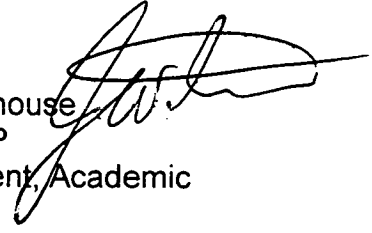


SIMON FRASER UNIVERSITY
Senate Committee on University Priorities

Memorandum

TO: Senate

FROM: John Waterhouse
Chair, SCUP
Vice President, Academic



RE: Proposal for a Major and Honors
Program in Biological Physics,
Faculty of Sciences (SCUP 06-12)

DATE: March 13, 2006

At its February 22, 2006 meeting SCUP reviewed and approved the proposal from the Faculty of Science for a Major and Honors Program in Biological Physics.

Motion

That Senate approve and recommend to the Board of Governors, the proposal for a Major and Honors Program in Biological Physics.

encl.

cc. B. Frisken

SIMON FRASER UNIVERSITY
MEMORANDUM

To: Senate Committee on University Priorities

From: C. MacKenzie, Chair
Senate Committee on Undergraduate Studies

Subject: Faculty of Sciences – new Biological Physics Major and Honors program
(SCUS Reference: SCUS 05-29 g)

Date: February 8, 2005

Action undertaken by the Senate Committee on Undergraduate Studies at its meeting on February 7, 2006 gives rise to the following motion:

Motion:

"that SCUP approve and recommend to Senate the new Biological Physics Major and Honors program."

The relevant documentation is attached for review by SCUP.

C. MacKenzie

Program Proposal
Biological Physics
November 2, 2005

I. Introduction

This proposal is for a highly interdisciplinary undergraduate science program leading to a BSc focused on the physical foundations of biology emphasizing micro- and nanoscale phenomena of the cell and its components as measured and interpreted using physical techniques and theory.

Still in its infancy, this interdisciplinary field will find application in the wider world through the development of biosensors, sophisticated mechanisms for drug delivery based on synthetic cells and biocompatible materials for medicine and dentistry, as well as answering fundamental questions such as the principles of macromolecular design and the physical foundations of evolution and the emergence of life. Research at the intersection of the biological and physical sciences has emerged as a high priority internationally, as recognized by both the American Physical Society (<http://www.aps.org/meet/biology-physics2/>) and the National Institutes of Health (http://www.nigms.nih.gov/funding/complex_systems.html).

SFU has already achieved national visibility through its research in this area. The impressive, if not astonishing, number of new SFU faculty with strongly interdisciplinary backgrounds in biology, chemistry and physics has also positioned us to become a leading institution in this field. It is entirely appropriate that we capitalize on this expertise through the development of an undergraduate program in biological physics. Only a few universities in Canada have yet undertaken such a program, and even fewer have the numerical strength of faculty in this area that SFU has. Physics students graduating from such a program will be better prepared to tackle interdisciplinary problems at the boundaries between physics and the life sciences. Life science students with a better background in physical science and mathematics will be able to tackle increasingly-quantitative problems in biology, as suggested by the recent report of the US National Academy of Sciences study entitled Bio2010 (<http://www4.nationalacademies.org/news.nsf/isbn/0309085357?OpenDocument>).

II. Program Description

This proposal includes both majors and honors streams, each consisting of a core of lower and upper division courses, along with four additional upper division courses chosen from courses offered by MBB and Physics; students may also take MATH 462 Fluid Mechanics as part of this degree. The Majors program includes 67-68 lower division and 36 upper division credits. Students desiring an Honors degree would choose between two options outlined below. Possible sequences of courses can be found in the Appendix to this proposal.

These students will meet the new general undergraduate curriculum requirements (WQB) in the following ways:

- Students will automatically meet their Q requirements,
- Students will be able to use BISC 101/102 to satisfy B-Sci requirements,
- Students can most efficiently fulfill their lower division W-intensive requirement and a B requirement by making sure that one of their B-Hum or B-Soc courses is writing-intensive,
- Designed as a W-intensive lab course, PHYS 433 Biophysical Laboratory can be used to satisfy upper division W-requirements.
- There are 6, 4 and 5 electives in the Major, Honors (physics stream) and Honors (MBB stream) respectively. These should be used to satisfy other breadth requirements. Students can use the chemistry courses as undesignated breadth.

IV. Calendar Description

Biological Physics Major Program

This program is designed for students who are interested in using physical approaches to tackle biological problems. Students should speak with an advisor as soon as possible to schedule their programs.

Lower Division – 67-68 LD credits

Students must complete all of

BISC 101-4	General Biology I
BISC 102-4	General Biology II
CHEM 121-4	General Chemistry and Laboratory I
CHEM 122-2	General Chemistry II
MATH 151-3	Calculus I
MATH 152-3	Calculus II
PHYS 101-3 or 120-3 or 125-3 or 140-4	Mechanics
PHYS 102-3 or 121-3 or 126-3 or 141-4	Electricity, Magnetism and Light
PHYS 130-2 or 131-2	Physics Laboratory I (PHYS 140/141 exempt)
BISC 202-3	Genetics
CHEM 281-4	Organic Chemistry and Laboratory I

CHEM 282-2	Organic Chemistry II
MATH 232-3	Elementary Linear Algebra
MATH 251-3	Calculus III
MATH 252-3	Vector Calculus
MBB 221-3	Cellular Biology and Biochemistry
MBB 222-3	Molecular Biology and Biochemistry
PHYS 211-3	Intermediate Mechanics
PHYS 221-3	Intermediate Electricity and Magnetism
PHYS 231-3	Physics Laboratory II
PHYS 255-3	Waves and Vibrations
And either PHYS 285-3	Introduction to Relativity and Quantum Mechanics
Or CHEM 260-4	Atoms, Molecules, Spectroscopy

Upper Division – 36 UD credits

Students must complete all of

MATH 310-3	Differential Equations
MBB 309-3	Molecular Biology and Biochemistry Laboratory II
MBB 322-3	Molecular Physiology
MBB 331-3	Molecular Biology
PHYS 347-3	Introduction to Biological Physics
PHYS 385-3	Quantum Physics
PHYS 433-3	Biological Physics Laboratory

and one of

MBB 323-3 or PHYS 344-3 or CHEM 360-3 [Thermodynamics]

and 4 other UD MBB or Physics courses. MATH 462 may be included amongst these 4. The following courses are suggested:

MBB 308-3	Molecular Biology and Biochemistry Laboratory I
MBB 321-3	Intermediary Metabolism
MBB 403-3	Physical Biochemistry
MBB 413-2	Physical Biochemistry Laboratory
MBB 421-3	Nucleic Acids
MBB 422-3	Biomembranes
MBB 423-3	Protein Structure and Function
MBB 441-3	Bioinformatics
MBB 442-3	Proteomics
PHYS 324-3	Electromagnetics
PHYS 492-3	Special Topics in Physics
PHYS 413-3	Classical Mechanics
PHYS 484-3	Nonlinear Physics
MATH 462-3	Fluid Dynamics

Biological Physics Honors Program (15-17 additional UD credits)

Honors program graduates may do graduate work in either physics or in molecular biology, or related areas, and should choose their courses accordingly.

Additional Upper Division Requirements

Either (Option A)

MBB 493-15 Individual Study Semester

Or all of (Option B)

PHYS 384-3 Methods of Theoretical Physics I

PHYS 415-3 Quantum Mechanics

PHYS 425-3
PHYS 432-5
PHYS 445-3

Electromagnetic Theory
Undergraduate Honors Thesis
Statistical Physics

V. New courses

Although much of the program can be built on existing courses, two new courses (lecture and lab) are required. These courses define the program and bring together faculty and pedagogy from different departments. We will also regularize a current biannual offering of a special topics course on biological physics. Several of these courses could be shared between departments, and not all need be offered annually. Course outlines are included in documentation for Senate.

PHYS 347-3 Introduction to Biological Physics

This third year course introduces the discipline of biological physics, bringing together physical and biological approaches to biophysical problems. To make the course broadly accessible, the prerequisites are simplified to 45 undergraduate credit hours, including first-year biology, chemistry, mathematics and physics. This course incorporates some essential mathematical methods including differential equations and statistics.

PHYS 433-3 – Biological Physics Laboratory

This course is modeled after a biophysics laboratory developed by Ray Goldstein at University of Arizona. Experimental techniques covered will include optical tweezers, NMR, light scattering, and spectroscopy and experiments will be designed with a biological focus. We intend to design the course so that it will be suitable for certification as a W-intensive course. The course will also have a focus on data analysis and will build on basic data analysis as covered in PHYS 231.

Appendix – Recommended Sequence of Courses

Semester	Major Biophysics	CR	Honors Biophysics (Physics)	CR	Honors Biophysics (MBB)	CR
S1 or 1-1	BISC 101	4	BISC 101	4	BISC 101	4
FALL	CHEM 121	4	CHEM 121	4	CHEM 121	4
	MATH 151	3	MATH 151	3	MATH 151	3
	PHYS 101/120/125/140	3	PHYS 101/120/125/140	3	PHYS 101/120/125/140	3
			elective	3	elective	3
subtotal		14		17		17
S2 or 1-2	BISC 102	4	BISC 102	4	BISC 102	4
SPRING	CHEM 122	2	CHEM 122	2	CHEM 122	2
	MATH 152	3	MATH 152	3	MATH 152	3
	PHYS 102/121/126/141	3	MATH 232	3	MATH 232-3	3
	PHYS 130/131	2	PHYS 102/121/126/141	2	PHYS 102/121/126/141	2
	elective	3	PHYS 130/131	3	PHYS 130/131	3
subtotal		17		17		17
S3 or 2-1	CHEM 281	4	CHEM 281	4	CHEM 281	4
FALL	MATH 232	3	MATH 251	3	MATH 251	3
	MATH 251	3	MBB 221	3	MBB 221	3
	MBB 221	3	PHYS 255	3	PHYS 255	3
	PHYS 255	3	elective	3	elective	3
subtotal		16		16		16
S4 or 2-2	CHEM 282	2	CHEM 282	2	CHEM 282	2
SPRING	MATH 252	3	MATH 252	3	MATH 252	3
	MBB 222	3	MBB 222	3	MBB 222	3
	PHYS 285	3	PHYS 221	3	PHYS 221	3
	elective	3	PHYS 231	3	PHYS 231	3
			PHYS 285	3	PHYS 285	3
subtotal		14		17		17
S5 or 3-1**	MATH 310	3	BISC 202	3	BISC 202	3
FALL	MBB 308	3	MATH 310	3	MATH 310	3
	PHYS 211	3	MBB 308	3	MBB 308	3
	PHYS 231	3	PHYS 211	3	PHYS 211	3
	PHYS 347	3	PHYS 347	3	PHYS 347	3
subtotal		15		15		15
S6 or 3-2**	MBB 321	3	MBB 321	3	MBB 321	3
SPRING	PHYS 221	3	MBB 331	3	MBB 331	3
	PHYS 344	3	MBB or PHYS UD	3	MBB 323	3
	elective	3	PHYS 344	3	MBB or PHYS UD	3
	elective	3	PHYS 385	3	PHYS 385	3
			elective	3	elective	3
subtotal		15		18		18
S7 or 4-1**	BISC 202	3	MBB or PHYS UD	3	MBB or PHYS UD	3
FALL	MBB 331	3	MBB or PHYS UD	3	MBB or PHYS UD	3
	MBB or PHYS UD	3	PHYS 384	3	MBB or PHYS UD	3

	PHYS 433	3	PHYS 433	3	PHYS 433	3
	elective	3	PHYS 445	3	elective	3
				3	elective	3
subtotal		15		18		18
S8 or 4-2**	MBB or PHYS UD	3	MBB or PHYS UD	3	MBB 493	15
SPRING	MBB or PHYS UD	3	PHYS 415	3		
	PHYS 385	3	PHYS 425	3		
	elective	3	PHYS 432	5		
	elective	3				
subtotal		15		14		15
TOTAL		121		132		133