



<p>1.0 Degree Title Please specify the two degrees for concurrent degree programs</p> <p><input type="text" value="Bachelor of Science (B.Sc.)"/></p> <p>1.1 Major (Legacy= Subject) (30-char. max.)</p> <p><input type="text" value="Quantitative Biology"/></p> <p>1.2 Concentration (Legacy = Concentration/Option) If applicable to Majors only (30 char. max.)</p> <p><input type="text"/></p> <p>1.3 Minor (with Concentration, if Applicable) (30 char. max.)</p> <p><input type="text"/></p>	<p>2.0 Administering Faculty/Unit</p> <p><input type="text" value="Science"/></p> <p>Offering Faculty/Department</p> <p><input type="text" value="Science/Biology"/></p> <p>3.0 Effective Term of Implementation (Ex. Sept. 2004 = 200409) Term</p> <p><input type="text" value="201109"/></p>
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4.0 Rationale for new proposal

Interdisciplinary research that draws from the natural and physical sciences is rapidly becoming the standard at the world's best universities and research institutes. The Quantitative Biology (QB) program will attract students with a deep interest in modern biology, who wish to gain a strong grounding in physical sciences and their application to biological questions. In the program, students will learn these skills from many other departments including chemistry, computer sciences, mathematics and physics (see addendum, 4.0).

5.0 Program Information
Please check appropriate box(es)

<p>5.1 Program Type</p> <p><input checked="" type="checkbox"/> Bachelor's Program</p> <p><input type="checkbox"/> Master's</p> <p><input type="checkbox"/> M.Sc. (Applied) Program</p> <p><input type="checkbox"/> Dual Degree/Concurrent Program</p> <p><input type="checkbox"/> Certificate</p> <p><input type="checkbox"/> Diploma</p> <p>Graduate Certificate</p> <p>Graduate Diploma</p> <p>Ph.D. Program</p> <p>Doctorate Program (Other than Ph.D.)</p> <p>Private Program</p> <p>Off-Campus Program</p> <p>Distance Education Program (By Correspondence)</p> <p>Other (Please specify)</p>	<p>5.2 Category</p> <p><input type="checkbox"/> Faculty Program (FP)</p> <p><input checked="" type="checkbox"/> Major</p> <p><input type="checkbox"/> Joint Major</p> <p><input type="checkbox"/> Major Concentration (CON)</p> <p><input type="checkbox"/> Minor</p> <p><input type="checkbox"/> Minor Concentration (CON)</p> <p>Honours (HON)</p> <p>Joint Honours Component (HC)</p> <p>Internship/Co-op</p> <p>Thesis (T)</p> <p>Non-Thesis (N)</p> <p>Other</p> <p>Please specify</p> <p><input type="text"/></p>	<p>5.3 Level</p> <p><input checked="" type="checkbox"/> Undergraduate</p> <p><input type="checkbox"/> Dentistry/Law/Medicine</p> <p><input type="checkbox"/> Continuing Ed (Non-Credit)</p> <p><input type="checkbox"/> Collegial</p> <p><input type="checkbox"/> Masters & Grad Dips & Certs</p> <p><input type="checkbox"/> Doctorate</p> <p>Post-Graduate Medicine/Dentistry</p> <p>Graduate Qualifying</p> <p>Postdoctoral Fellows</p>
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6.0 Total Credits

7.0 Consultation with Related Units Yes No

Financial Consult Yes No

Attach list of consultations.

8.0 Program Description (Maximum 150 words)

Interdisciplinary research that draws from the natural and physical sciences is an important aspect of modern biology. The Quantitative Biology program is designed for students with a deep interest in biology who wish to gain a strong grounding in physical sciences and their application to biological questions. The program has two options; an ecology and evolutionary biology stream and a physical biology stream. Both streams provide a balance of theory and experimental components.

9.0 List of proposed program for the New Program/Major or Minor/Concentration.

If new concentration (option) of existing Major/Minor (program), please attach a program layout (list of all courses) of existing Major/Minor.

Proposed program (list courses as follows: Subj Code/Crse Num, Title, Credit weight under the headings of: Required Courses, Complementary Courses, Elective Courses)

See Addendum

4.0 Rationale (continued)

The proposed QB program has minimal overlap with the joint major in PHGY-PHYS or PHGY-MATH (Math and Physics consultations) and is complementary to the existing joint majors in Biology (CS-BIO and BIO-MATH). The CS-BIO and BIO-MATH programs give equal weight to their component disciplines, and provide the student with a Joint Major. The QB program will provide students with a Biology degree, as the program's focus is on biological systems- from ecosystems to single molecules. A significant experimental component in both natural and physical sciences is provided in the QB Physical Biology stream.

In general, the QB program provides a critical balance of both breadth and depth. Breadth in physical science courses (30+ credits in CHEM, COMP, MATH or PHYS courses 200-level or higher) provides the required quantitative skills, and depth through 500-level biology courses (6 credits), independent study (3 credits) and the QB seminar courses BIOL 395 and 495 (2 credits) will ensure that students can apply quantitative methods to important problems in biology. Discussion and analysis of a diverse set of topics ranging from theoretical ecology and evolution, to biophysics, to computational biology will be provided to U2 and U3 students through the BIOL 395 and 495 seminar series. BIOL 395 and 495 will run concomitantly, with all U2 and U3 students attending the same seminar series but with the U3 students giving presentations. Enrollment is restricted to U2, U3 students in the Quantitative Biology program, joint CS-BIOL and joint BIOL-MATH programs, and joint PHGY-PHYS, PHGY-MATH programs. This seminar series will provide a means for students in these complementary programs to develop a scientific cohort, and will promote integration between students and faculty. A unique framework for advising, based in a committee of stream advisors from all the participating departments, will advise students in their course selections and help them to successfully navigate through this challenging program.

The QB program is expected to produce students who are exceptionally trained for graduate studies in ecology and evolutionary biology, biophysics, biochemistry, biomedical sciences, medicine, patent law, and the biotechnology sector.

Advising notes for U0 students

It is highly recommended that freshman BIOL, CHEM, MATH, and PHYS courses be selected with an advisor to ensure they meet the core requirements of the Quantitative Biology program.

This program is recommended for U1 students achieving a CGPA of 3.2 or better; and entering CEGEP students with a Math/Science R-score of 28.0 or better.

Major Program in Quantitative Biology (70-71 credits)

Quantitative Biology Program Core Requirements (38-42 credits)

Biology (20 credits):

BIOL 200 (3)	Molecular biology
BIOL 201 (3)	Cell biology and metabolism
BIOL 202 (3)	Basic genetics
BIOL 205 (3)	Biology of organisms
BIOL 215 (3)	Introduction to ecology and evolution
BIOL 466 (3)	Independent Study Project
*BIOL 395 (1)	Quantitative Biology seminar I
*BIOL 495 (1)	Quantitative Biology seminar II

*see new course and revised course proposal

Chemistry (4 credits)

CHEM 212* (4) Introductory organic chemistry

*Students who have taken the equivalent of CHEM 212 can make up the credits with a complementary CHEM course in consultation with a stream advisor.

Computer Science (6 Credits)

COMP 202* (3) Introduction to computing
COMP 250 (3) Introduction to computer science

*Students who have taken COMP 202 or have sufficient programming experience can make up the credits with a complementary COMP course in consultation with a stream advisor. We strongly recommend COMP 364.

Math (9 credits)

MATH 222 (3) Calculus 3 (*not required for students who have taken MATH 150 and MATH 151*)
MATH 223 (3) Linear algebra
MATH 315 (3) Ordinary differential equations

Physics (3 credits)

PHYS 230 (3) Dynamics of Simple Systems

Stream 1: Theoretical ecology and evolutionary biology (21 credits)

Biology Required Courses (9 credits)

BIOL 206 (3) Methods in Biology of Organisms
BIOL 304 (3) Evolution
BIOL 308 (3) Ecological Dynamics

Biology Complementary Courses

Field Courses (3 credits from the following list or any other field course with permission):

BIOL 240	(3)	Monteregian Flora
BIOL 331	(3)	Ecology/Behaviour field course
BIOL 334	(3)	Applied Tropical Ecology
BIOL 432	(3)	Limnology

9 credits chosen from the following list, of which 6 credits must be at the 400-level or above:

BIOL 310	(3)	Biodiversity and ecosystems
BIOL 373	(3)	Biometry
BIOL 324	(3)	Ecological Genetics
BIOL 434	(3)	Theoretical Ecology
BIOL 435	(3)	Natural Selection
BIOL 590	(3)	Linking Community and Ecosystem Ecology
BIOL 594	(3)	Evolutionary Ecology

Stream 2: Physical biology (20-21 credits)

Required courses; 8 - 9 credits:

BIOL 301	(4)	Cell and Molecular Biology Lab
CHEM 223	(2)	Physical Chem I
PHYS 232	(3)	Heat and Waves
or PHYS 242*	(2)	Electricity and Magnetism

*required for PHYS 342 and PHYS 434

Biology Complementary Courses

6 credits from the following list:

BIOL 309	(3)	Mathematical models in biology
BIOL 300	(3)	Molecular biology of the gene
BIOL 303	(3)	Developmental biology
BIOL 306	(3)	Neural basis of behavior
BIOL 313	(3)	Cell biology
PHYS 319	(3)	Biophysics

6 credits from the following list:

BIOL 518	(3)	Advanced topics in cell biology
BIOL 520	(3)	Gene activity in development
BIOL 524	(3)	Topics in molecular biology
BIOL 530	(3)	Advances in neuroethology
BIOL 551	(3)	Cell cycle control
BIOL 588	(3)	Advances in Molecular/Cellular Neurobiology

Common Complementary Courses; streams 1 and 2

At least 9 credits from the following courses

Recommendations for either Eco-Evo or Physical streams

CHEM 365	(2)	Statistical Thermodynamics
or PHYS 333	(3)	Thermal and statistical physics
COMP-206	(3)	Introduction to software systems
COMP 251	(3)	data structures and algorithms
COMP-350	(3)	Numerical computing
or MATH 317	(3)	Numerical analysis
COMP 364	(3)	Computer tools for life scientists *see revised course proposal
MATH 314	(3)	Advanced Calculus
MATH 319	(3)	Partial Differential Equations
MATH 327	(3)	Matrix numerical analysis
MATH 323	(3)	Probability
MATH 326	(3)	Nonlinear Dynamics and Chaos
MATH 348	(3)	Topics in geometry
MATH 437	(3)	Mathematical Methods in Biology
MATH 447	(3)	Stochastic Processes

Recommendations for Physical stream

CHEM 222	(4)	Organic chemistry II
CHEM 243	(2)	Physical Chem 2
CHEM 253	(1)	Physical Chem 2 Laboratory
CHEM 345	(3)	Molecular properties and structure I
CHEM 355	(3)	Molecular properties and structure II
CHEM 514	(3)	Biophysical chemistry
PHYS 342	(3)	EM waves
PHYS 434	(3)	Optics
PHYS 534	(3)	Nanotechnology

Recommendations for Eco-Evo stream

MATH 204	(3)	Principles of Statistics 2
MATH 242	(3)	Analysis 1
MATH 324	(3)	Statistics
MATH 340	(3)	Discrete Structures 2
MATH 423	(3)	Regression and Analysis of Variance
MATH 524	(4)	Nonparametric Statistics
MATH 525	(4)	Sampling Theory and Applications

10.0 Approvals			
Routing Sequence	Name	Signature	Date
Department	<input type="text"/>	<input type="text"/>	<input type="text"/>
Curric/Acad Committee	<input type="text"/>	<input type="text"/>	<input type="text"/>
Faculty 1	<input type="text"/>	<input type="text"/>	<input type="text"/>
Faculty 2	<input type="text"/>	<input type="text"/>	<input type="text"/>
Faculty 3	<input type="text"/>	<input type="text"/>	<input type="text"/>
SCTP	<input type="text"/>	<input type="text"/>	<input type="text"/>
GS	<input type="text"/>	<input type="text"/>	<input type="text"/>
APPC	<input type="text"/>	<input type="text"/>	<input type="text"/>
Senate	<input type="text"/>	<input type="text"/>	<input type="text"/>
Submitted by			
Name	<input type="text"/>	To be completed by ARR:	
Phone	<input type="text"/>	CIP Code	
Email	<input type="text"/>		
Submission Date	<input type="text"/>		

Quantitative Biology stream advisors

Biology: F. Guichard, J Vogel

Chemistry: TBN

Math: A. Hundemer

Physics: P. Francois

SOCS: D. Ruths, J. Waldispuhl

Participating faculty

Biology: Gary Brouhard, Thomas Bureau, Gregor Fussman, Fred Guichard, Paul Harrision, Michel Loreau, Claire Mazancourt, Jackie Vogel

Chemistry: Gonzalo Cosa, Anthony Mittermaier, Paul Wiseman

SOCS: Matthieu Blanchette, Michael Hallet, Derek Ruths, Jerome Waldispuhl

Mathematics and Statistics: Rustum Choksi, Anthony Humphries, Axel Hundemer

Physics: Paul Francois, Martin Grant, Peter Grutter, Walter Reisner