final stages of Quebec approval and the Neuroscience program is in the initial stages of Quebec approval.

Rather than take a pre-packaged inter- or multi-disciplinary program, students often combine two programs. Figure 2 shows the distributions of students enrolled in a second program. About 35% of the students take some sort of second program, with the majority of

those being minors that are usually between 18 and 24 credits. Looking only at the minors, about 15% are Management minors, 40% are Arts minors and the 45% are minors for Science students. A small number of students manage to complete 2 minors (2%) or two majors (3%). Of the students who complete two majors, 63% are Arts Major Concentrations (36 credits).







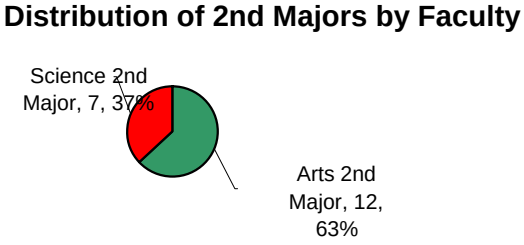


Figure 2 - Distribution of B.Sc. students completing a second program (Students graduating June 2006)

As shown by the bar chart in Figure 2, the choice of primary program does have an impact on whether or not a student completes a second program. About 40% of students in a Faculty Program also complete a minor, whereas only about 17% of Honours program students complete a minor. This is to be expected since the Honours programs are often more specialized and thus have a larger program credit weight. We can see that there is a tradeoff between specialization and breadth.

2 Report on Honours Programs

2.1 Preamble

The Honours Program Review Group consists of the following members: Charles Lin (Atmospheric and Oceanic Sciences), Chair; Anne Comeau (Biology); Julie Desbarats (Physiology); Patrick Hayden (Computer Science); Elizabeth Munro (Physics/Mathematics and Statistics), Student member; Brigitte Vachon (Physics) and Terry Wheeler (Natural Resource Sciences).

The Group had three meetings (March 20, 31, April 11, 2006). Jennifer Hunter was present in the first two meetings as well. Her assistance was invaluable in gathering the necessary data and in providing advice. The report was prepared and written by all members of the Group as a result of discussion at these meetings and email exchanges among the Group.

The report consists of the following sections: Goals of Honours Programs, Summary of Existing Programs, Research Opportunities, Recognition of Honours Programs, and Recommendations.

2.2 Goals of Honours Programs

Given McGill University's status as Canada's most research intensive university, and the university's recognition of the importance of incorporating research in undergraduate teaching, undergraduate Honours programs provide a focal point for the role of research in teaching.

Honours programs in the Faculty of Science provide undergraduate students with the opportunity to gain exposure and experience to current research in their chosen discipline. Through participation in advanced courses, Honours students receive additional training in the theoretical background and methodological approaches that form the basis for recent advances in the field.

Students graduating from the Honours program are well-prepared to assess, critique and conduct research. As such, they enter graduate programs or employment in research-intensive areas with a distinct advantage over many other students.

2.3 Enrolment and Graduation Data for Honours Programs

Table 8 gives the enrolment data for all of the Honours programs for 2002, 2003 and 2004. Note that overall, about 10% of the students are enrolled in an Honours program. Within the Honours programs, the most popular programs include Chemistry, Computer Science, Mathematics, Physics, Psychology and Biochemistry.

	Fall 2002			Fall 2003			Fall 2004				
Honours Program	Full-Time	Part-Time	Total	Full-Time	Part-Time	Total	Full-Time	Part-Time	Total	%Hon	%Total
Applied Mathematics - Hon	3		3	5		5	4		4	1.3%	0.1%
Atmospheric Science - Hon	4		4	4		4	8		8	2.5%	0.2%
Biology -Hon	15	3	18	23		23	18	1	19	6.0%	0.6%
Chemistry -Hon	23	1	24	19	4	23	22	2	24	7.5%	0.7%
Computer Science -Hon	39	2	41	24	5	29	14	2	16	5.0%	0.5%
Earth Sciences -Hon	6		6	4	2	6	5		5	1.6%	0.2%
Geography -Hon	2		2	2		2	2		2	0.6%	0.1%
Math & Computer Science -Hon	17		17	17	2	19	17		17	5.3%	0.5%
Mathematics and Physics -Hon	40	2	42	35		35	32	1	33	10.4%	1.0%
Mathematics -Hon	22	1	23	19	1	20	15	1	16	5.0%	0.5%
Physics and Chemistry-Hon			0	1		1	3		3	0.9%	0.1%
Physics -Hon	36	1	37	26	3	29	30	1	31	9.7%	1.0%
Probablility & Statistics -Hon	1		1	1	1	2	5	1	6	1.9%	0.2%
Psychology -Hon	37		37	30	1	31	20	2	22	6.9%	0.7%
Honours Program Total (Science)	245	10	255	210	19	229	195	11	206	64.8%	6.4%
Anatomy and Cell Biology -Hon	4		4	3		3	5		5	1.6%	0.2%
Biochemistry -Hon	32	1	33	45	2	47	47	2	49	15.4%	1.5%
Immunology (Interdept) -Hon	13		13	14		14	16		16	5.0%	0.5%
Microbiology & Immunology -Hon	18		18	16		16	21		21	6.6%	0.7%
Physiology -Hon	13		13	20		20	21		21	6.6%	0.7%
Honours Program Total (Medicine)	80	1	81	98	2	100	110	2	112	35.2%	3.5%
Honours Program Total	325	11	336	308	21	329	305	13	318	100.0%	9.9%

Table 8: Enrolment for Honours Programs (%Hon is the percentage of those enrolled in Honours programs, %Total is the percentage of the tototel enrolment.)

Table 9 shows the graduation data for Honours programs. About 18% of the graduates come from the Honours program. This is higher than the 10% of students enrolled in Honours programs because students often do not declare their honours programs until the second of third year of their studies.

				2003		2004		Sum of 2003 and 2004			
Honours Programs	2000	2001	2002	# of Deg.	GPA	# of Deg.	GPA	% on Dean's Honor List	% of Hon. Prog.	% of Total Graduates	
Applied Mathematics -Hon	1	3		0		1	3.53	0.0%	0.3%	0.1%	
Atmospheric Science -Hon	2	1	1	3	3.67	2	3.66	0.0%	1.7%	0.3%	
Biology -Hon	22	12	16	17	3.79	21	3.73	39.5%	13.2%	2.3%	
Chemistry -Hon	15	13	13	12	3.57	12	3.50	25.0%	8.3%	1.5%	
Computer Science -Hon	12	12	18	20	3.46	12	3.49	6.3%	11.1%	2.0%	
Earth Sciences -Hon	4	9	2	1	3.76	3	3.39	0.0%	1.4%	0.2%	
Geography -Hon	1		1	1	3.55	1	3.54	0.0%	0.7%	0.1%	
Mathematics and Physics -Hon	7	8	6	11	3.66	4	3.72	40.0%	5.2%	0.9%	
Math & Computer Science -Hon	5	9	6	0		4	3.80	50.0%	1.4%	0.2%	
Mathematics -Hon	2	4	2	4	3.52	4	3.55	0.0%	2.8%	0.5%	
Probablility & Statistics -Hon	1		1	1	3.39	1	3.60	0.0%	0.7%	0.1%	
Physics -Hon	2	7	8	10	3.51	5	3.78	20.0%	5.2%	0.9%	
Psychology -Hon	12	18	11	18	3.78	17	3.71	40.0%	12.2%	2.1%	11.4%
Anatomy and Cell Biology -Hon	1	1	1	1	3.90	0		100.0%	0.3%	0.1%	
Biochemistry -Hon	20	20	22	20	3.75	17	3.62	27.0%	12.8%	2.3%	
Immunology (Interdept) -Hon	15	8	13	8	3.60	5	3.74	7.7%	4.5%	0.8%	
Microbiology & Immunology -Hon	19	19	21	18	3.68	19	3.72	24.3%	12.8%	2.3%	
Physiology -Hon	8	6	6	7	3.60	8	3.69	20.0%	5.2%	0.9%	6.3%
TOTAL (Honours Programs)	149	150	148	152	3.65	136	3.65	25.0%	100.0%	17.7%	

Table 9- Graduation Data for Honours Programs

2.4 Summary of Existing Programs

Honours programs vary widely throughout the Faculty of Science, ranging from a Major program with an added 3-credit research component in U3 (e.g. Atmospheric Sciences), to a research-intensive stream requiring seminar courses and independent research beginning in U2 (e.g. Biology, Physiology), to an entirely independent program beginning in U1 and focused on highly challenging course material (e.g. Physics). These different structures reflect the distinct cultures and requirements of each discipline and the committee felt that attempting to uniformize the programs at this level would have an overall detrimental effect. In addition to the structure of the programs, differences exist in the minimum GPA/CGPA entrance and graduating requirements, as well as the year (U1, U2, U3) during which a student can join an Honours program. The definition and content of Honours programs currently available in the

Faculty of Science are summarized below. A detailed comparison between each program can be found in the Appendix.

Two aspects of Honours Programs stood out as particularly valuable and thus worthy of further development. The first is that all Honours programs have (or should have) an element of extra challenge compared with Majors Programs, either through a significant (9 to 12 credit) research component, or through special "Honours" courses adding depth or breadth to the corresponding non-Honours courses, or through a combination of the two. The second aspect is the small size of the Honours programs, an attribute which is particularly valued by Honours students, and allows small-group learning in contexts and through methods not accessible to larger groups. It is also worth noting that some components of Honours programs such as laboratory and supervised research projects and seminar courses put an intrinsic limit on the number of students that can be enrolled in an Honours program. However, in practice it was found that this logistical constraint has not limited the number of Honours graduates in Science, with the possible exception of Psychology, which has a large number of students in both the B.Sc. and B.A. programs.

2.4.1 Anatomy and Cell Biology

Credits: 73

Definition: The program is distinguished by a 9 credit research project and 2 specific courses and other complementary courses which may be opened to all students. Students present their research work to a committee of 5 professors who decide on their final project grade.

Entrance requirements: CGPA of at least 3.0 at the end of U1. CGPA of at least 3.2 at the end of U2 for entrance in U3.

Program requirements: CGPA of at least 3.2

When Honours program declared: Students should register at the Major level in U1 and, if accepted, may enter the Honours program at the beginning of U2.

2.4.2 Atmospheric Sciences

Credits: 70

Definition: There is not much difference between Honours and Majors programs in terms of courses, except for the 3-credit Honours research project (ATOC 480) and some additional 500-level and mathematics courses.

Entrance requirements: GPA of 3.30 after U1

Program requirements: GPA and CGPA of 3.30

When Honours program declared: U2

2.4.3 Biochemistry

Credits: 76

Definition: The Honours program is significantly more course intensive than the Major program. There is complementary research course (BIOC 491, 6 cr) and a required Advanced

Biochemistry Laboratory (BIOC 460) in which students perform research with a professor and write a final research-review paper.

Entrance requirements: Students going into U2 with a GPA of at least 3.2 and a mark of B or better in every required course are contacted by the department and encouraged to select the Honours Program.

Program requirements: GPA of at least 3.20 and a B or better in every required course.

When Honours program declared: U2

2.4.4 Biology

Credits: 68 or 71

Definition: This program consists of a 9 or 12 credit research project and a 4 credit seminar course. The goal of the Honours Program is to give exceptionally talented and interested students an opportunity to perform research. The Honours Program includes attendance at seminars, written and oral expression of science, use of literature, and presentation of personal research.

Entrance requirements: CGPA of 3.5 and finding a research supervisor

Program requirements: CGPA of 3.5 at the end of U3.

When Honours program declared: U3

2.4.5 Chemistry

Credits: 74 (Note from the FRG chair: Since this document was written, all Honours and Majors in Chemistry have been reduced by 3 credits. This is because the major used to include the Freshman math course MATH 133, which is now considered part of the pre-program. Hence, this program is now 71 credits and other Chemistry programs are similarly reduced by 3 credits.)

Definition: 6-credit Honours research project, additional chemistry courses at the 300 and 400 level.

Entrance requirements: no requirements

Program requirements: CGPA of at least 3.0

When Honours program declared: U1

2.4.6 Chemistry, Bio-organic option

Credits: 78

Definition: 6-credit Honours research project , additional chemistry and biomedical courses at the 300 and 400 level.

Entrance requirements: no requirements

Program requirements: CGPA of at least 3.0

When Honours program declared: U1

2.4.7 Chemistry, Environmental Chemistry option

Credits: 77

Definition: 6-credit Honours research project, additional chemistry and associated courses at the 300 and 400 level.

Entrance requirements: no requirements

Program requirements: CGPA of at least 3.0

When Honours program declared: U1

2.4.8 Chemistry, Materials

Credits: 77

Definition: 6-credit Honours research project, additional chemistry and materials science courses at the 300 and 400 level.

Entrance requirements: no requirements

Program requirements: CGPA of at least 3.0

When Honours program declared: U1

2.4.9 Computer Science

Credits: 72

Definition: 3-credit Technical Project and Report, 12 credits must be at the 500 level, Honours versions of Algorithms and Data Structures, and Algorithm Design courses.

Entrance requirements: CGPA of at least 3.0

Program requirements: Honours students must maintain a CGPA of 3.00 and must have at least this average upon graduation as well.

When Honours program declared: U1

2.4.10 Earth Sciences

Credits: 75

Definition: A 6-credit Honours Research Project (EPSC 480) is required.

Entrance requirements: no GPA minimum entrance requirement

Program requirements: CGPA of 3.2 or better for graduation

When Honours program declared: U1

2.4.11 Environment

Credits: 63 to 72

Definition: This program is identical to the Majors program with the addition of a single 6-credit U3 research course (ENVR 495), which consists of a full-year research experience in a professor's lab. Registration in this course is restricted to Honours students.

Entrance requirements: a minimum Program GPA of 3.3

Program requirements: Students must earn a B grade (3.0) or higher for the Honours research course (ENVR 495 or ENVR 496-497). CGPA of at least 3.0 and minimum program GPA of 3.3

When Honours program declared: U3

2.4.12 Geography

Credits: 66

Definition: 6-credit research paper.

Entrance requirements: CGPA of at least 3.0

Program requirements: Program GPA of at least 3.3

When Honours program declared: anytime

2.4.13 Immunology (Interdepartmental)

Credits: 75

Definition: This is a joint program of the Departments of Biochemistry, Microbiology and Immunology, and Physiology. This is a demanding, highly structured program, which prepares students for graduate training in immunology or for medicine, especially for students with interest in clinical research. A U3 9-credit undergraduate research project, seminar and thesis are the defining features of this program.

Entrance requirements: CGPA > 3.3, permission of the program coordinators, and finding a research supervisor

Program requirements: CGPA at graduation > 3.3, and B or better in all immunology courses.

When Honours program declared: U2

2.4.14 Mathematics

Credits: 60

Definition: Different stream of Honours Math courses

Entrance requirements: GPA of at least 3.0

Program requirements: To remain in an Honours program and to be awarded the Honours degree, the student must maintain a 3.00 GPA in the required and complementary Mathematics courses of the program, as well as an overall CGPA of 3.00.

When Honours program declared: after one semester of U1

2.4.15 Applied Mathematics

Credits: 68

Definition: Different stream of Honours Math courses

Entrance requirements: GPA of at least 3.0

Program requirements: To remain in an Honours program and to be awarded the Honours degree, the student must maintain a 3.00 GPA in the required and complementary Mathematics courses of the program, as well as an overall CGPA of 3.00.

When Honours program declared: U1

2.4.16 Microbiology and Immunology

Credits: 73

Definition: This program combines the substantial background given by the Major program with a challenging opportunity to carry out a laboratory research project in the U3 year. The required courses provide a broad exposure to biomedical sciences, as well as a high degree of specialization. Students are prepared for a significant research experience under the supervision of a professor in the Department. Those considering careers in research in the biological sciences or in medicine, or employment in the biotechnology field, are encouraged to take advantage of this program.

Entrance requirements: Minimum CGPA of 3.3 at the end of U2, and interview with program coordinator.

Program requirements: Must pass all required courses with a C or better and achieve a sessional GPA of at least 3.30 in U3.

When Honours program declared: U3

2.4.17 Physics

Credits: 78

Definition: Distinct stream of Honours courses both in Physics and Mathematics. At least 3 credits of Honours research project.

Entrance requirements: GPA in required and complementary courses in any year must remain above 3.00. Grades in every required and complementary courses must be C or better.

Program requirements: GPA in required and complementary courses in any year must remain above 3.00. Grades in every required and complementary courses must be C or better.

When Honours program declared: U1 or U2

2.4.18 Physiology

Credits: 75

Definition: The Honours program becomes more specialized during the final two years, including a research techniques course and a tutorial mentoring course in U2, and a seminar

course in U3, all restricted to Honours students. It also includes a 9-credit Honours Research Project in the lab of a Department member in U3. The program is restricted to a limited number of students who are selected on the basis of good performance and motivation. The goals of the program are to provide students with an in-depth knowledge of physiology and related biomedical sciences.

Entrance requirements: Minimum CGPA of 3.3 at the end of U1

Program requirements: CGPA of 3.20 with no less than a B in all Physiology courses.

When Honours program declared: U2

2.4.19 Planetary Sciences

Credits: 81

Definition: A 6-credit Honours Research Project (EPSC 480) is required, as well as additional mathematics courses compared with Major in Earth and Planetary Sciences or Honours in Earth Sciences.

Entrance requirements: CGPA of at least 3.20

Program requirements: CGPA of 3.2 or better for graduation

When Honours program declared: U1

2.4.20 Probability and Statistics

Credits: 63

Definition: Different stream of Honours Math courses

Entrance requirements: no requirements

Program requirements: To remain in an Honours program and to be awarded the Honours degree, the student must maintain a 3.00 GPA in the required and complementary Mathematics courses of the program, as well as an overall CGPA of 3.00.

When Honours program declared: U1

2.4.21 Psychology

Credits: 60

Definition: There is a common first year curriculum between Honours and Majors students. The relatively low number of credits allow for students to take electives in preparation for options other than graduate school, such as law and business schools. The goal of the Honours program is however to prepare students for graduate school. The significant opportunity to do research in this program is unique to McGill. There is a 9-credit undergraduate research thesis that is started and completed in U2 (PSYC 380D), with an option to do another 9 credits of research in U3 (PSYC 498D). 75% of the Honours students take both options, for a total of 18 credits in research. This used to be 100%, as the 18 credits of research were required prior to 2003. The program also includes a 3-credit seminar in U3 (PSYC 482).

Entrance requirements: U1 GPA of 3.5 (or higher - top 30 applicants are accepted based on GPA)

Program requirements: GPA and CGPA of at least 3.0 upon graduation

When Honours program declared: U2

2.4.22 Joint Honours Mathematics and Computer Science

Credits: 72

Definition: Honours Math courses

Entrance requirements: no requirements

Program requirements: To remain in an Honours program and to be awarded the Honours degree, the student must maintain a 3.00 GPA in the required and complementary Mathematics courses of the program, as well as an overall CGPA of 3.00.

When Honours program declared: U1

2.4.23 Joint Honours Mathematics and Physics

Credits: 81

Definition: Honours Math and Physics courses.

Entrance requirements: no requirements

Program requirements: A student whose average in the required and complementary courses in any year falls below a GPA of 3.00, or whose grade in any individual required or complementary course falls below a C (in both the final examination and supplemental examination if taken), may not register in this Joint Honours program the following year, or graduate with the Joint Honours degree, except with permission of both Departments.

When Honours program declared: U1

2.4.24 Joint Honours Physics and Chemistry

Credits: 80

Definition: Honours Math and Physics courses, at least 3 credit of Honours poject

Entrance requirements: no requirements

Program requirements: A student whose average in the required and complementary courses in any year falls below a GPA of 3.00, or whose grade in any individual required or complementary course falls below a C (in both the final examination and supplemental examination if taken), may not register in this Joint Honours program the following year, or graduate with the Joint Honours degree, except with permission of both Departments.

When Honours program declared: U1

2.5 Research Opportunities

The primary objective of McGill's Faculty of Science honours programs is to prepare students for a career in scientific research. Before we can specify the appropriate role of research in an honours program, however, we must define what constitutes research. Firstly, does it include working in a library, a laboratory, at a computer, or all of these? Secondly, how do we train these 'researchers'; do we want them to know all the techniques available in their area of expertise and to be able to act independently? Thirdly, we must decide where training stops and autonomy begins. These are all questions that must be asked when reviewing the vastly diverse honours programs McGill University's Faculty of Science.

The Oxford English Dictionary defines 'research' as the act of searching closely or carefully for or after a specified thing; to search into or investigate or study closely, to pursue a course of research. In scientific research, we generate testable questions and design experiments which will support or reject our hypotheses. These are critical skills which must be taught thoroughly. The O.E.D. defines a researcher as one who is devoted to scientific or literary research; a scientist is an investigator or inquirer addressing scientific questions. These definitions may assist in determining the purpose of 'research' in the honours programs we are examining.

Research as a component of an honours program must be evaluated in the capacity of the expected outcome. What do we want our students to learn so they can become active and productive members of the scientific community? Whether they take a program with a heavy dose of independent research, one that includes mainly directed teaching, or one based on practical laboratory work in a structured course setting may not make as large a difference as one might expect when assessing that outcome—a person capable of conducting credible, independent research in their chosen field.

We can all agree that classes are essential. Where possible, undergraduate coursework in an honours program should provide students with enough background to personally propose a research project associated with the on-going activities being performed in a specific laboratory. Supervisors should facilitate the evolution of these projects and resist the temptation to structure a project entirely without the student's input. But how much 'research' is enough to allow a student to exhibit that s/he has absorbed, assimilated and now has the ability to utilize the material effectively? Guidelines may be set by university or faculty committees but departmental flexibility is, in our view, essential.

In some areas, specifically those that are highly mathematical, the ideal of involving all honours students in research is simply unrealistic due to the amount of knowledge required before it becomes possible to engage the research literature. In these cases, the most effective preparation for future career success is a rigorous set of courses. The high proportion of honours-specific courses in the mathematics honours programs reflects this fact. At the other end of the spectrum, the psychology honours program includes a nine-credit research project in U2. The norm is to require an honours research project worth either 3 or 6 credits in U3, with the number of credits required in research decreasing from psychology through the life sciences, to the physical sciences and tapering off in mathematics. There are exceptions, however. Biochemistry requires no specific research credits but adds an advanced laboratory in biochemical techniques as a requirement for their honours students. As a rule, McGill honours programs should expose their students to independent research as soon as the students have acquired the skills that will allow them to do so.

With respect to access to the research opportunities provided by the honours programs, students with the necessary requirements, and the desire to enter honours programs, are generally not refused, although most departments do have a cap on the number of students accepted into their honours programs. Caps are required either because of research laboratory space limitations or, in the cases of biology on physiology, to ensure that the honours class size is conducive to active participation in a round-table discussion with a seminar speaker.

A discussion of research opportunities available to honours students would be incomplete without some discussion of the NSERC Undergraduate Student Research awards program, which provide funding for student research projects undertaken primarily over the summer term. While only a minority of students receive the awards, in many departments such as computer science and mathematics, the majority of the recipients are honours students. The School of Computer Science has gone one step further and created a $2,500 prize for the best summer research project, creating a further incentive for students to strive for research excellence. In addition, many honours students also work in research laboratories during the school year or in the summer and are assigned to independent projects as opposed to mundane tasks such as dishwashing. This should be taken into consideration when asking the question of whether our honours students get enough research experience from their program requirements.

No matter how it presents itself, research appears to have a central position, and is a focal point in nearly all honours programs evaluated for this exercise. A review of the honours programs in the Faculty of Science reveals many similarities plus a few unique qualities specific to certain departments. The variety of other course requirements such as techniques laboratories, statistics courses, and honours-specific courses all have a bearing on how effectively research can be carried out by the student. All of these supplementary aspects have their effect on how a student will approach the problem established as their project.

2.6 Recognition of Honours Programs

There seems to be insufficient recognition by McGill of the significant extra work required of some Honours program. Some Honours students take the same number of 500-level courses as first year M.Sc. students as well as write a thesis in their final year, while others do time consuming research projects and gain graduate seminar experience, yet they receive the same B.Sc. degree as students who do not complete the extra requirements of an Honours program. An explicit designation of Honours-specific courses in the transcript and explicit recognition of the Honours Program on the B.Sc. diploma would help in this respect.

In programs where there is a significant difference between the Majors and Honours programs (e.g., Physics), it is commonly recognized that if the same Honours student were to follow a Majors program, his/her GPA would be higher. This could hurt the chances of Honours students when they apply for admission to graduate or professional schools and for scholarships. For example, medical school entrance requirements look first at the GPA, thus potentially putting Honours students at a disadvantage. Some departments "adjust" the GPA for Honours students when preparing ranking for scholarships. While the committee is not prepared to recommend that such "adjustment" be made as a general rule, we feel that some acknowledgement of the difficulty of the Honours program be made in cases when appropriate.

"First Class Honours" is also the designation of students with a high CGPA at convocation. There is also possible confusion resulting from 4-year programs at some Canadian universities being termed “Honours”, as opposed to 3-year programs. Some universities require an “Honours” degree for graduate studies, and the meaning is not clear. There is thus confusion among undergraduates at McGill choosing between Honours, Majors and Faculty programs. A clear definition of the Honours program would help in clarifying the confusion. To this end, a 1-page document outlining the Honours program in the Faculty of Science section of the calendar and in the McGill admissions web site would be useful. This document would describe in generic terms the Majors, Faculty and Honours programs, together with the names and contact information of advisors.

2.7 Recommendations

Members of the Committee spoke to many departmental advisors in preparation of this report. Each stated that his/her Honours program is working well. After careful discussion, the committee would like to make the following recommendations. We have for the most part not targeted specific programs, as we feel there should be consultation with the affected programs and departments before such recommendations are made.

1. The Honours program should be more challenging in course content, research or seminar requirements compared to the Majors and Faculty programs. One way to do this is to have a minimum number of credits at the 300-level and above (say 45), of which a number of them (say 15) must be 400-level or above. A preliminary survey indicates that only 7 out of 24 existing Honours programs currently meet this requirement.

2. There should be acknowledgement of the difficulty of the Honours program in student ranking, in cases where there are currently significant differences between the Honours program and the Majors and Faculty programs.

3. Courses specific to Honours programs should have the qualifier "Honours" added (e.g., "Honours Quantum Physics") to distinguish them from corresponding courses in the Majors and Faculty programs.

4. There should be an explicit designation of Honours programs on the B.Sc. diploma, in recognition of the extra work required of the programs.

5. The timing of the declaration of the Honours program should ideally be at the U2 and not U1 year. In programs where this is not possible, there should be a mechanism for strong students to transfer to the Honours program after U1. *[Note from the FRG chair: The Department of Mathematics&Statistics notes that their current mechanism allows for students to select the Honours program at the end of the first semester of U1. It would be difficult, in their case, to move this later because starting in the 2nd semester of U1 there is a special stream of courses for Honours students.]*

6. There should be a 1-page document in the Faculty of Science section of the calendar and in the McGill admissions web site outlining in generic terms the Majors, Faculty and Honours programs. This will help students in choosing the different options. The names and contact information for advisors should be shown as well.

7. A CGPA of at least 3.3 in U2/U3 program courses should be required of students in Honours programs. A preliminary survey of student grades indicates this will affect about 33

out of 320 students. *[Note from the FRG chair: The Department of Mathematics&Statistics points out that their Honours program includes very challenging courses, for which a CGPA of 3.0 might be an appropriate cutoff.]*

8. The name "Honours" could be confusing, as for example, top Honours graduating students at McGill have the designation "First Class Honours". This might be clarified by referring to the latter as "First Class Distinction", and reserving the designation "Honours" for the Honours programs. Some effort should be expended to clarify the use of the name “Honours” .

3 Report on Major Programs

3.1 Preamble

The Major Program Review Group consists of the following members: Laura Nilson (Biology), Chair; Kathleen Cullen (Physiology); Jim Gleason (Chemistry), Jim McGilvray (Philosophy), Raffaella Bruno (Mathematics and Statistics).

The Group had three meetings (March 27, April 5, 11, 2006). Jennifer Hunter was present at the first two meetings and provided valuable assistance and advice. General discussions of the group generated ideas for approaching the analysis and presenting the findings. Given the diversity within the Major programs across the Faculty, the departments were analyzed as groups generated roughly according to related field. Each Group member prepared a section of the report, which was compiled and summarized by the Chair and then circulated among the group for editing to produce the final report.

The report consists of a general summary of the stated goals of the Major programs, followed by a more detailed summary of the programs in related departments. The report ends with a synthesis of specific conclusions, recommendations and outstanding questions.

3.2 Goals of Major Programs

The Major programs serve the majority of students in the Faculty of Science. Each year,typically 60-65% of degrees in the Faculty of Science are granted to students in Major program. The remainder are divided roughly equally between the Faculty and Honours programs (Table 2). Although the specific requirements vary widely across departments, the Major programs aim to provide students with a solid education in the discipline. The Major programs are typically distinguished from the Faculty programs, which require less specialization but potentially allow for more breadth of study, by a higher credit requirement. Conversely, the Major programs have a lower credit requirement than the Honours programs and lack the minimum CGPA requirement and independent research component that characterize the Honours programs. Nevertheless, in addition to providing some degree of preparation for future employment, the Major programs appear to be generally considered to provide sufficient preparation for graduate studies.

3.3 Enrolment and Graduation Data for Major Programs

Table 10 provides a summary of the enrolment data for all Major and Joint-Major programs. The most popular programs in Fall 2004 were Biology, Psychology (note that Psychology has an even larger enrolment in the B.A. programs), Biochemistry, Physiology and Microbiology&Immunology. Over the period from 2002 to 2004 there seems to be a trend towards the biological and biomedical sciences.

Major Program	Fall 2002			Fall 2003			Fall 2004				
	Full-Time	Part-Time	Total	Full-Time	Part-Time	Total	Full-Time	Part-Time	Total	%Major	%Total
Atmospheric Sciences	20	1	21	20	1	21	19	3	22	0.9%	0.7%
Atmospheric Sciences & Physics	3	1	4	6		6	10		10	0.4%	0.3%
Biology	336	7	343	317	14	331	357	11	368	14.6%	11.4%
Chemistry	69	14	83	81	6	87	98	11	109	4.3%	3.4%
Computer Science	242	26	268	141	27	168	79	21	100	4.0%	3.1%
Earth & Planetary Sciences	28	1	29	20	6	26	27		27	1.1%	0.8%
Environment	161	4	165	160	11	171	134	7	141	5.6%	4.4%
Geography	19	3	22	16	1	17	15		15	0.6%	0.5%
Math & Computer Science	27	2	29	17	1	18	18	2	20	0.8%	0.6%
Mathematics	53	4	57	55	3	58	66	7	73	2.9%	2.3%
Physics	64	3	67	66	8	74	76	6	82	3.2%	2.5%
Physics & Computer Science	11	1	12	5	1	6	5		5	0.2%	0.2%
Physics and Geophysics	6		6	2	1	3	4		4	0.2%	0.1%
Psychology	186	6	192	199	8	207	233	10	243	9.6%	7.5%
Software Engineering	19		19	28		28	35	1	36	1.4%	1.1%
Undeclared	86	3	89	218	6	224	77	3	80	3.2%	2.5%
Major Program Total (Science)	**1,330**	**76**	**1,406**	**1,351**	**94**	**1,445**	**1,253**	**82**	**1,335**	**52.8%**	**41.4%**
Anatomy and Cell Biology	130	3	133	141	4	145	158	7	165	6.5%	5.1%
Biochemistry	267	25	292	241	22	263	286	18	304	12.0%	9.4%
Microbiology & Immunology	282	6	288	308	8	316	305	8	313	12.4%	9.7%
Physiology	264	8	272	283	9	292	390	5	395	15.6%	12.2%
Physiology and Mathematics	12		12	5	1	6	7	1	8	0.3%	0.2%
Physiology and Physics	8		8	8		8	9		9	0.4%	0.3%
Major Program Total (Medicine)	**963**	**42**	**1,005**	**986**	**44**	**1,030**	**1,155**	**39**	**1,194**	**47.2%**	**37.0%**
Major Program Total	**2,293**	**118**	**2,411**	**2,337**	**138**	**2,475**	**2,408**	**121**	**2,529**	**100.0%**	**78.4%**

Table 10: Enrolment Data for Major Programs (%Major is percenatage of all students in Major programs, %Total is percentage of all B.Sc. students)

Table 11 summarizes the graduation data for 2003 and 2004. About 64% of the graduates completed a Major program. Considering the GPA for all areas which graduated more than 20 students, we can see that the average GPAs range between 2.92 (Computer Science) to 3.42 (Physiology). Physiology also had a high proportion of students on the Dean's Honours List.

				2003		2004		Sum of 2003 and 2004			
Major Programs	2000	2001	2002	# of Deg.	GPA	# of Deg.	GPA	% on Dean's Honor List	% of Major Prog.	% of Total Graduates	
Atmospheric Science	9	6	2	5	2.92	1	3.15	0.0%	0.6%	0.4%	
Biology & Environm Sciences	7		1	2	2.28	0		0.0%	0.2%	0.1%	
Biology	77	49	76	74	3.35	94	3.28	4.8%	16.1%	10.3%	
Chemistry	21	15	12	12	2.91	8	3.15	0.0%	1.9%	1.2%	
Computer Science	72	103	90	106	3.04	82	2.92	5.9%	18.0%	11.5%	
Earth & Planetary Sciences	14	10	9	10	3.07	7	3.27	5.9%	1.6%	1.0%	
Environment	6	27	20	28	3.30	54	3.38	8.5%	7.9%	5.0%	
Geography	11	7	7	4	2.79	5	3.14	0.0%	0.9%	0.6%	
Math & Computer Science	5	11	7	10	3.06	8	3.13	0.0%	1.7%	1.1%	
Mathematics	9	8	9	6	2.84	11	3.04	0.0%	1.6%	1.0%	
Physics and Geophysics	2	2	1	3	3.18	0		0.0%	0.3%	0.2%	
Physics & Computer Science	1			5	3.28	2	3.09	14.3%	0.7%	0.4%	
Physics	16	7	19	18	3.06	18	3.19	2.8%	3.4%	2.2%	
Psychology	48	50	55	54	3.11	52	3.15	3.8%	10.2%	6.5%	41.7%
Anatomy and Cell Biology	17	12	13	24	3.35	15	3.26	0.0%	3.7%	2.4%	
Biochemistry	63	44	72	46	3.10	61	3.15	4.7%	10.2%	6.6%	
Microbiology & Immunology	63	61	62	44	3.36	68	3.32	7.1%	10.7%	6.9%	
Physiology	78	42	51	41	3.42	58	3.32	9.1%	9.5%	6.1%	
Physiology and Mathematics	0	0	0	3	3.48	2	2.57	20.0%	0.5%	0.3%	
Physiology and Physics	0	0	0	1	3.96	2	3.37	33.3%	0.3%	0.2%	22.4%
TOTAL (Major Programs)	519	454	506	496	3.19	548	3.20	5.5%	100.0%	64.1%	

Table 11- Graduation Data for Major Programs

3.4 Summary of Existing Programs

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

Across these departments, the common stated goal of the Major program is to provide a substantial background in the chosen field of study. The Anatomy and Cell Biology, Biochemistry, Microbiology and Immunology, and Biology departments mention a few examples of employment areas that may be suitable for graduates, and each also lists preparation for graduate studies as a goal of the program. The exception is the Physiology department, which states no goals other than intensive studies in the discipline. These broad stated goals are appropriate, given that the Major program will enroll the majority of students in a department and must therefore accommodate a wide variety of educational objectives.

Table 12 summarizes the different programs, showing the number of required and complementary courses for each major. For comparison, the total number of program credits

for the corresponding Faculty and Honours programs are also given. The Major program in the Biology department has a considerably lower credit requirement than those in the Biomedical units (Anatomy and Cell Biology, Biochemistry, Microbiology and Immunology, Physiology). The higher credit requirements of the Biomedical units are consistent with those in other departments in the Faculty of Science (see below). The number of credits within the program that can be provided by complementary courses is also generally higher in the Biology department than in the Biomedical units. This discrepancy may reflect the fact that the Biology department offers a large number of different concentrations within the Major, thus requiring the program flexibility afforded by designating complementary courses, while the Biomedical Major programs are more specific.

Department/Unit	Major Program			Faculty Program	Honours program
	required	compl.	total	total	total
Anatomy and Cell Biology	46	21	67	57	73
Biochemistry	49	18 or 21	67/70	55	76
Micro. and Immunology	58	9	67	57	73
Physiology*	37	27 or 28	64/65	55	75
Biology	22	33	55	54/55	68/71
Biology (+ Mathematics)				57	

* Physiology joint majors are listed with the Mathematics or Physics departments

Table 12: Program Requirements in Biological and Biomedical Majors

Also informative is the comparison of the Major program to the Honours and Faculty programs. The Honours programs are distinguished from the Major programs by a higher total credit weight and a minimum CGPA requirement, but for these units/departments there is little or no difference in the stated goals of the program. While an Honours program provides the most intensive training in a discipline and is thus well-suited for students intending to pursue graduate studies, the Major programs in these units/departments are also expected to provide adequate preparation for graduate work. The Honours programs in these units/departments also differ from the Major programs in their research requirement; depending on the department, Honours students are required to complete 6-12 credits of independent research. It is worth noting, however, that non-Honours students in some departments do have the option of participating in independent research projects through existing courses, and that this option will be expanded as the recently-introduced 396 Undergraduate Research Courses become available. This analysis therefore suggests that the primary distinction between the Major and Honours program will be the different course/credit requirements and the minimum CGPA requirement.

The distinction between the Major and Faculty programs appears less clear. In general, the Faculty programs are less specialized and have lower credit requirements. One exception is the Faculty program in Biology, where the total credit requirement is the same as that for the Major program. The stated goals for the Biology Faculty program are also similar to those for the Major program, and include preparation for graduate studies. In general, the Faculty

programs in these departments share the common theme of a less specialized program, and therefore presumably offer more flexibility in course selection. However, the Faculty program descriptions do not detail the rationale for such a course of study and do not mention the specific goals of or advantages to such an option.

3.4.2 Chemistry, Physics, Computer Science, Mathematics and Statistics

Table 13 provides an overview of the major programs in this group. For Physics and Chemistry, the stated goal of the majors programs is to prepare students for a career in either discipline. In addition, the degree can serve as a basis for entry into graduate school. Both programs, including the options in the Chemistry Major (Bio-Organic, Environmental, Materials) leave sufficient room for students to complete a minor if desired.

Department	Major	Major Program			Faculty program	Honours program
		required	compl.	total	total	total
Chemistry	Chemistry	56	6	62	52	74
	Bio-Org Option	63	3	66		78
	Environmental Option	62	3	65		77
	Materials Option	62	3	65		77
	+Biological Sciences				55	
	+Mathematics				51/52	
Physics	Physics	60	0	60	54	78
	+ AOS *	64	3	67		n/a
	+Comp. Sci *	66	0	66		n/a
	+Geophysics *	69	0	69		n/a
	+Physiology *	65	15	80		n/a
	+Mathematics **					81
	+Chemistry **					
Comp. Sci	Comp. Sci	42	18	60		72
	Software Engineering	60	9	69		
Math	Major	27	27	54		60
	+Comp. Sci *	51	21	72		72
	+Physiology *	62	15	77		n/a
	+Statistics and Comp. Sci				54	
	+Chemistry and Physics				56	
	Applied Mathematics					68
	Probability and Statistics					63

* Joint Major, ** Joint Honours

Table 13: Program Requirements for Physical Sciences, Math and Computer Science

The combined majors in Physics (with Computer Science, Geophysics, Physiology, and Atmospheric and Oceanic Science) and the combined degrees with Mathematics have higher credit requirements, but this is normal for a more specialized degree. The combined Physiology/Physics major is higher than others, a result of fewer common requirements between a standard Physiology and Physics major. These degrees are in excess of 67 credits

each, leaving insufficient room for a student to complete a minor without exceeding 90 credits. However, considering that these same students are effectively doing a double major, this is not viewed as a negative. There is opportunity for these students to take some electives to round out their studies or to specialize further.

The number of required course credits is higher than in some other majors (e.g. Computer Science, Math). One source of this higher number of required courses is the experimental nature of the degree. In the regular majors, there are 10-13 credits of labs. These are experimental sciences and thus labs are fundamental to any major degree program. A second source is the need for students to have a solid foundation in math in order to comprehend difficult concepts (e.g., quantum mechanics).

One additional upward pressure on credit requirements is the need to satisfy outside accreditation entities. In Chemistry, for example, the major satisfies the requirements of the Canadian Society for Chemistry and the Ordre des Chimistes du Québec. The latter is beneficial for graduating students as membership in the order is required to practice as a chemist in Quebec and they are directly admitted to the order if they have completed the major at McGill.

In the Mathematics and Statistics department, the Major program provides an education in Mathematics for students who do not plan to go on to do a higher degree. The program can be adapted to a variety of student interests from course selection. For Statistics specialists, continuation to a Masters in Statistics is possible.

The program does accomplish its goals. The student develops skills in analytical and logical reasoning as well as technical skills for the application of mathematics in a possible variety of real-world scenarios.

The credit requirements are reasonable for a straight major, and the joint major necessarily carries a higher credit load. There is one hidden prerequisite, MATH 133 in the Joint Major with Physiology, which should be eliminated. In answer to the question “Do the joint-major programs make sense - could they be replaced by a general multi-stream program?”: No the programs are tailored to the specific needs of the clientele. As a specific example of this, a Computer Science major component would have to require MATH 240, but the joint Mathematics/Computer Science major uses MATH 235 and prevents the student from taking much of the same material twice.

3.4.3 Atmospheric Science, Earth and Planetary Sciences, Geography, Environment and Psychology

It is difficult to assess these programs by the same standards. As outlined below, the aims of their major programs – as stated in the Calendar – differ, as do the profiles of individual Major programs. In addition, Geography and Psychology present interesting cases for assessing Science Major programs in general: these departments offer both B.A. and B.Sc. programs and degrees, and their B.A. and B.Sc. major programs differ considerably in terms of credit requirements and numbers of students enrolled (Table 14 and see below).

Atmospheric and Oceanic Sciences aims to produce students who – while they can go on to graduate work – can reasonably expect employment with a B.Sc. The department’s Major program is an aggregate: half the major requirements are filled by courses in other departments, and 13 of the 18 courses in the complementary group are outside the department. There is a joint major with physics; during 2002-04, enrollments in this program were on average 6.5 p/a, compared to 21.5 in the department’s regular major program. The department

graduates comparatively few students. Gender ratio overall: approx. 40 F / 60 M. In 2000-04, 4.6 majors students graduated per year.

Earth and Planetary Sciences (includes courses often offered in departments called **Geology** at other universities) claims that B.Sc. students can seek and are likely to be able to find employment in an area that accepts a B.Sc. as sufficient qualification – for example, in petroleum and mining industries. Other students – there are no data on how many and no claim is made to prepare students for this with the Major program – are likely go on to graduate work. Unlike Atmospheric, Earth and Planetary's major program is not an aggregate; the courses are primarily within the department. Average enrollment in the major 2002-04: 27.5; gender ratio approx. 50-50. Graduate p/a 2000-04: 10 p/a.

Environment offers many programs for which one may receive a B.A., B.a.&Sc. or B.Sc., including both a B.Sc. from the Faculty of Science and a B.Sc.(Ag. Env. Sci,) from the Faculty of Agriculture and Environment Sciences. This review looks only at the B.Sc. students in programs offered by the Faculty of Science. The Environment programs have some unique characteristics. Each program consists of an introductory core set of four ENVR courses, common to all Environment programs, then a specialized domain (there are 8 domains available in the B.Sc.) and then a final core of two courses where students apply their domain knowledge to some contemporary environmental problem. The design of the Enviroment programs was done carefully in order to ensure students got both breadth and depth. Some domains, perhaps especially those that involve association with agriculture, allow a B.Sc. recipient to secure employment. Others are more research oriented and serve as entries to graduate programs of various sorts.

Geography claims to offer a B.Sc. degree (Major or Honours) that will allow a student to secure employment. There is also a B.A. major concentration (36 credits) offered by the Faculty of Arts, which attracts more students than the 56-credit B.Sc. program. Average enrollment major programs 2002-04: Science p/a: 18; Male/Female distribution, Majors Science: 22/78. Graduates from the B.Sc. programs continue on to careers in environmental consulting and skills in Geographic Information Science (GIS) are very marketable. Geography graduates are well prepared for graduate work in urban planning and environmental studies.

Psychology explicitly states in the course calendar that a graduate degree in Psychology is necessary for professional qualification, undergraduate Science and Arts programs (Major and Honours) are said to have the purpose of providing – by appeal to experimental and theoretical work – understanding of mind and behaviour. The understanding provided is seen as preparing a student for further work in psychology, or for any number of "practical applications." Like Geography, there is a 36-credit major concentration offered in the Faculty of Arts, as compared to the 54-credit major in the Faculty of Science. Enrolment is high in both the Arts and Science majors, although considerably higher in the B.A. programs. Average enrollments Major programs 2002-04 p/a Science: 214; Arts: 723. Graduates p/a Majors: Science 52; Arts 199.

Department	Major Program			Faculty program	Honours program
	required	compl.	total	total	
Atmospheric & Oceanic Sci	46	15	61	n/a	70
+Physics *	52	18	70	n/a	n/a
Earth & Planetary Sciences	51	15	66	n/a	75/81
+Physics *	35	33	68	n/a	n/a
Geography (B.Sc.)	22	36	58	n/a	66
Geography (B.A.)			36	n/a	60
Psychology (B.Sc.)	15	39	54	54	54
Psychology (B.A.)			36		54
Environment (B.Sc.)	Varies by domain		57/66		

Table 14 - Program Requirements (AOS, EPS, Geog, Enviornment, Psychology)

General observations: By the standard of the number of credits required of Science Majors at McGill, all the Majors of the departments mentioned above are within the range. As mentioned, the differences between the Arts and Science Major programs in Psychology and Geography raise interesting questions. One is justification of the heavier requirements for Science Major students in general: what does this increased credit load provide/guarantee the student that could not be had with a basic 36 credit requirement and the option of taking as many more credits as the student wishes or needs (up to 90 credits less any faculty-wide requirements)? Another is questions of quality: do students in Science major programs do better than those in Arts major programs? Worse? Is there any difference at all?

[Note from FRG chair: the proposed B.Sc. Liberal, as outlined in Section 4.6, effectively provides a smaller major for students who wish to have broader education. Thus, all options are available to the students, and they can select the kind of program that best matches their goals.]

3.5 Enrollment in Major programs

3.5.1 General trends regarding recent enrollment

Between 2002-2004, overall enrollment in the Faculty of Science rose from 2,988 to 3,147, and students are preferentially entering biological science programs. Enrollment in Majors programs in biomedical disciplines (including Biology, Physiology, Anatomy and Cell Biology, Psychology, Microbiology and Immunology, and Biochemistry) has increased slightly from 73.66% to 77.38% of the total enrollment in the Faculty of Science. In the meantime, enrollment in physical science disciplines (Chemistry, Math, Computer Science, Physics, and related disciplines) has decreased from 17% to 15.27% of total enrollment. The

remaining percentage is accounted for by the Departments of Earth and Environmental sciences (Atmospheric Science, Earth and Planetary Sciences, Environmental Science, and Geography) which have fallen just slightly - from 8.3% to 7.3%.

During this same time period the most significant gains in enrollment were seen in the Psychology Major program, which jumped from 192 to 243 students, and the Physiology Major program (from 272 to 395). Other notable increases in enrollment were seen in the Anatomy and Cell Biology Major program (133 to 165), and the Microbiology and Immunology Major program (288 to 313). The most significant losses occurred in the Computer Science Major program, with enrollment dropping from 268 to 100 between 2002-2004.

This popularity of a Major degree in the biological sciences could be the result of several factors. With the burst of the "dot com bubble" fields such as computer science may be viewed as less desirable. Instead students may perceive that training in biological science as a more secure approach for obtaining long term employment. The shift could also be a result of the changing gender ratios in science. Like most schools in North America, McGill now admits more females than males per year, and the science faculty is about 58% female and 42% male. Although more young women are entering science, they are still going into fields that traditionally attract higher numbers of female students (such as biology and psychology).

In the Faculty of Science there is no Major program that stands out as particularly "easy," as measured by an elevated GPA. There is, however, an interesting difference between the average GPAs obtained in the Faculty versus Major programs for departments with the largest enrollments. For example, students in Anatomy and Cell biology, Physiology, Biology, Biochemistry and Microbiology and Immunology who were enrolled in the Faculty programs had consistently lower GPAs than those in the Major programs. While this trend is striking, the cause remains unclear. It is possible that some of the weaker students are choosing the Faculty program and that their GPA would be even lower if they were in the Major program.

3.6 Summary and Recommendations

3.6.1 Recommendation: Clarify goals and outcomes for Major Programs

In general, the stated goal of the Major programs is to provide students with a solid background in a given discipline. The course requirements and credit loads suggest that the students do receive a substantial training in the field, and in this sense the Major program meets its goal.

However, it is the opinion of the committee that the achievement of many of the more specific goals stated in the course calendar, such as preparation for graduate study or particular employment, is difficult to assess with the available information. Specific data on the student outcomes, such as number of students that pursue graduate studies, find employment in the field, or feel that their education contributed to professional or personal success, would allow a more meaningful assessment of the attainment of the stated educational goals of the program. The committee recommends that a system be established to collect and record such data.

3.6.2 Recommendation: Limit maximum number of credits in Major programs, to allow students to have space for a Minor program (maximum of 66).

This survey of the Major programs in the Faculty of Science revealed considerable variability in total credit requirements. Joint Major programs and interdisciplinary programs by definition have the highest credit requirements, and this was felt to be appropriate. In addition, relatively high credit totals for the Chemistry department Majors are at least in part defined, and justified, by requirements for accreditation by external professional entities.

Despite these examples of particularly high credit requirements, however, the Major programs in most departments have lower credit requirements and thus allow students more flexibility in their programs. Students in a Major program can choose further courses in their discipline, thus increasing the depth of their program, but also typically have enough assigned credits to instead complete a 24 credit minor, increasing the breadth of their educational experience. Exceptions are three of the Biomedical Units (Anatomy and Cell Biology, Biochemistry, and Microbiology and Immunology) and Software Engineering. The committee recommends that, in the absence of a clear justification for a heavier credit load, these units/departments reduce their credit requirements to a maximum of 66, to maintain consistency across departments and to allow their Major program students this option.

3.6.3 Recommendation: Define a reasonable range of credits in Major programs (54-66)

The committee also considered the larger question of whether, even with these reductions, the credit requirements for Science Major programs remain unjustifiably large. For example, while heavy course requirements might be justified in a program that aims to prepare a student for graduate research, such as the existing Honours programs, what justifies a Major program with requirements of 18 to 20 courses or more? Is this a "reasonable" core of courses for a Major program? If not, should *everyone* in a Major program be *required* to take these courses, even students who may not have any desire to do graduate work and research? What if Science Major programs all required substantially fewer courses, perhaps as low as 13? Such a reduced requirement would, for example, allow students to complete two Majors within their 90 credit three-year program, and of course would not prevent Major students from taking additional courses in their discipline to satisfy their individual needs, such as preparation for graduate school or professional certification. *(Note from Faculty Review Group Chair: This point was raised by a member of the Major Programs Review Group. The new B.Sc. Liberal program proposed by the Faculty Program Review Group addresses this concern. The Department of Chemistry also points out that certain majors require substantial material and certain courses in order to be accredited.)*

Such a discussion centers around the issue of the number of courses that reasonably constitute a university Major, an admittedly difficult question to answer. As detailed above, our analysis identified Major programs within the Faculty of Science requiring as many as 70 credits or as few as 54 credits. While acknowledging the difficulty in specifying a standard number of credits suitable to all Major programs, the committee was generally in agreement that a 54-66 credit range provides an intensive training that is appropriate to a Major program. It was also felt, however, that students whose future goals do not require such an intense program should have access to a formal option that suits their needs.

3.6.4 Recommendation: Consider accreditation for Professional Statistician and Associate Statistician by the Statistical Society of Canada.

Finally, two specific recommendations, regarding accreditation by professional societies, arose from the analysis of the Major program in the Mathematics and Statistics department.

First, the Statistical Society of Canada (SSC) offers two levels of accreditation, the Professional Statistician (P.Stat.) and the Associate Statistician (A.Stat.). SSC is currently working on norms by which accreditation can be established via university programs. Once these norms have been finalized, McGill should ensure that its Statistics offerings will satisfy these standards and that interested students are aware of the courses required. In addition, the Society of Actuaries offers accreditation for actuaries through university courses (Validation through Educational Experience or VEE). The Department of Mathematics and Statistics recommends that steps be taken to help students interested in this area by: having McGill courses approved for the VEE, providing mentoring for students interested in actuarial science, and possibly introducing new courses in relevant areas.

4 Report on Faculty Programs

4.1 Preamble

The Faculty Program Review Group consists of the following members: Laurie Hendren (Asoociate Dean (Academic) and School of Computer Science), Chair; Louis Hermo, Department of Anatomy & Cell Biology; Don Francis, Department of Earth & Planetary Sciences; Christopher Barrett, Department of Chemistry; Bill Anderson, Department of Mathematics & Statistics; Jennifer Di Massimo, Staff; Department of Microbiology & Immunology; Tanya Skamene, Student; Department of Physiology.

The group had live meetings and also communicated via an online wiki. The report was compiled by the chair, with input from several group members. This program review group operated slightly differently from the others because unlike the Honours and Majors group, which had mostly positive reactions to the programs they were reviewing, the Faculty programs group was less enthusiastic about the existing Faculty programs. Thus, the review group decided early on that part of the review process would be the analysis of the problems with the existing programs and the design of a better replacement. This exercise thus led to the design of a replacement, called the Liberal programs, which was proposed and approved through the normal McGill approval process, with input from all of the departments. These new Liberal programs begin September 2007 and the Faculty programs will stop admitting new students after that time. Faculty programs will officially be closed as the final students in those programs graduate.

The report consists of the following sections: goals, an analysis of enrolment and graduation data, a summary of the Faculty programs and a discussion of the ways in which the Faculty program could be improved.

4.2 History and Goals of the Faculty Programs

The calendar states that the Faculty programs are meant to be "An approved coherent selection of courses giving students a useful concentration in a recognized area. Students in a Faculty program may choose a pattern of study that can range from one yielding a broad education to one specializing in particular areas."

It appears that the Faculty programs were first introduced in the late 1960s and early 1970s when the B.Sc. programs were reworked to adjust for the introduction of the CEGEP system. Apparently, they were intended to replace the old B.Sc. General degree, which required some depth and some breadth. Over the years, different Faculty programs have been introduced and others retired. The Psychology Faculty program was retired in 2006 (because it was almost equivalent to the Major program) and even before this report, the Mathematics&Computer Science plus the Mathematics, Statistics & Computer Science programs were slated for retirement (because there exists a solid Mathematics & Computer Science Joint Major program, and a Statistics & Computer Science Joint Major program has recently been approved).

The evolution of the Faculty Programs has created a heterogeneous mix. Some of the programs are effectively slightly smaller major programs (the four biomedical programs),

while others provided a broad overview of several disciplines (for example, the Math, Chemistry & Physics program). The original idea of "depth plus breadth" appears to have gotten a bit lost and is applied unevenly in the different programs.

4.3 Enrolment and Graduation Data

Table 15 gives the enrolment data for all of Faculty Programs, including the Psychology program, which has since been retired. The most striking point is that many of the Faculty programs had very small enrolments, with only the Biology and the four biomedical programs having a significant number of students. The program with the highest enrolment (and the highest relative enrolment as compared to the Major program of the same discipline) was in Anatomy and Cell Biology. The mathematics and physical sciences programs had very few students.

	Fall 2002			Fall 2003			Fall 2004				
Faculty Program	Full-Time	Part-Time	Total	Full-Time	Part-Time	Total	Full-Time	Part-Time	Total	%Faculty	%Total
Biology - FP	46	7	53	47	6	53	48		48	12.6%	1.5%
Biology & Mathematics - FP	10		10	9	2	11	12		12	3.2%	0.4%
Chemistry - FP	3		3	7		7	4		4	1.1%	0.1%
Chemistry & Biological Sci - FP	6		6	1		1	1		1	0.3%	0.0%
Chemistry & Mathematics - FP	1		1	2		2	4	1	5	1.3%	0.2%
Math & Computer Science - FP	4		4	2		2	1		1	0.3%	0.0%
Math, Chemistry & Physics - FP	6		6	2	1	3	3		3	0.8%	0.1%
Math, Stats & Computer Sci - FP	5	1	6	1		1	2		2	0.5%	0.1%
Physics - FP	5		5	2	1	3	1	1	2	0.5%	0.1%
Psychology - FP	13		13	17		17	15	3	18	4.7%	0.6%
Faculty Program Total (Science)	**99**	**8**	**107**	**90**	**10**	**100**	**91**	**5**	**96**	**25.3%**	**3.0%**
Anatomy and Cell Biology -FP	115	4	119	129	5	134	143	6	149	39.2%	4.6%
Biochemistry -FP	28	4	32	44	7	51	37	4	41	10.8%	1.3%
Microbiology & Immunology -FP	26	2	28	24	3	27	19	2	21	5.5%	0.7%
Physiology -FP	41	3	44	70	2	72	72	1	73	19.2%	2.3%
Faculty Program Total (Medicine)	**210**	**13**	**223**	**267**	**17**	**284**	**271**	**13**	**284**	**74.7%**	**8.8%**
Faculty Program Total	**309**	**21**	**330**	**357**	**27**	**384**	**362**	**18**	**380**	**100.0%**	**11.8%**

Table 15- Enrolment Data for Faculty Programs

Table 16 gives the graduation data, which follows much the same trends. The Biology and the four biomedical programs account for almost all of the graduates, with the other programs having only a handful of graduates each year.

Faculty Programs	2000	2001	2002	2003 # of Deg.	2003 GPA	2004 # of Deg.	2004 GPA	Sum of 2003 and 2004 % on Dean's Honor List	% of Faculty Prog.	% of Total Graduates	
Biology and Mathematics -FP	1			3	3.52	2	2.09	0.0%	1.7%	0.3%	
Biology -FP	18	28	32	26	3.29	32	3.26	12.1%	19.5%	3.6%	
Chemistry & Mathematics -FP			1	1	2.32	0		0.0%	0.3%	0.1%	
Chemistry & Biological Sci -FP			2	1	3.74	0		0.0%	0.3%	0.1%	
Chemistry -FP	1	4	6	4	2.70	4	3.54	12.5%	2.7%	0.5%	
Math, Chemistry & Physics -FP		2	2	0		1	3.47	0.0%	0.3%	0.1%	
Math & Computer Science -FP	1			0		1	2.49	0.0%	0.3%	0.1%	
Math, Stats & Computer Sci -FP	2	1	1	1	3.51	0		0.0%	0.3%	0.1%	
Physics -FP	4	2	2	1	2.32	2	3.59	0.0%	1.0%	0.2%	
Psychology -FP	5	13	7	1	3.20	4	3.17	20.0%	1.7%	0.3%	5.2%
Anatomy and Cell Biology -FP	20	36	49	34	3.05	50	3.33	8.3%	28.3%	5.2%	
Biochemistry -FP	13	15	11	18	3.01	19	2.80	5.4%	12.5%	2.3%	
Microbiology & Immunology -FP	15	20	11	19	3.26	12	3.25	6.5%	10.4%	1.9%	
Physiology -FP	19	19	19	32	3.19	29	3.31	6.6%	20.5%	3.7%	13.1%
TOTAL (Faculty Programs)	99	140	143	141	3.15	156	3.22	8.1%	100.0%	18.2%	

Table 16- Graduation Data for Faculty Programs

4.4 Summary of Programs

4.4.1 Biomedical Programs (Anatomy&Cell Biology, Biochemistry, Physiology and Microbiology&Immunology)

The four biomedical Faculty Programs accounted for a large majority of Faculty Program graduates. These four programs all follow a similar pattern. First, they are all defined as a smaller "Major" program as they contain a subset of the required and complementary courses of the Major programs. Second, they all include at least 9 credits of "upper-level" Science courses, which can be outside of the program's discipline.

These departments were asked for their evaluation of how well their Faculty programs were working and also to give preliminary feedback about the idea of the proposed B.Sc. Liberal program.

Biochemistry pointed out that only about 10% of their students choose the Faculty program over the Major or Honours programs, perhaps because it perceived as lacking the cachet of those programs. Often students choose the Faculty program so they can complete a minor in another area without needing to go over the 90 credit requirements or attending summer terms. The Biochemistry Faculty program is also used as an "escape hatch" for a small number of students who have great difficulty completing one or more required/complementary courses in the Major program.

Overall, the Biochemistry department was satisfied with their Faculty program and pointed out that any replacement should satisfy the same needs (i.e. allow students to complete a minor and serve students who need an escape hatch).

The Microbiology&Immunology department provided a similar analysis, but noted that about 20% of their students chose the Faculty program. They pointed out that the core courses are the same in both their Faculty and Major programs, and that many students appreciate the flexibility to add courses and minors to their program. In their opinion, any replacement to the Faculty programs should leave the option for students to create their own selection of extra courses, to accommodate diverse interests. This point was considered when designing the new B.Sc. Liberal program which includes a breadth option that allows students to create a "General Science Minor" with specific regulations to ensure both breadth and depth.

Although the Program Review Group did not directly get feedback from Physiology, the subsequent discussions about the B.Sc. Liberal program gave a similar picture. The Faculty program was ideal for students who wished to complete a minor and students were advised to consider a minor, rather than including a large number low-level elective courses. However, it was also pointed out that students did not always follow this advice.

The Anatomy&Cell Biology Faculty program attracts the largest proportion of students. The student representative on the Program Review Committee was asked to determine why so many students were choosing this option. She identified three reasons: 1) students wanted more electives in order to study a variety of other courses or to pursue minors; 2) students have heard that some courses in the major program are difficult and they don't feel that those courses enhance their overall understanding of Anatomy&Cell Biology; and 3) many courses in the program are offered only in alternate years, and so students already found it difficult to create a schedule that covers the courses required for the Faculty Program. This last point seems to be specific to Anatomy&Cell Biology. Some steps have been taken to offer key courses every year.

The overall opinion of these four units was that a program like the Faculty Program was useful and provided a good option for students who wished to diversify their studies. Any replacement for these programs should build upon this flexibility and allow for diverse program needs, while at the same time providing a quality program which would not be considered to be a "second-class" degree.

4.4.2 Biology Faculty Program

Of the other Faculty Programs, the Biology program is the most popular. It has the same number of program credits as the Major in Biology (54 or 55), but it contains fewer required and complementary Biology courses, and instead allows for 18 credits of Science courses outside of Biology. In total, the program has 15 credits of required Biology courses, 21-22 credits of complementary Biology courses and 18 credits of other Science courses.

Since the total number of credits of the Major and Faculty programs in Biology are the same, it is not the case that it is easier for a student in a Faculty program to complete a minor program. However, in the Faculty program a student can include a significant component of another discipline within the program requirements and if he/she likes can also do a minor in another area. Students who use this program wisely can make a very interesting program,

but the reduced number of required and complementary courses also means that a student may also include a lot of lower-level courses.

4.4.3 Mathematics, Computer Science and Physical Science and Psychology Faculty Programs

The remaining Faculty programs are not very popular and attract very few students. The Psychology Faculty Program was almost identical to the Major program and for that reason it was retired in 2006. The Mathematics&Computer Science program is effectively a slightly easier version of the Mathematics&Computer Science Joint Major and was slated for retirement. The Mathematics, Statistics&Computer Science Faculty Program has been made redundant by the recent introduction of Major and Honours programs in Statistics& Computer Science.

The Chemistry department participates in four joint Faculty Programs (FP in Chemistry (52), Chemistry and Biological Sciences (55), Chemistry and Mathematics (52), and Chemistry, Mathematics, and Physics (56). Over the past 5 years these 4 programs have attracted only 2-6 students per year, and traditionally many of these are students who are worried about being unable to complete a Major or Honours Program successfully, or have had difficulty passing a course in the Major Program. The CGPA of these students is frequently in the 2.0-3.0 range, and it is rare that any student in this program for the past 5 years has been considered by the Department to be one of the stronger students. The Faculty Program in Chemistry does not provide a background of suitable depth in the Chemical Sciences to be suitable for admission to Graduate Studies in Chemistry, whereas the Chemistry department strongly recommends either a Major or Honours to any students considering Graduate Study. For the cases of the Faculty Program in Chemistry (FPC) and Biology, FPC and Mathematics, and (especially) the FPC, Mathematics, and Physics all within 1 course of similar credit weighting, this background in the Chemical Sciences is further diluted, and the student is considered even less suited to Graduate School in any Chemistry-related field. The Chemistry Department could see no real long term advantage for any student in the Faculty program in Chemistry, when not combined with a full minor from another department.

The remaining Mathematics and Physics Faculty programs follow a similar trend. The only exception is the Mathematics and Biology program, which may be a useful combination to consider for a Joint Major, once the Faculty programs have been retired.

In short, the Faculty Programs in this group tend to attract a very small number of students and it is often the case that these are the weak students who are having trouble completing the Major program. In the design of the B.Sc. Liberal program, we have considered this and have designed the General Science minor is such a way as to smooth the transition for students who have started in a Major and then switched to a Liberal program.

4.5 Faculty Program Requirements

Table 17 summarizes the program requirements for the existing Faculty Programs. In the credits column both the total number of credits and the number of those credits that must be at the 300-level or above is given. Some Faculty Programs were found to have a hidden prerequisite of CHEM 212 (Organic Chemistry 1), so a final column in Table 17 gives the "real total". The real totals range between 51 and 59 credits. Note that some programs,

namely the Biology and the Mathematics, Chemistry and Physics programs require a minimum of only 12 credits at the 300-level or above. Since there are no restrictions on elective credits, this means that students in those programs can theoretically take all of their elective courses at the 100 and 200-level and can complete a 90-credit degree with only 12 credits at the 300-level or above.

	Credits		Required		Compl.		Hidden Prereqs	Real Total
	Total	300-level+	Total	300-level+	Total	300-level+		
Biology	54-55	12	15	0	39-40	12	CHEM 212	58-59
Biology and Mathematics	57	24	21	9	36	15	CHEM 212	61
Chemistry	52	24	31	15	21	9		52
Chemistry and Biological Sciences	55	18	49	18	6	0	CHEM 212	59
Chemistry and Mathematics	51-52	24	46	24	5-6	0		51-52
Mathematics and Computer Science	54	30	48	24	6	6		54
Mathematics, Statistics and Comp. Sci.	54	27	33	12	21	15		54
Mathematics, Chemistry and Physics	56	12	47	12	9	0		56
Physics	54	30	36	18	18	12		54
Anatomy and Cell Biology	57	21	36	0	21	21		57
Biochemistry	55	21	31	15	24	6	CHEM 212	59
Microbiology and Immunology	57	21	36	15	21	6		57
Physiology	55	21	34	15	21	6	CHEM 212	59

300-level+ is the mimimal number of credits at the 300-level or above required to complete the program.

Table 17- Breakdown of Required and Complementary Courses for all Faculty Programs

In order to study this potential problem in more detail, the data in Figure 3 shows how many credits at the 300-level or above were completed by students in the four most popular Faculty Programs (students graduating in June 2006). This shows that although many students chose to complete their programs with a reasonable number of electives at the 300-level or above (for example, those represented by the green regions correspond to students who completed more than 36 credits at the 300-level or above), there do exist students in the red regions (those who completed fewer than 24 credits at the 300-level or above). This is particularly evident for the Anatomy&Cell Biology Faculty Program, although there are some problem cases in the Biology Faculty Program as well.

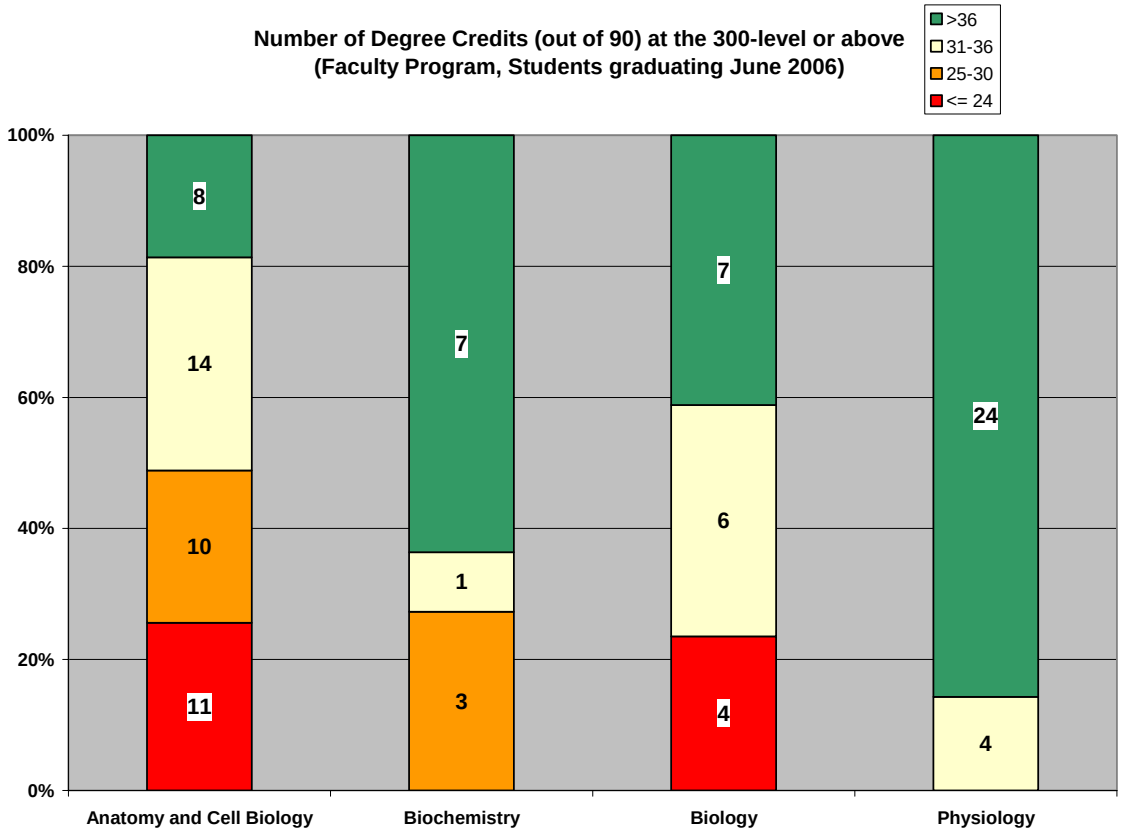


Figure 3- Distribution of upper-year courses for the four most popular Faculty Programs

Figure 4 shows two example students from the graduating cohort in June 2006. Student A completed 36 credits at the 300-level or above, with 12 credits from the Biology courses, 12 credits from the other science courses in his/her program and 12 credits of elective Arts courses. This student completed an Arts minor concentration. On the other hand, Student B really did the minimal amount of work required in his/her electives, with all 36 credits at the 100 or 200 level, and all of those courses would be considered as "general interest courses", not courses part of a minor or major program.

Biology Faculty (Student A)	100	200	300	400	500	Total
Biology Program Courses		21	12		3	36
Other Program Science Courses		6	12			18
Elective Science Courses	6					6
Elective Arts Courses		18	12			30
Total	6	45	36	0	3	90

Biology Faculty (Student B)	100	200	300	400	500	Total
Biology Program Courses		18	15	3		36
Other Program Science Courses		12	6			18
Elective Science Courses	6	12				18
Elective Arts Courses		18				18
Total	6	60	21	3	0	90

Figure 4 - Example Students

4.6 Highlights of the new B.Sc. Liberal Program

As indicated in the introductory part of this program review, one of the tasks of the Review Group for Faculty Programs was to think of a better alternative for the Faculty Programs. The idea was to keep the good aspects of the Faculty Programs, but also to create something that was more consistent over all of the units and that embodied the idea of depth plus breadth. The goal was to create a program that was different from, but equally valid to, the Major and Honours programs. We were also inspired by the recent success of the B.A.&Sc. degree, which shows that students appreciate the option of being able to combine two quite different disciplines in their degree.

The key design decision for the B.Sc. Liberal programs was that it would consist of two pieces, a Core Science Component (CSC) of 45-50 credits and a Breadth Component of at least 18 credits. This gives an overall program requirement of 63-68 credits, in the same range as a Joint Major. This makes the overall degree as rigorous as the other programs.

The CSC embodies the core material of each discipline, and each department has defined at least one CSC. For the four biomedical units this corresponds reasonably well to the old Faculty Programs, but without the extra general Science complementary courses. They contain the same core material. The Biology CSC keeps the same spirit as being a bit more flexible than the Biology Majors program, allowing up to 9 credits in a biologically-related area. In addition, the requirements for complementary courses was made more rigorous, allowing at most 6 credits at the 200-level. Chemistry has introduced three CSCs, a general option, a biological option and a physical option. In each case the key core courses are included. All of the other units have introduced one CSC per department and each case the core material is included. Thus there is now a uniform structure over all of the departments.

The breadth component of the B.Sc. Liberal is meant to allow a student a way of broadening their studies in a structured manner. The breadth component can be satisfied by completing one of the many minor program available to Science students. This includes minors in other Science areas, Arts minor concentrations, Management minors (including the newly introduced minors in Finance and Marketing), the minor in Education for Science students, the Technological Entrepreneurship minor and so on. All of these minors already existed, but no B.Sc. program previously required any of them.

In addition, we have introduced two new minors which can also be used to satisfy the breadth requirement. The *Field Studies Minor* includes 15 credits from a field study semester (there are currently three of these: African, Barbados and Panama), plus an additional 3-credit complementary course. The *General Science Minor* was created based on the feedback we received in the review process. It was important that we left open the opportunity for students to create their own breadth program and also to provide a smooth transition for students who wished to switch from a Major program. Our intent was to ensure that the student got at least some breadth and some depth. Thus, at least some of the minor must be in a discipline different from the CSC, and at least some of the minor must be composed of upper-level courses. After considerable discussion, we arrived at the following rule: "all credits must be from courses at the 200-level or above, and must include either (i) at least 9 credits at the 300-level or above and at least 9 credits outside of the CSC area; or (ii) at least 12 credits at the 300-level or above, and at least 6 credits outside of the CRC area." The first option is most suitable for students who are creating their own specialized minor, whereas the second option is more suitable for a student who is switching from a Major program and who may already have completed extra credits in their CSC area.

For students who prefer a larger second program, the breadth component requirements can also be satisfied with an Arts major concentration (36 credits) or a second CSC. In the case of a second CSC, at least 24 credits must be distinct from the primary CSC.

The B.Sc. Liberal programs will be offered for the first time in September 2007. Initial feedback from Student Affairs Office advisors and some departmental advisors is that students appreciate having this option available. It will be interesting to track the enrolment in these programs and to see if they become a bit more popular than the Faculty programs in the non-biomedical areas or not.

It may also be interesting to reconsider the biomedical major concentration which is offered as part of the B.A.&Sc. degree. This is a 36 credit major concentration that covers mostly the introductory courses of the four biomedical areas. Students in this program often are disappointed that they do not progress to very many higher level courses. Thus, it might be interesting to retire that major concentration and direct students interested in interdisciplinary studies with biomedical twist to the B.Sc. Liberal program. In the B.Sc. Liberal program they could choose one of the four biomedical CSCs and then broaden their studies with Arts, Management or other Sciences.

5 The Three I's

All of the program review groups at McGill were asked to address the "three I's", Internationality, Interdisciplinarity and Inquiry-based Learning.

5.1 Internationality

The Faculty of Science contributes to McGill's goal of creating an international environment within its community. Students from around the world are part of the Faculty community and Science students also pursue their studies around the world through Field Studies programs offered in such geographically and culturally diverse locations as Panama, Barbados and in East Africa in Kenya and Tanzania.

Students who enroll in off-campus courses are exposed to Canada's Maritime coast, the Badlands region of Western Canada and natural regions within the province of Quebec. Many students take advantage of the Conférence des recteurs et principaux des universités du Québec [CRÉPUQ] tuition exchange agreement and take three to six credits in a term at another university or take a full term at another university in the province. The Faculty also encourages students to expand their education beyond McGill with one to two term exchanges organized with its 27 bilateral partners in countries ranging from Australia to Turkey as well as institutions across North America. Students are also able to design their own study away programs at degree-granting institution of their choice with the permission of the Student Affairs Office.

5.1.1 Science Office for Global Opportunities

The Faculty of Science has recently launched a new Office for Global Opportunities which will serve as a central resource for the undergraduate Field Study Semesters (FSS) administered by Science (Africa, Panama) and Agricultural and Environmental Sciences (Barbados). The FSS are presently run out of many different offices, from Biology to the MSE to the Faculty of Science Dean's area; consolidation will streamline operations and allow for better sharing of best-practices.

SOGO will also administer Science's expanding internship programs. These internships - branded up till now as the Internship Year in Engineering and Science (8, 12, or 16 months) and the Industrial Practicum (4 months) - were previously run in conjunction with Engineering until Engineering withdrew from this partnership. Martine Dolmière is the new Global Opportunities Officer. She brings with her experience as an international student advisor in International Student Services.

5.1.2 International Research

Faculty of Science professors engage in a wide variety of international research. Some research is aimed explicitly at global problems including environmental studies, animal diversity, weather patterns, global waterways and related areas. Many other research groups participate in international teams that are studying problems of common interest and sharing

international facilities. This spirit of being part of the international research community is conveyed to the undergraduate students.

5.1.3 International Admissions

The Faculty of Science attracts a very diverse applicant pool. Figure 5 shows the breakdown of the country of birth for confirmed applicants (i.e. those who confirmed acceptance of an admission offer) for the total applicant pool of Fall 2004, 2005 and 2006. The largest pools are from Canada (51%) and the USA (9.5%). However, 75 other countries are also represented, accounting for 39.5% of the total. It is also interesting to note the different female/male ratios for these three pools. For Canada the ratio is 1.42 females per male, whereas the ratio for USA is 1.05 and for other countries 1.24. It is unclear if this difference might be because different applicant pools tend apply to different majors or not. (Figure 1 showed that the life and biomedical sciences had a higher proportion of female students, whereas the physical, mathematical and computations sciences had a lower proportion.).

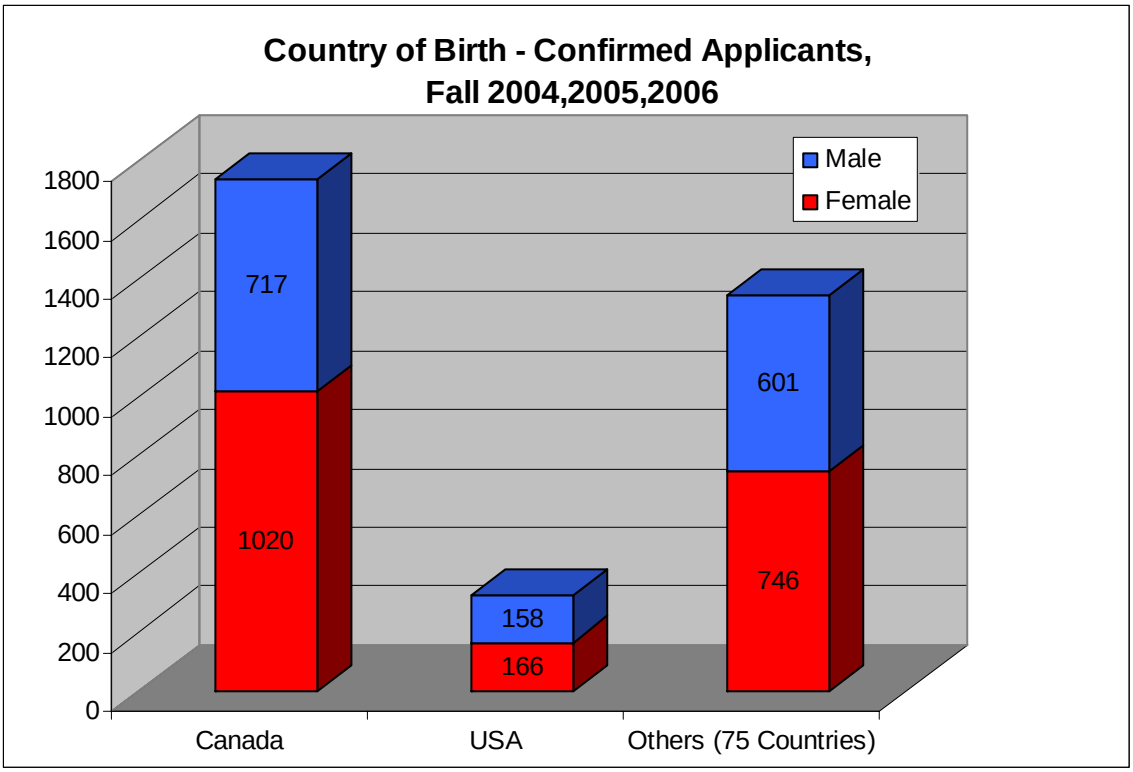


Figure 5- Confirmed Applicants Overview

Figure 6 gives the breakdown of confirmed applicants for all countries contributing a total of at least 10 applicants over the Fall 2004, Fall 2005 and Fall 2006 time periods. The next three highest pools are China, South Korea and France, followed by a wide variety of countries from around the world.

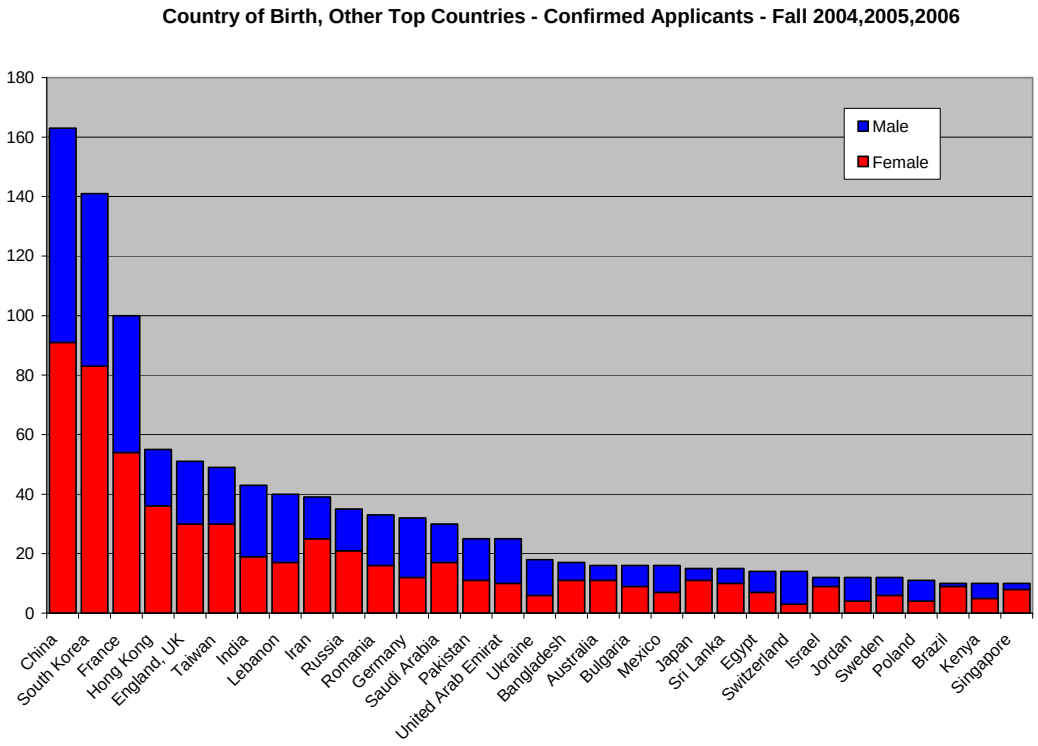


Figure 6- Confirmed Applicants - Other top Countries

5.1.4 Mother Tongue of Confirmed Applicants

Another way of looking at the diversity of our confirmed applicants is to consider their mother tongue. As all Science courses are presented in English, there may be special challenges for students whose mother tongue is not English. Figure 7 shows the breakdown by English, French and other. 57% of the confirmed applicants speak English as their first language, 14% French and 29% other.

With such a large fraction of the student body studying in their second (or third) language, care must be taken for appropriate support of these students, particularly in their first terms at McGill.

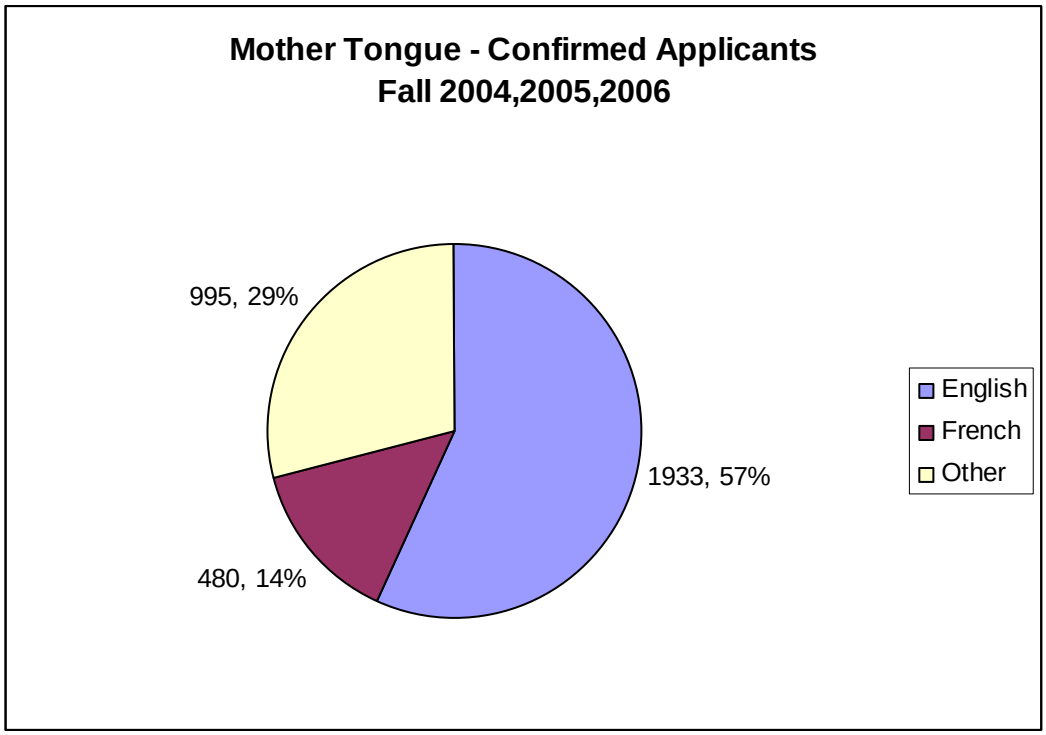


Figure 7- Breakdown of confirmed applicants by mother tongue

5.2 Interdisciplinarity in Programs

As already outlined in this document, the Faculty of Science supports interdisciplinarity through numerous joint Majors and joint Honours programs, plus interdisciplinary programs such as the Environment major, the Earth System Science major and the Neuroscience major (currently in the approval process). The newly implemented B.Sc. Liberal programs, replacing the old Faculty programs, introduce a new modular mechanism for students to combine core Science studies with breadth from a wide range of other disciplines, including Arts, other Sciences, Management and Education.

5.3 Inquiry-based and Interdisciplinary learning

One of the strengths of the Faculty of Science is its long-standing tradition of combining excellence in research with excellence in teaching – the teacher-scholar model. Over the last 2 years, the Faculty of Science has introduced further initiatives to share our research excellence with our undergraduates.

5.3.1 OURS: Office for Undergraduate Research in Science

``[T]he creation of a network of undergraduate research offices in our Faculties" is one of the goals of the White Paper (actions II.2.1). Science is the only faculty to date to have created a dedicated Office for Undergraduate Research. This has allowed Science to advance on several projects, including a new series of undergraduate research project courses, an annual undergraduate research conference, and the Soup and Science lunchtime series (all of which are described below). OURS has given new prominence to undergraduate research, providing

students with a resource for questions about how to get involved. Victor Chisholm is OURS' Undergraduate Research Officer.

5.3.1.1 SURAs: Science Undergraduate Research Awards

Science Undergraduate Research Awards (SURAs) are meant to stimulate interest in science research, and the pursuit of research careers in these fields. Recipients engage in a research and development activity under the supervision of a professor holding grant funding. It is an opportunity to gain research experience in an academic setting, while receiving financial support. SURAs are for 16 weeks of full-time research. For 2007, there will be 16 awards, each valued at $5600 minimum.

SURAs are similar to NSERC USRAs, with the important distinction that SURAs are open to all students, Canadian and International, registered in a McGill undergraduate science program. They require a matching contribution from a research supervisor.

5.3.1.2 Undergraduate "396" research project courses

Each year, hundreds of science students register in various research project courses, from independent studies to majors and honours projects. Registration in research project courses in Science is up by 24% from 323 in Fall 2005 to 402 students in Fall 2006. Many of these, however, are restricted to upper-year students, or are not open to students from other departments.

To address this, the Faculty of Science introduced a new series of flexible 3-credit research project courses that can be taken by students after as little as one semester of study at McGill, and both inside and outside their own department. The 396 courses (BIOL 396, CHEM 396, MIMM 396, etc.) are elective courses, taken outside of the main programs.

5.3.1.3 Dean's Multi-disciplinary Undergraduate Research List (DMURL)

In order encourage students to try research in more than one area, the Faculty of Science has recently introduced a new designation, the Dean's Multi-disciplinary Undergraduate Research List (DMURL), granted to students who have completed at least 9 credits of undergraduate research, spanning at least two areas. The first recipients of this designation graduate in May 2007.

5.3.1.4 Undergraduate Research Conference

In 2005, the Faculty of Science inaugurated an annual Undergraduate Research Conference during Homecoming. The URC provides 60--70 students the opportunity to present their research posters to panels of McGill judges, and compete for prizes. The URC highlights some of our best undergraduate projects to the McGill community of students, faculty members, and alumni. The third annual conference, to be held Friday, October 19, 2007, will remain a science Undergraduate Research Conference, but we will also invite social science students in Arts, and Macdonald Campus students. The Faculty of Science (capital S) is determined to show that science (small s) crosses faculty lines. The URC also includes a special guest lecturer: in 2005, Nobel laureate Leon M. Lederman; in 2006, Science alumnus and Nobel laureate Rudolph A. Marcus; and in 2007, McGill alumnus Steven Pinker.

McGill will host this year's Universitas 21 undergraduate research conference. It will overlap with and take place immediately following the Science URC, i.e., October 19-23, 2007. OURS will coordinate the academic conference component (oral presentations) of the project (which will also involve cultural visits and other aspects). The U21 URC team is led by Prof. Ian Butler.

5.3.1.5 Soup and Science

In order to give undergraduates a taste of the breadth of scientific inquiry that takes place here -both inside and outside their departments-, Science instituted *Soup and Science* in January 2006. At the start of each fall and winter term, every day for one week, 5 to 6 different professors talk about their research, each for only 3 minutes. The roster of participating professors changes daily. The short duration of the talks ensures that students get a condensed and tantalizing sample of topics that they did not know about. The talks are followed by free lunch, where students have a chance to talk more with the professors. It is a success, with up to 120 students showing up each day for food for the mind and body. The Faculty of Arts will introduce a parallel series in Fall 2007, to take place the week after *Soup and Science*, to introduce students to interdisciplinary approaches to hot topics in that Faculty.

5.3.1.6 Science Writing Workshops and Courses

The Faculty of Science hired Linda Cooper as a Faculty Lecturer who specializes in teaching Science writing. Starting in May 2007 she is offering writing workshops for students engaged in summer research projects and beginning in Fall 2007 she is offering a new course, REDM 399 – Science Writing, a 1-credit course intended to complement their work in an undergraduate research course.

5.3.2 Student-led initiatives

5.3.2.1 mSURJ: the McGill Science Undergraduate Research Journal

mSURJ - created by students for students, and first published in 2006 - is extremely significant for science at McGill. Prior to mSURJ, there was no undergraduate science journal at McGill. mSURJ gives undergraduate researchers the opportunity to refine their ideas through a rigourous peer-review process, the means to develop writing and editing skills, and a place to publish their findings. The process of research is not finished until findings are written down and communicated to others. If a tree falls in the forest, and there is no one around to hear it, does it make any sound? Research without communication is a fallen and unheard tree--yet it is not always apparent in the undergraduate experience that results and findings must be communicated and shared. mSURJ has created a way for this to happen. mSURJ promotes scientific communication and the value of knowledge dissemination to the whole undergraduate science community. The Faculty of Science has been pleased to lend substantial financial and administrative support to this endeavor.

5.3.3 Increased Enrolment in Undergraduate Research Courses

There has been a long-standing commitment to undergraduate research in the Faculty of Science and a long history of involving students in undergraduate research, particularly in the Honours programs. However, it is interesting to try and measure the impact of the recent initiatives that were intended to further build upon previous strengths. Based on a new custom report developed for tracking DMURL recipients we recently discovered that it is not

only the Honours students who are participating in undergraduate research. We were very pleased to find that around 55% of the students graduating in May 2007 had completed at least one of the approved undergraduate research courses in Science. Table 18 summarizes the enrolment in research courses over the last three academic years. There is significant increase in the enrolment in research courses, with a 22% increase in Fall 2006 versus Fall 2004, a 141% increase in Summer 2006 versus Summer 2005 and a 38% increase in Winter 2007 versus Winter 2005. Most of the increase in the summer term came from the introduction of the new 396 research courses. For the Fall and Winter terms, 20-30% of the increase was due to the new 396 courses and the remaining part of the increase was increased enrolment in existing research courses.

Term	Enrolment in ALL research courses	Change vs 1 year ago	Change vs 2 years ago	% change vs 1 year ago	% change vs 2 years ago
Fall 2004	329	n/a	n/a	n/a	n/a
Fall 2005	323	-6	n/a	-1.82%	n/a
Fall 2006	402	79	73	24.46%	22.19%
Summer 2005	29	n/a	n/a	n/a	n/a
Summer 2006	70	41	n/a	141.38%	n/a
Winter 2005	302	n/a	n/a	n/a	n/a
Winter 2006	358	56	n/a	18.54%	n/a
Winter 2007	417	59	115	16.48%	38.08%

Notes:
Enrolment data are from a custom report from ARR showing registration on a term by term basis in the courses approved for the Faculty of Science's Dean's Multidisciplinary Undergraduate Research List.

Table 18 - Enrolment Increase in Undergraduate Research Courses

5.3.4 The next step – undergraduate labs for research-based learning

In the previous sections we have outlined a wide variety of initiatives aimed at fostering undergraduate research in the Faculty of Science. In addition to the buzz of excitement about undergraduate research, coming from both the students and the faculty, the enrolment numbers showed that undergraduate research is on the rise and more than half the B.Sc. graduating students have participated in at least one undergraduate research course. The next step is the renovation of the undergraduate labs, in accord with research-based teaching. We have estimated the costs for renovation of our undergraduate labs at $8.1M +/- 0.5M. We have a detailed estimate which is available upon request, prepared by comparing our facilities to others in Canada, particularly to those at Queen's University and the University of Toronto. We propose to fund this over a period of five years, at $1.62M per year, through the following formula: 50% philanthropy, 40% central, 10% Faculty.

We will also need more and better trained teaching techs for these new inquiry-driven labs, and as these labs will involve heavy involvement of graduate students, we will require further funds for paying teaching assistants. There is a real cost to doing inquiry-based learning, but it is money well spent. To show we are serious about this --- and it appears everywhere in our recent strategic plans --- we have to allocate resources and start doing it.

6 Conclusions and Outcomes

In this document we have provided an overview of the Faculty of Science undergraduate programs, summarized the program reviews for the three program review groups (the Honours, Majors, and Faculty Programs) and discussed the three "I"s .

The reviews of the Honours and Majors programs found that the programs were well-defined overall and were serving the purposes for which they were intended. The Honours programs were particularly well suited for students preparing for graduate studies and the Majors programs provided a solid foundation as well. Some small recommendations were made which are listed in Section 2.7 for the Honours program and Section 3.6 for the Majors program. These recommendations will be revisited during the 2007-2008 academic year and will be brought to the Academic Committee and departments for consideration.

The review of the Faculty program was mixed. Several departments found many positive features of the program. In particular, the ability for students to add minors and courses for breadth, was often cited as a positive aspect of the Faculty programs. On the other hand, there were some weaknesses. The enrolments in Faculty programs were very uneven, with very low enrolment in all except for the Biology and Biomedical programs. Further, the purpose and structure of the Faculty programs was widely varying, having evolved over time. Finally, the low number of requirements in the program allowed some students to complete a degree that lacked a significant focus and appropriate number of upper-level courses. The Faculty Program review group also considered how to replace the Faculty Programs with a better defined and more modular program. Based on feedback from the departments the B.Sc. Liberal program was created and this replaces the Faculty Programs starting in September 2007. The hallmark of the new B.Sc. Liberal programs is depth plus breadth, implemented as a Core Science Component plus a Breadth Component.

Finally, we looked at the three "I"s, Internationality, Interdisciplinarity and Inquiry-based Learning, in the Faculty of Science. The study of the international nature of the undergraduate pool of students showed some interesting trends. It would be very helpful to have enrolment management tools that would help to further analyze these trends and to follow the success of these different applicant pools. The recent initiatives for supporting interdisciplinarity and inquiry-based learning were outlined and some initial data showing the impact of those initiatives, in terms of increased enrolment in undergraduate research courses, was given. The next big initiative will be the renovation of undergraduate labs and the development of course material to support inquiry-driven learning.