### New Program/Major or Minor/Concentration Proposal Form

**1.0 Degree Title**
Please specify the two degrees for concurrent degree programs

- B.Sc.

**1.1 Major (Legacy = Subject) (30-char. max.)**

- Joint Major in Biology and Mathematics

**1.2 Concentration (Legacy = Concentration/Option)
If applicable to Majors only (30 char. max.)**

**1.3 Minor (with Concentration, if Applicable) (30 char. max.)**

**2.0 Administering Faculty/Unit**

- Science

**2.1 Offering Faculty/Department**

- Biology; Mathematics

**3.0 Effective Term of Implementation**

- (Ex. Sept. 2004 = 200409)

  - Term: 200901

**4.0 Rationale for new proposal**

This program is proposed to replace the previously existing faculty program in Biology and Mathematics, to train undergraduate students in both mathematics and biology. It will increase the visibility of the math-biology interface that opens many prospects for students, and will train the next generation of graduates to have the necessary quantitative skills to undertake theoretical research.

**5.0 Program Information**

Please check appropriate box(es)

**5.1 Program Type**

- Bachelor's Program
- Master's
- M.Sc. (Applied) Program
- Dual Degree/Concurrent Program
- Certificate
- Diploma
- Graduate Certificate
- Graduate Diploma
- Ph.D. Program
- Doctorate Program (Other than Ph.D.)
- Private Program
- Off-Campus Program
- Distance Education Program (By Correspondence)
- Other (Please specify)

**5.2 Category**

- Faculty Program (FP)
- Major
- Joint Major
- Major Concentration (CON)
- Minor
- Minor Concentration (CON)
- Honours (HON)
- Joint Honours Component (HC)
- Internship/Co-op
- Thesis (T)
- Non-Thesis (N)
- Other

**5.3 Level**

- Undergraduate
- Dentistry/Law/Medicine
- Continuing Ed (Non-Credit)
- Collegial
- Masters & Grad Dips & Certs
- Doctorate
- Post-Graduate Medicine/Dentistry
- Graduate Qualifying
- Postdoctoral Fellows

**5.4 Level of Program**

- Undergraduate
- Masters
- M.Sc. (Applied) Program
- Postgraduate Medicine/Dentistry
- Postdoctoral Fellows

**6.0 Total Credits**

- 76 credits

**7.0 Consultation with Related Units**

- Yes
- No

**Financial Consult**

- Yes
- No

- Attach list of consultations.
8.0 Program Description (Maximum 150 words)

The program is built on a selection of mathematics and biology courses that recognizes mathematical biology as a field of research, with 3 concentrations within biology.

**Program Prerequisites (28 credits):**
- MATH 140 (3) Calculus 1; MATH 141 (4) Calculus 2; MATH 133 (3) Vectors, Matrices and Geometry
- BIOL 111 (3) Principles: Organismal Biology; BIOL 112 (3) Cell and molecular biology;
- CHEM 110 (4) General Chemistry 1; CHEM 120 (4) General Chemistry 2; PHYS 101 (4) Introductory Physics – mechanics

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)

**Required courses (37 credits – BIOL/CHEM: 16; MATH/COMP: 21)**
- BIOL 200 (3) Molecular Biology
- BIOL 201 (3) Cell biology and metabolism or equivalent (BIOC 212 / ANAT 212)
- BIOL 215 (3) Introduction to Ecology and Evolution
- BIOL 308 (3) Ecological Dynamics
- CHEM 212 (4) Organic Chemistry
- MATH 222 (3) Calculus 3
- MATH 242 (3) Analysis 1
- MATH 243 (3) Analysis 2
- MATH 223 (3) Linear Algebra or MATH 247 (3) Honours Applied Linear Algebra
- MATH 315 (3) Ordinary Differential Equations
- MATH 323 (3) Probability
- COMP 202* (3) Introduction to Computing 1
* Students who have sufficient knowledge in a programming language should take COMP 250 rather than COMP 202.

**Complementary Courses (39 credits – BIOL/NEUR/PHGY/PHYS/PSYC: 21; MATH: 18)**

Students must complete 21 credits of BIOL/NEUR/PHGY/PHYS/PSYC courses and 18 credits of MATH courses comprised as follows:

Either BIOL 466/467 (3) Independent Research Project
Or MATH 410 (3) Majors Project

Students have to complete one of the following two sequences of MATH courses:

Either
- MATH 314 (3) Advanced Calculus
- MATH 317 (3) Numerical analysis
  or MATH 327 (3) Matrix numerical analysis
- MATH 319 (3) Partial Differential Equations
- MATH 326 (3) Nonlinear Dynamics and Chaos
  or MATH 437 (3) Mathematical Methods in Biology

Or
- MATH 324 (3) Statistics
- MATH 423 (3) Regression and Analysis of Variance
- MATH 447 (3) Stochastic Processes

The remaining MATH courses may be chosen from any of the two preceding sequences and/or from the following list:
- MATH 204 (3) Principles of Statistics 2
- MATH 340 (3) Discrete Structures 2
- MATH 523 (4) Generalized Linear Models
- MATH 524 (4) Nonparametric Statistics
- MATH 525 (4) Sampling Theory and Applications

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### 10.0 Approvals

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**Submitted by**

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Furthermore, students must complete one of the following streams in Biology:

**Ecology and Evolutionary Ecology stream (at least 15 credits)**

Required stream course:
- BIOL 206  (3) Methods in Biology of Organisms

One field course selected from the following list or any other field course with permission:
- BIOL 240  (3) Montereigan Flora
- BIOL 331  (3) Ecology/Behaviour field course
- BIOL 334  (3) Applied Tropical Ecology
- BIOL 432  (3) Limnology

At least 9 credits chosen from the following list, of which 6 credits must be at the 400-level or above:
- BIOL 202  (3) Basic Genetics
- BIOL 304  (3) Evolution
- BIOL 310  (3) Large Scale Ecology
- BIOL 324  (3) Ecological Genetics – requires BIOL 202
- BIOL 434  (3) Theoretical Ecology
- BIOL 585  (3) Game Theory and Evolutionary Dynamics – requires BIOL 434
- BIOL 590  (3) Linking Community and Ecosystem Ecology – requires BIOL 434
- BIOL 594  (3) Evolutionary Ecology

**Molecular Evolution stream (at least 17 credits)**

Required stream courses:
- PHYS 102  (4) Introductory Physics – electromagnetism
- BIOL 202  (3) Basic Genetics
- BIOL 301  (4) Cell and Molecular Laboratory

At least 6 credits chosen from the following list:
- BIOL 518  (3) Advanced Topics in Cell Biology (requirements: see notes)
- BIOL 569  (3) Developmental Evolution
- BIOL 572  (3) Molecular Evolution
- BIOL 592  (3) Integrated Bioinformatics
- BINF 511  (3) Bioinformatics for Genomics

**Neurosciences stream (at least 16 credits)**

Required stream courses:
- PHYS 102  (4) Introductory Physics – electromagnetism
- BIOL 306  (3) Neurobiology

At least 9 credits selected from:
- BIOL 389  (3) Laboratory in Neurobiology
- PHGY 314  (3) Integrative Neuroscience
- PSYC 427  (3) Sensitomotor Behaviour
- PHGY 425  (3) Analyzing Physiological Systems (requirements: see notes)
- BIOL 530  (3) Neural Basis of Behaviour
- NEUR 603  (3) Computational Neurosciences (requirements: see notes)

Notes:
For the remaining BIOL/NEUR/PHGY/PHYS/PSYC credits, if any, students can top up their credits to the required 21 credits with any course listed in the above streams in Biology or any other course in Biology subject to the approval of the program coordinator.

Notes:
BIOL 518, PHGY 425 and NEUR 603: prerequisites at the discretion of the instructor (resp. Jackie Vogel, Erik Cook and Christopher Pack).
Program coordinators: Claire de Mazancourt and Frederic Guichard (Biology), Stephen Drury and Axel Hundemer (Mathematics).