

SIMON FRASER UNIVERSITY
MEMORANDUM

To: R. Heath
Secretary to SCUS

From: C.H.W. Jones, Dean
Faculty of Science

Subject: **Restructured
Biochemistry Curriculum**

Date: March 9, 1993

=====

On March 8 1993 the Faculty of Science approved a restructured curriculum for the undergraduate degree programme in Biochemistry as described in the attached documentation. This restructuring represents a fairly major revision to the programme.

The Biochemistry Programme

The Biochemistry Programme is an interdisciplinary, undergraduate programme offered jointly by the Departments of Chemistry and Biosciences; the programme is administered by the Biochemistry Curriculum Committee of the Faculty.

In the Spring of 1992 the Biochemistry Curriculum Committee was reconstituted to take advantage of the expertise reflected in the recently hired new faculty members in this area. The new committee comprises: T.B. Borgford and D. Sen (Chemistry); N.H. Haunerland and J.V. Price (Biosciences); G. Tibbits (Kinesiology). Dr. Borgford is the Committee Chair.

In the Summer of 1992 the Committee undertook a major review of the Biochemistry Programme in close consultation with the Departments of Chemistry and Biosciences. As a result of that review, a number of significant changes were recommended which will modernize the curriculum and which will reduce overlap between some of the present courses. The restructured curriculum was approved by the Departments of Chemistry and Biosciences in the Fall of 1992 and the proposal has now received approval by the Faculty of Science Undergraduate Curriculum Committee and the Faculty as a whole.

The Recommendation

The key features of the recommendation are summarized in the attached memorandum from Dr. Bob Brooke, Chair of the Faculty Undergraduate Curriculum Committee.

The Faculty of Science recommends approval of the restructured Biochemistry Curriculum and the new courses presented in the proposal.

The Library has provided an analysis of the proposed additional Library holdings. The Faculty of Science will provide the funding for the required periodicals (\$2,015 p.a.) and the costs for new monographs (\$3,559 p.a.). We will provide the additional funding for the less-essential monograph holdings of \$5,932 over the next two to three year period.

CHW Jones.
C.H.W. Jones

CHWJ:rh:Encl.

c. T. Borgford, Chair
Biochemistry Curriculum Committee

R.C. Brooke, Chair
Faculty of Science Undergraduate Curriculum Committee

- 3) Calendar revisions to accommodate the restructured Biochemistry Curriculum, and
- 4) a proposed schedule for implementation of the courses into the new core Biochemistry program.

Please place the Restructured Biochemistry Curriculum proposal as summarized above on the agenda of the next Faculty of Science meeting. Thank you.

Robert Brooke
R.C. Brooke

RCB:ln:Att.

Recommended Changes to Major (Core) Program

- 1) *CHEM 218 and CHEM 255 become prerequisites for both BICH 311 and BICH 312*

Rationale: CHEM 218 (Introduction to Analytical Chemistry) and CHEM 255 (Organic Chemistry Laboratory II) teach students the basic laboratory skills necessary in the Biochemistry lab courses BICH 311 (Analytical Biochemistry Laboratory) and BICH 312 (Metabolism Laboratory). However, many students are choosing to take CHEM 218 and CHEM 255 after they have already taken BICH 311 and BICH 312.

- 2) *CHEM 261 become a prerequisite for BICH 403.*

Rationale: Students who have not already taken CHEM 261 (Physical Chemistry) are poorly prepared for BICH 403 (Physical Biochemistry).

- 3) *Biochemistry students be given the option of taking either MATH 310 or STAT 302 and, MATH 310 will no longer be a prerequisite for BICH 403.*

Rationale: MATH 310 (Introduction to Ordinary Differential Equations) is currently part of the Biochemistry core to prepare students for a small number of exercises in BICH 403 (Physical Biochemistry). Although it was not our intention to discourage students from taking a course in differential equations, we felt that the limited application of differential equations in BICH 403 could not justify the inclusion of *only* MATH 310 in the core. The option of taking STAT 302 (Analysis of Experimental and Observational Data) would give students a background, presently lacking, in experimental design and data analysis. Currently, the prerequisite to STAT 302 is either STAT 101 or STAT 102.

Since neither of the STAT prerequisites for STAT 302 is a component of the Biochemistry core, the Department of Mathematics and Statistics is examining alternatives to these prerequisites. For example, it may be possible to allow MATH 151 and MATH 152 to stand as prerequisites for a new upper level statistics course concerned with experimental design and data analysis or such a course might be offered without prerequisites.

- 4) *Biochemistry students will be given the option of taking CMPT 101, or CMPT 102, or CMPT 103.*

Rationale: Students are currently required to take CMPT 102 (Introduction to FORTRAN for Science Students). Although this requirement insures that students receive training in many of the fundamentals of computing, it restricts them to a single computer language.

The Department of Computing Science, in consultation with Curriculum Committees from Biochemistry, Biosciences and Kinesiology, is currently examining the possibility

of offering a more broadly based service course similar to KIN 203 (Computer Applications in Kinesiology).

- 5) *Introduction of three new elective courses: 1) BICH 421-3 Nucleic Acids 2) BICH 422- 3 - Biomembranes 3) BICH 423-3 - Protein Structure and Function.*

Rationale: The three new courses will expand the number of upper division electives available to students in the Biochemistry core program. Each course will be offered once a year.

- 6) *Removal of BISC 302 from the Biochemistry Core*

With the implementation of the new core program this course would be more appropriate as an elective.

- 7) *Inclusion of BISC 431 -4 (3-0-6) in the Biochemistry Core*

Rationale: There are relatively few laboratory courses in the current Biochemistry Core. BISC 431 (Molecular Biotechnology) would give biochemistry students a much needed exposure to modern laboratory techniques in molecular biology. Also, inclusion of BISC 431 in the Biochemistry Core would help to satisfy the requirements for upper division credits by compensating for the removal of BISC 302.

- 8) *Add one credit to BICH 412 (therefore BICH 412-4 (2 - 1- 4))*

Rationale: In recent years the content of BICH 412 (Enzymology) has expanded to include an extra hour of lecture and tutorial material. The addition of one credit hour to the vector reflects this change to the content.

- 9) *Integration of courses BISC 201, BISC 301, BISC 401, BICH 301 and BICH 302 (ie. eventually these course will be removed from the calendar) and the lecture component of BISC 405 into a suite of 4 new courses designated BICH 221 (3-1-0) (Cellular Biology and Biochemistry), BICH 222 (3-1-0) (Molecular Biology and Biochemistry), BICH 321 (3-1-0) Intermediary Metabolism , and BICH 322 (3-1-0) (Molecular Physiology).*

Rationale: The courses slated for integration contain the fundamentals of Biochemistry. However, the subject matter is not presently given in an integrated or coherent manner. As a consequence, there are significant redundancies and incongruities in the six courses. (Most notable are the courses BISC 301 and BICH 301 which have an identical syllabus, are taught from the same text book and serve equally as prerequisites for BICH 302). By organizing the contents of the six courses into four new offerings with specific syllabuses (please see the sample outlines attached) redundancies and incongruities are avoided. The proposed restructuring will make it possible to introduce molecular biology and biochemistry (in addition to cell biology) to students in their second year. The principle benefits of this are

that 1) students enrolled in Biological Sciences will have exposure to subject matter which they might not otherwise receive, and 2) instructors of third and fourth year courses can present subject matter at a higher level.

The courses BICH 221 and BICH 222 will be offered 3 times a year and the courses BICH 321 and BICH 322 will be offered twice a year (please see Proposal for the Implementation of Courses below)

10) *BICH 222 become a prerequisite for BISC 321*

Rationale: The calendar currently describes BISC 321 (Introduction to Molecular Biology) as "The study of gene structure and evolution, DNA replication, and the regulation of gene expression in bacteria and higher organisms" (please compare with proposed calendar description and sample outline for BICH 222). The proposed BICH 222 would serve to introduce many of these topics to students and allow the contents of BISC 321 to be presented in greater detail and at a more advanced level.

Instructors

Instructors for the courses BICH221, BICH222, BICH321, and BICH322 may be drawn from both Biological Sciences and Chemistry, and can include instructors who formerly taught in the 5 courses removed from the calendar. For example, faculty members who are qualified to teach in the new program are as follows;

BICH 221	Brandhorst Boone Borgford Cornell Scott Kermode Moore Hauerland	BICH 222	Brandhorst Baillie Borgford Beckenbach Honda Smith Price Sen
BICH 321	Borgford Cornell Cushley Hauerland Richards	*BICH 322	Baillie Boone Borgford Burr Delaney Cornell Pinto Price Sen Scott Richards

*because of the diversity of subject matter in BICH 322 this course will likely be team-taught by two or three instructors.

Proposal for the Implementation of Courses

To implement the new curriculum we have drawn up a schedule for the first offering of the new courses (BISC and BICH core courses) and last offering of redundant courses. Current offerings appear in italics and the new offerings are given in bold.

Semester

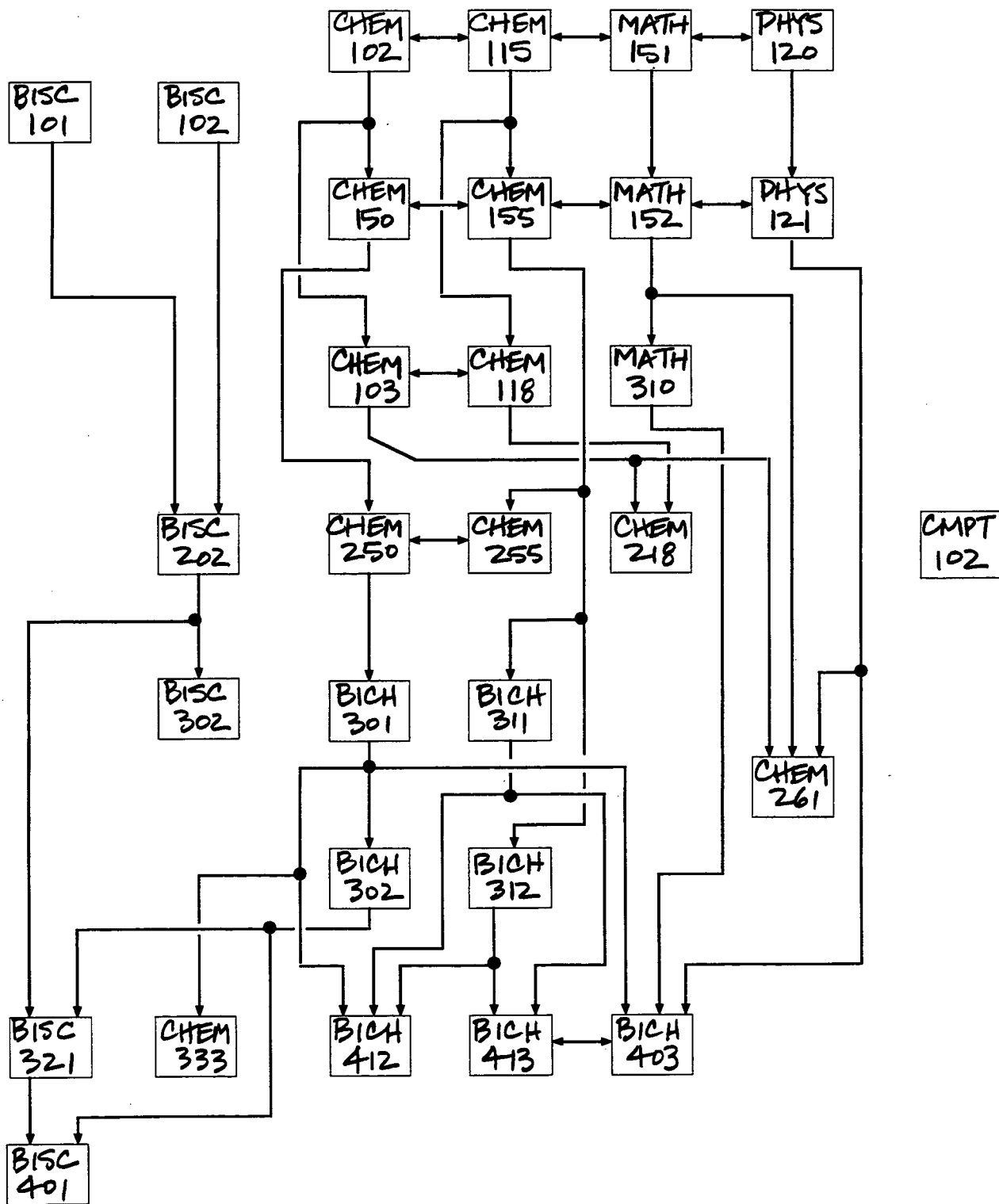
93-2	<i>(BISC 201)</i>			<i>(BICH 302)</i>	
93-3	<i>(BISC 201)</i>		<i>(BISC 301)</i>	<i>(BICH 301)</i>	
94-1	(BICH 221)		<i>(BISC 301)</i>	<i>(BICH 301)</i>	<i>(BICH 302)</i> <i>(BISC 401)</i>
94-2	(BICH 221)	(BICH 222)	<i>(BISC 301)</i>		<i>(BICH 302)</i>
94-3	(BICH 221)	(BICH 222)	(BICH 321)		
95-1	(BICH 221)	(BICH 222)	(BICH 321)	(BICH 322)	<i>(BISC 401)</i>
95-2	(BICH 221)	(BICH 222)		(BICH 322)	
95-3	(BICH 221)	(BICH 222)	(BICH 321)		
96-1	(BICH 221)	(BICH 222)	(BICH 321)	(BICH 322)	
96-2	(BICH 221)	(BICH 222)		(BICH 322)	

In addition, the courses BICH 421 and 422 will first be offered in 94-3 and BICH 423 will first be offered in 95-1.

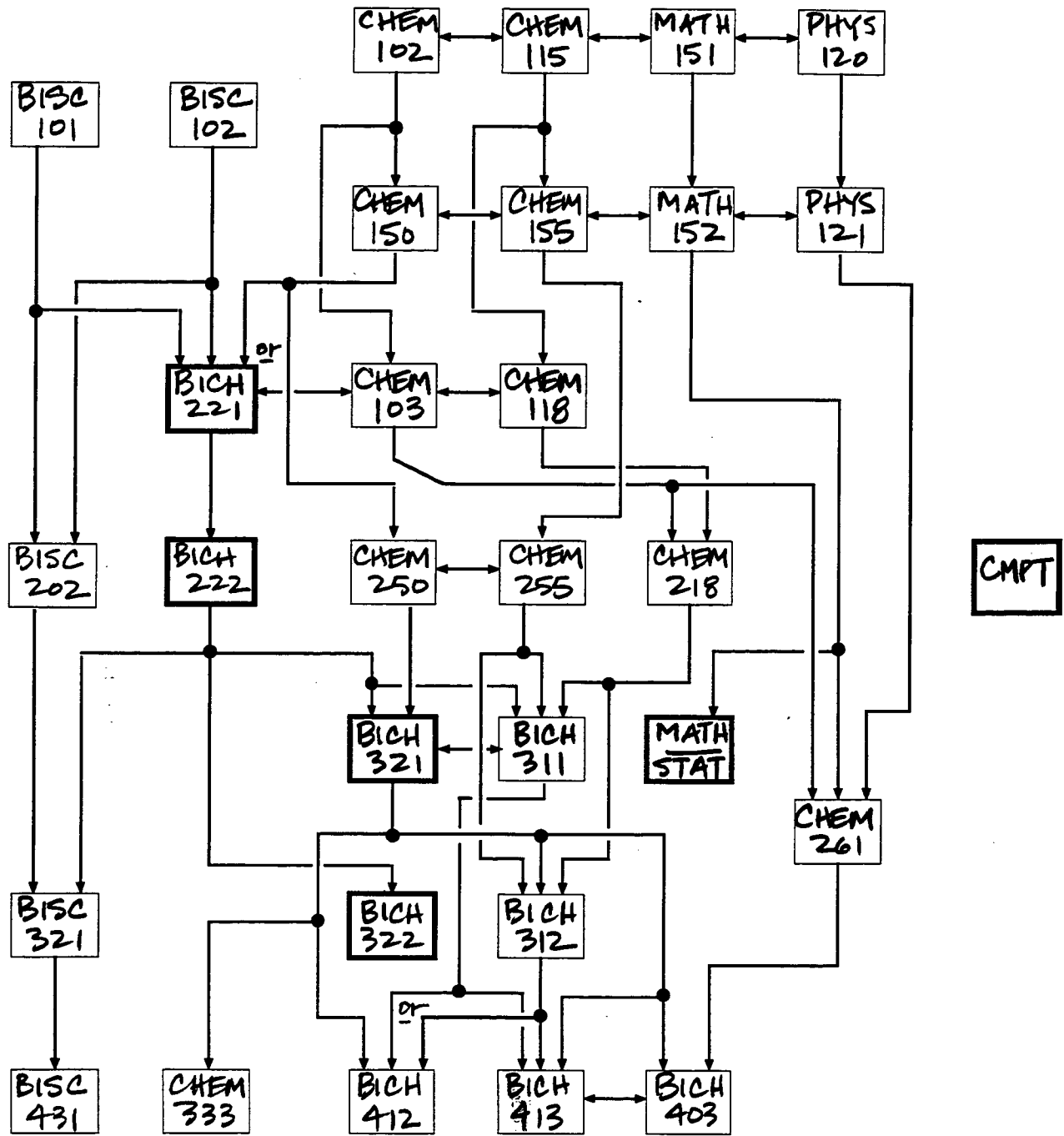
Flowcharts

On the following flow charts horizontal lines indicate corequisites and vertical lines indicate prerequisites. Major differences from the "existing core" are indicated by bold boxes on the flowchart of the "proposed core".

THE EXISTING BIOCHEMISTRY CORE



THE PROPOSED BIOCHEMISTRY CORE



THREE ADDITIONAL COURSES ARE PROPOSED AS BIOCHEMISTRY ELECTIVES.

BICH 421

BICH 422

BICH 423

PREREQUISITES {

BISC 321

BICH 321
(or 301)
BICH 322
(or 302)

BISC 321
and either BICH 321 (or 301)
or BICH 322 (or 302)

BIOCHEMISTRY CALENDAR REVISIONS (1994/1995 Calendar): COURSES

The following revisions are necessitated by the changes to the curriculum.
(NCPF = New course Proposal Form; ed = editorial)

Page	Course	Current text	Change to, add or delete
NCPF (ed)	BICH 221-3	(New course:)	<i>Cellular Biology and Biochemistry</i> A study of the molecular processes which underlie cell structure and function, integrating ultrastructural, physiological and biochemical approaches. Modern techniques used in the analysis of organelle and cell function are integral parts of the course. (3-1-0) Prerequisites: BISC 101, 102 and either CHEM 103 or 150 (both CHEM 103 and CHEM 150 are recommended as prerequisites or corequisites). Students may not receive credit for both BICH 221 and BISC 201.
NCPF (ed)	BICH 222-3	(New course:)	<i>Introduction to Molecular Biology and Biochemistry</i> An introduction to DNA replication and recombination, RNA transcription and protein synthesis in the context of their locations within the cell and their timing in the cell cycle. The relationship between structure and function of proteins and nucleic acids will be addressed. (3-1-0) Prerequisite: BICH 221 (or BISC 201). CHEM 250 is a recommended prerequisite or corequisite.
172	BICH 301-3		course removed from calendar
	BICH 302-3		course removed from calendar
	BICH 311-2	Prerequisite: CHEM 155 (or 256) . Corequisite: BICH 301 .	Prerequisites: CHEM 255 (or CHEM 356) , CHEM 218 and BICH 222 . BICH 321 should be taken concurrently .
	BICH 312-2	Prerequisite: CHEM 155 (or 256) . Corequisite: BICH 302 .	Prerequisites: CHEM 255 (or 356) , CHEM 218 and BICH 321 .

BIOCHEMISTRY CALENDAR REVISIONS : COURSES

(NCPF = New course Proposal Form; ed = editorial)

Page	Course	Current text	Change to, add or delete
NCPF (ed)	BICH 321-3	(New course:)	<i>Intermediary Metabolism</i> Major catabolic and anabolic pathways and their regulation. Particular emphasis is placed on bioenergetics and experimental methods encountered in biochemical research. (3-1-0) Prerequisites: BICH 222 and CHEM 250 (or 252). BICH 311 should be taken concurrently. Students may not receive credit for both BICH 321 and BICH 301.
NCPF (ed)	BICH 322-3	(New course:)	<i>Molecular Physiology</i> Cellular and biochemical aspects of immunology, muscle contraction, cell motility, neural transmission, the action of hormones. The course will also explore the cellular and molecular basis of cancer. (3-1-0) Prerequisite: BICH 222. BICH 321 (or BICH 301) is recommended. Students may not receive credit for both BICH 322 and BICH 302.
172	BICH 403-3	Prerequisites: PHYS 121 (or 102), MATH 310 and BICH 301. Ordinarily, BICH 413 will be taken concurrently, but may be taken subsequently to BICH 403.	Prerequisites: CHEM 261, BICH 321 (or BICH 301). BICH 413 should be taken concurrently.
	BICH 412-3 (now 412-4)	... (1-0-4) Prerequisites: BICH 301 (or BISC 301) and BICH 311 (or 312).	... (2-1-4) Prerequisites: BICH 321 (or BICH 301) and one of BICH 311 or BICH 312.
	BICH 413-3	Prerequisites: BICH 301, 302, 311 and 312. Ordinarily, BICH 403 will be taken concurrently but may precede BICH 413.	Prerequisites: BICH 321 (or BICH 301), 311 and 312. BICH 403 should be taken concurrently.

BIOCHEMISTRY CALENDAR REVISIONS : COURSES

(NCPF = New course Proposal Form; ed = editorial)

Page	Course	Current text	Change to, add or delete
NCPF (ed)	BICH 421-3	(New course:)	<i>Nucleic Acids</i> Recent literature is examined for insights into the structure and properties of DNA and RNA, drawing on a variety of biochemical, chemical and molecular biological perspectives. (3-1-0) Prerequisite: BISC 321
NCPF (ed)	BICH 422-3	(New course:)	<i>Biomembranes</i> A review of recent research on the structure, dynamics, function and biosynthesis of membranes, membrane lipids and proteins. (3-1-0) Prerequisites: BICH 321 (or 301) and 322 (or 302). BICH 413 is recommended.
NCPF (ed)	BICH 423-3	(New course:)	<i>Protein Structure and Function</i> The course will discuss recent research in transition state theory; specificity in enzyme catalyzed reactions; the use of recombinant DNA techniques to describe and modify enzyme catalysis; the function of enzymes in organic solvents; and the development of new catalytic activities through monoclonal antibody techniques. (3-1-0) Prerequisites: BISC 321, and either BICH 321 (or 301) or 322 (or 302).
173	BISC 305-3	Prerequisite: BISC 201	Prerequisite: BICH 221 (or 201) .
	BISC 313-3	Prerequisites: BISC 301 or BICH 302 , CHEM 252. Corequisite: BISC 312. Students with credit for BISC 311-3 will not receive credit for BISC 313-3	Prerequisite: BICH 321, CHEM 250 (or 252) . Corequisite: BISC 312. Students with credit for BISC 311-3 will not receive credit for BISC 313-3

BIOCHEMISTRY CALENDAR REVISIONS : COURSES

(NCPF = New course Proposal Form; ed = editorial)

Page	Course	Current text	Change to, add or delete
173	BISC 321-3	Prerequisites: BISC 301 or BICH 302; BISC 202.	Prerequisite: BICH 222 and BISC 202.
174	BISC 356-3	Prerequisites: BISC 201 , CHEM 150 (or 251) and 155 (or 256).	Prerequisites: BICH 222 , CHEM 150 (or 251) and 155 (or 256).
	BISC 366-3	Prerequisites: BISC 201 , CHEM 150 (or 251) and 155 (or 256).	Prerequisites: BICH 222 , CHEM 150 (or 251) and 155 (or 256).
	BISC 405-3	Prerequisites: BISC 301 or BICH 302. BISC 305 is recommended.	Prerequisites: BICH 322 (or 302) and one of BISC 329, BICH 311 or 312. BISC 305 is recommended.
	BISC 411-3	Prerequisite: BISC 301 or BICH 302 , or permission of instructors.	Prerequisites: BICH 222 , or permission of instructor.
	BISC 412-3	Prerequisite: BISC 301 or BICH 302; BISC 321 corequisite.	Corequisite: BISC 321.
	BISC 431-4	Prerequisite: BISC 321. Recommended BISC 401 and/or BISC 402 concurrently.	Prerequisite: BISC 321. Recommended BICH 322 (or 302) and/or BISC 402 concurrently.
	BISC 432-3	Prerequisite: BISC 301 or BICH 302.	Prerequisite: BICH 321 (or 301 or 302).
175	BISC 453-3	Prerequisite: BISC 301 or BICH 302 , <u>and</u> BISC 203 and 321.	Prerequisite: BICH 322 (or 302) , <u>and</u> BISC 203 and 321.
	BISC 457-3	Plant Biochemistry and Molecular Biology ... Prerequisites: BISC 301 or BICH 302 <u>and</u> BISC 337 or 366.	Plant Molecular Biology and Biotechnology ... Prerequisites: BICH 321 (or 301) <u>and</u> BISC 337 or 366.
180	CHEM 333-3	Prerequisites: BICH 301, or BISC 301, or CHEM 250 (or 252) and CHEM 232.	Prerequisites: BICH 321 (or 301) or CHEM 250 (or 252) and CHEM 232.
216	KIN 305-3	Prerequisites: ... BISC 201 ...	Prerequisites: ... BICH 222 (or BISC 201) ...
	KIN 306-3	Prerequisites: ... BISC 201 ...	Prerequisites: ... BICH 222 (or BISC 201) ...
217	KIN 430-3	Prerequisite: BISC 201. Students with credit in KIN 330 may not take KIN 430 for further credit. It is recommended that students take BISC 301 prior to enrolling in KIN 430.	Prerequisite: BISC 222 (or BISC 201). Students with credit for KIN 330 may not take KIN 430 for further credit.
	KIN 460-3	Prerequisites: BISC 201 , KIN 105 (formerly KIN 100), 142 and 90 credit hours.	Prerequisites: BICH 222 (or BISC 201) , KIN 105 (formerly KIN 100), 142 and 90 credit hours.

BIOCHEMISTRY CALENDAR REVISIONS : PROGRAM

(The current description of the Biochemistry Program , found on pages 147 and 148, will be replaced with the following:)

Biochemistry Program

Associated Faculty

D.L. Baillie	Biological Sciences
A.T. Beckenbach	Biological Sciences
C. Boone	Biological Sciences
T.J. Borgford	Chemistry
B.P. Brandhorst	Biological Sciences
R.B. Cornell	Chemistry
R.J. Cushley	Chemistry
B.M. Honda	Biological Sciences
J.V. Price	Biological Sciences
W.R. Richards	Chemistry
J. K. Scott	Chemistry
D. Sen	Chemistry
M.J. Smith	Biological Sciences

Advisor: Dr. W.R. Richards
Rm. 6144 South Sciences Building
291-4355

Major, minor and honors programs in Biochemistry are offered by the Faculty of Science. Entry into these programs requires the permission of the Program Advisor of the Biochemistry Curriculum Committee.

Major Program

(120 Semester Hours)

All students taking Biochemistry must complete the core program as specified below, together with elective courses chosen in consultation with the Biochemistry Program Advisor.

Core Program

(90-91 Semester Hours)

- BICH 221-3 Cell Biology and Biochemistry
- 222-3 Molecular Biology and Biochemistry
- 311-2 Analytical Biochemistry Laboratory

312-2 Metabolism Laboratory
321-3 Intermediary Metabolism
322-3 Molecular Physiology
403-3 Physical Biochemistry
412-4 Enzymology
413-2 Physical Biochemistry Laboratory

BISC 101-4 Introduction to Biology
102-4 Introduction to Biology
202-3 Genetics
321-3 Introduction to Molecular Biology
431-4 Molecular Biotechnology

CHEM 102-3 General Chemistry I
103-3 General Chemistry II for the Physical Sciences
115-2 General Chemistry Laboratory I
118-2 General Chemistry Laboratory II
150-3 Organic Chemistry I
155-2 Organic Chemistry Laboratory I
218-3 Introduction to Analytical Chemistry
250-3 Organic Chemistry II
255-2 Organic Chemistry Laboratory II
261-3 Physical Chemistry I
333-3 Inorganic Chemistry of Biological Processes

one of the following courses in Computing Sciences

CMPT 101-4 Modula 2
102-3 Introduction to FORTRAN for Science Students
103-3 Introduction to PASCAL Programming

MATH 151-3 Calculus I (or 154-3 Calculus I for the Biological Sciences*)
152-3 Calculus II (or 155-3 Calculus II for the Biological Sciences*)
and either

MATH 310-3 Introduction to Ordinary Differential Equations
or

STAT 302-3 Analysis of Experimental and Observational Data
(prerequisite STAT 102).

(MATH 232-3 Elementary Linear Algebra and MATH 251-3 Calculus III
are recommended).

PHYS 120-3 Physics I (or 101-3 General Physics I*)
121-3 Physics II (or 102-3 General Physics II*)

Course alternatives marked with an asterisk are possible only for students who have transferred to Biochemistry from another program. Students who have declared (or intend to declare) a biochemistry major or honors program should **not** register for these alternative courses.

In addition to the core program, students majoring in Biochemistry must complete 30 semester hours of electives, at least 12 of which must be upper division credits (excluding EDUC 401 to 407). Nine semester hours must be taken in subjects outside the Faculty of Science, including a minimum of 6 hours from the Faculty of Arts. Further BSc general degree regulations are given in the *Faculty of Science* section.

Although many variations are possible, a student entering with BC High School Chemistry 12, Algebra 12 and Physics 12 (or equivalents) might take the following typical program.

LEVELS 1 and 2:

BISC 101-4 and 102-4
CHEM 102-3, 115-2, 150-3 and 155-2,
MATH 151-3 and 152-3,
PHYS 120-3 and 121-3

Total 30 semester hours

LEVELS 3 and 4:

BICH 221-3 and 222-3
BISC 202-3
CHEM 103-3, 118-2, 218-3, 250-3 and 255-2
CMPT 101-4 or 102-3 or 103-3
6 hours of electives

Total 31 - 32 semester hours

LEVELS 5 and 6:

BICH 311-2, 312-2, 321-3 and 322-3
BISC 321-3
CHEM 261-3
MATH 310-3 or STAT 302-3,
9 hours of electives

Total 28 semester hours

LEVELS 7 and 8:

BICH 403-3, 412-4 and 413-2
BISC 431-4
CHEM 333-3
15 hours of electives

Total 31 semester hours

Students entering without the equivalent of B.C. High School Chemistry 12 may not enter CHEM 102-3, but may begin with CHEM 101-3 and 106-2 and then follow a program similar to the one above.

Honours Program

(132-133 semester hours)

In addition to the core courses shown for the major program, students taking honors in Biochemistry must complete a further 42 semester hours, to include: CHEM 357-3 (Chemical and Instrumental Methods of Identification of Organic Compounds), and either BICH 491-5 (Undergraduate Research) or BICH 493-15 (Individual Study Semester), plus at least 9 semester hours of credit from the following list of courses:

BICH 421-3 Nucleic Acids
BICH 422-3 Biomembranes
BICH 423-3 Protein Structure and Function
BISC 402-3 Molecular Genetics
BISC 453-3 Advanced Developmental Biology
BISC 457-3 Plant Biochemistry and Molecular Biology
CHEM 450-3 Mechanistic Organic Chemistry
CHEM 411-3 Crystal Structure Analysis

or with the permission of the Undergraduate Advisor

BICH 420-3 Selected Topics in Contemporary Biochemistry
BICH 490-3 Directed Study in Advanced Topics of Biochemistry
BISC 471-3 Special Topics in Biology
BISC 472-3 Special Topics in Biology
BISC 473-3 Special Topics in Biology

plus 9 semester hours in courses outside the Faculty of Science (including 6 hours in the Faculty of Arts, but excluding EDUC 401 to 407); and sufficient upper division courses to bring the total number of upper division credit to at least 60 semester hours. Further BSc. honors requirements are given in the *Faculty of Science* section.

Minor Program

(64-66 semester hours minimum)

Lower Division Requirements

(50 semester hours minimum)

BICH 221-3 and 222-3

BISC 101-4 and 102-4

CHEM 102-3, 103-3, 115-2, 118-2, 150-3, 155-2, 218-3, 250-3 and 255-3

MATH 151-3 and 152-3 (or 154-3 and 155-3)

PHYS 120-3 and 121-3 (or 101-3 and 102-3)

Upper Division Courses

(15-17 semester hours)

BICH 311-2, 312-2, 321-3, 322-3

and at least two of

BICH 403-3 (requires CHEM 261), 412-4, 413-2, 420-3, 421-3, 422-3, 423-3, 490-3

BISC 321-3 (requires BISC 202)

Co-operative Education Program

Major and honours students in Biochemistry may apply for admission into the Science Co-operative Education Program. The program includes four work semesters during the normal academic program. For further details, refer to the *Co-op Education* section.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Biosciences/Chemistry

Abbreviation Code: BICH Course Number: 221 Credit Hours: 3 Vector: 3-1-0

Title of Course: Cellular Biology and Biochemistry

Calendar Description of Course:

A study of the molecular processes which underlie cell structure and function, integrating ultrastructural, physiological and biochemical approaches. Modern techniques used in the analysis of organelle and cell function are integral parts of the course.

Nature of Course: Lecture

Prerequisites (or special instructions):

BISC 101, BISC 102, and either CHEM 103 or CHEM 150 (both CHEM 103 and CHEM 150 are recommended as prerequisites or corequisites). Students may not receive credit for both BICH 221 and BISC 201.

What course (courses), if any, is being dropped from the calendar if this course is approved?

2. Scheduling

How frequently will the course be offered? three times per year

Semester in which the course will first be offered? 94-1

Which of your present faculty would be available to make the proposed offering possible?

M. Moore, A. Kermode, C. Boone, J. Scott

3. Objectives of the Course

The companion courses BICH 221, 222, 321 and 322 integrate the instruction of cell and molecular biology, biochemistry and molecular aspects of physiology.

To provide an integrated overview of cell function.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas?

Faculty: none

Staff: none

Library: none

Audio Visual: none

Space: none

Equipment: none

5. Approval FEB. 18, 1993

Date

[Signature]
[Signature]

Department Chair

9 March 93

[Signature]

Dean

Mar 25/93

[Signature]

Chair SCUS

17.

BICH 221

Cellular Biology and Biochemistry

Sample outline:

- week 1: Overview of the cell and its chemical components
- week 2: Introduction to catalysis and energy metabolism
- week 3: The cytosolic compartment: glycolysis and lipid breakdown
- week 4: The mitochondrion: structure and function (citric acid cycle, oxidative phosphorylation)
- week 5: The chloroplast: structure and function (photosynthesis, Calvin cycle)
- week 6: Membranes: structure and functions
- week 7: Membrane transport: Ion pumps and channels
- week 8: The endomembrane system: ER, Golgi and intracellular sorting
- week 9: Lysosomes and peroxisomes
- week 10: The cytoskeleton, cell movement
- week 11: Cell signalling: strategies, cell junctions, plasmodesmata
- week 12: Cell signalling: receptors and second messengers
- week 13: Extracellular matrix, cell-cell recognition and adhesion

Recommended textbooks:

Alberts, Molecular Biology of the Cell
Stryer, Biochemistry

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Biosciences/Chemistry

Abbreviation Code: BICH Course Number: 222 Credit Hours: 3 Vector: 3-1-0

Title of Course: Introduction to Molecular Biology and Biochemistry

Calendar Description of Course:

An introduction to DNA replication and recombination, RNA transcription and protein synthesis in the context of their locations within the cell and their timing in the cell cycle. The relationship between structure and function of proteins and nucleic acids will be addressed.

Nature of Course: Lecture

Prerequisites (or special instructions):

BICH 221 (or BISC 201). CHEM 250 is a recommended prerequisite or corequisite.

What course (courses), if any, is being dropped from the calendar if this course is approved? N/A

2. Scheduling

How frequently will the course be offered? three times per year

Semester in which the course will first be offered? 94-2

Which of your present faculty would be available to make the proposed offering possible?

T. Borgford, B. Honda, D. Sen, M. Smith

3. Objectives of the Course

The companion courses BICH 221, 222, 321 and 322 integrate the instruction of cell and molecular biology, biochemistry and molecular aspects of physiology.

To provide an integrated overview of molecular and biochemical processes.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas?

Faculty: none

Staff: none

Library: none

Audio Visual: none

Space: none

Equipment: none

5. Approval

Date FEB. 18, 1993

[Signature]
BAM: [Signature]

Department Chair

9 March 93

[Signature]
CHW: [Signature]

Dean

Mar 25/93

[Signature]

Chair SCUS

BICH 222

Introduction to Molecular Biology and Biochemistry

Sample outline:

- week 1: Chemical Equilibria, free energy, catalysis
- week 2: Proteins I: amino acids, polypeptides, folding
- week 3: Proteins II: enzyme classes, serine protease, haemoglobin
- week 4: DNA Structure
- week 5: DNA replication; repair and mutagenesis
- week 6: Prokaryotes *vs.* Eukaryotes; The Nucleus; Chromosome structure; Chromatin
- week 7: The Cell Cycle; Chromosome Replication; Mitosis and Meiosis
- week 8: Recombination; Plasmids and Viruses
- week 9: Recombinant DNA and Techniques
- week 10: The Flow of Genetic Information; Prokaryotic Transcription; the lac operon
- week 11: Eukaryotic transcription; poly A and capping; Splicing
- week 12: Protein Synthesis
- week 13: Protein Degradation; Urea Cycle; Makeup Class

Recommended textbooks:

Alberts, Molecular Biology of the Cell
Stryer, Biochemistry

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. **Calendar Information**

Department: Biosciences/Chemistry

Abbreviation Code: BICH Course Number: 321 Credit Hours: 3 Vector: 3-1-0

Title of Course: Intermediary Metabolism

Calendar Description of Course:

Major catabolic and anabolic pathways and their regulation. Particular emphasis is placed on bioenergetics and experimental methods encountered in biochemical research.

Nature of Course: Lecture

Prerequisites (or special instructions):

BICH 222 and CHEM 250 (or 252). BICH 311 should be taken concurrently. Students may not receive credit for both BICH 321 and BICH 301.

What course (courses), if any, is being dropped from the calendar if this course is approved?
BICH 301, BICH 302.

2. **Scheduling**

How frequently will the course be offered? twice per year

Semester in which the course will first be offered? 94-3

Which of your present faculty would be available to make the proposed offering possible?

R. Cornell, R. Cushley, N. Haunerland, W. Richards

3. **Objectives of the Course**

The companion courses BICH 221, 222, 321 and 322 integrate the instruction of cell and molecular biology, biochemistry and molecular aspects of physiology.

To teach metabolism and mechanistic aspects of biochemical reactions at an advanced level.

4. **Budgetary and Space Requirements** (for information only)

What additional resources will be required in the following areas?

Faculty: none

Staff: none

Library: none

Audio Visual: none

Space: none

Equipment: none

5. **Approval** FEB. 18, 1993

Date

[Signature]
[Signature]

Department Chair

9 Mar 93

[Signature]

Dean

Mar 25/93

[Signature]

Chair SCTIS

BICH 321

Intermediary Metabolism

A comprehensive treaty of intermediary metabolism. The course covers major catabolic and anabolic pathways and their regulation. Particular emphasis is placed on bioenergetics and experimental methodology encountered in biochemical research.

Sample outline:

- week 1: Design of metabolic pathways, structure and function of coenzymes
- week 2: Structure and catabolism of carbohydrates; carbohydrate analysis
- week 3: Structure and catabolism of lipids; lipid analysis
- week 4: Structure and catabolism of amino acids; peptide and amino acid analysis
- week 5: Bioenergetics: citric acid cycle
- week 6: Bioenergetics: mitochondrial electron transport
- week 7: Bioenergetics: photosynthesis
- week 8: Bioenergetics: photosynthesis
- week 9: Biosynthesis of carbohydrates; complex carbohydrates
- week 10: Biosynthesis of lipids; chemical synthesis of lipids
- week 11: Biosynthesis of amino acids; peptide synthesis
- week 12: Biosynthesis of nucleotides and coenzymes; chemical synthesis of DNA
- week 13: Intergration of metabolisms; metabolic diseases

Recommended textbooks:

Stryer, Biochemistry
Zubay, Biochemistry, 3rd edition, 1993

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Biosciences/Chemistry

Abbreviation Code: BICH Course Number: 322 Credit hours: 3 Vector: 3-1-0

Title of Course: Molecular Physiology

Calendar Description of Course:

Cellular and biochemical aspects of immunology, muscle contraction, cell motility, neural transmission, the action of hormones. The course will also explore the cellular and molecular bases of cancer.

Nature of Course: Lecture

Prerequisites (or special instructions):

BICH 222. BICH 321 (or BICH 301) is recommended. Students may not receive credit for both BICH 322 and BICH 302.

What course (courses), if any, is being dropped from the calendar if this course is approved?

2. Scheduling

How frequently will the course be offered? twice per year

Semester in which the course will first be offered? 95-1

Which of your present faculty would be available to make the proposed offering possible?

T. Borgford, J. Burr, J. Scott, D. Sen, W. Richards

3. Objectives of the Course

The companion courses BICH 221, 222, 321 and 322 integrate the instruction of cell and molecular biology, biochemistry and molecular aspects of physiology.

To teach selected topics in molecular physiology at an advanced level.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas?

Faculty: none

Staff: none

Library: The following journals are requested: Bioessays and Current Opinion in Cell Biology.

Audio Visual: none

Space: none

Equipment: none

5. Approval FEB. 18, 1993

Date

[Signature]

Department Chair

9 March 93

ChW. Jones

Dean

Mar 25/93
[Signature]

Chair SCUS

23

Molecular Physiology

BICH 322

Sample Outline

- week 1: Immunology: Antibodies and Humoral Immunity
- week 2: Immunology: Cell mediated Immunity I
- week 3: Immunology: Cell mediated Immunity II; The Complement system.
- week 4: The Nervous System: Cells and Excitable membranes
- week 5: The Nervous System: Synaptic Transmission
- week 6: Muscle Contraction
- week 7: Cell Motility
- week 8: Membrane Transport
- week 9: Hormones and strategies of Chemical Signalling
- week 10: Signal Transduction: Mechanisms I
- week 11: Signal Transduction: Mechanisms II
- week 12: Cancer: Cellular Aspects
- week 13: Cancer: Molecular Genetic Aspects

Texts*: Molecular Biology of the Cell by B. Alberts et al.
Biochemistry by L. Stryer

* It is expected that these textbooks will be supplemented in specific cases with material from more advanced texts and from review papers.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Biosciences/Chemistry

Abbreviation Code: BICH Course Number: 421 Credit Hours: 3 Vector: 3-1-0

Title of Course: Nucleic Acids

Calendar Description of Course:

Recent literature is examined for insights into the structure and properties of DNA and RNA, drawing on a variety of biochemical, chemical and molecular biological perspectives.

Nature of Course: Lecture

Prerequisites (or special instructions):

BISC 321

What course (courses), if any, is being dropped from the calendar if this course is approved? N/A

2. Scheduling

How frequently will the course be offered? once per year

Semester in which the course will first be offered? 94-3

Which of your present faculty would be available to make the proposed offering possible?

D. Sen

3. Objectives of the Course

To study nucleic acid structure and properties at an advanced level.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas?

Faculty: none

Staff: none

Library: The following journals are requested: Current Opinion in Structural Biology and Current Opinion in Genetics and Development.

Audio Visual: none

Space: none

Equipment: none

5. Approval

Date FEB. 18, 1993

[Signature]

Department Chair

9 March 93

[Signature]

Dean

[Signature]
Mar 25/93

[Signature]

Chair SCUS

25

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Biosciences/Chemistry

Abbreviation Code: BICH Course Number: 422 Credit hours: 3 Vector: 3-1-0

Title of Course: Biomembranes

Calendar Description of Course:

A review of recent research on the structure, dynamics, function and biosynthesis of membranes, membrane lipids and proteins.

Nature of Course: Lecture

Prerequisites (or special instructions): BICH 301/BICH 302 until replacement by BICH 321/BICH 322

BICH 321 (or 301) and 322 (or 302). BICH 413 is recommended.

What course (courses), if any, is being dropped from the calendar if this course is approved? N/A

2. Scheduling

How frequently will the course be offered? once per year

Semester in which the course will first be offered? 94-3

Which of your present faculty would be available to make the proposed offering possible?

R. Cornell

3. Objectives of the Course

To give students an understanding of biological membranes and to familiarize students with current major research initiatives in the field

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas?

Faculty: none

Staff: none

Library: none

Audio Visual: none

Space: none

Equipment: none

5. Approval

Date FEB. 18, 1993
[Signature]
Department Chair

9 March 93
[Signature]
Dean

Mar 25/93
[Signature]
Chair SCUS

SCUS 73-74b: (When competing this form, for instructions see Memorandum SCUS 73-74a.)

SENATE COMMITTEE ON UNDERGRADUATE STUDIES
NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: Biosciences/Chemistry

Abbreviation Code: BICH Course Number: 423 Credit Hours: 3 Vector: 3-1-0

Title of Course: Protein Structure and Function

Calendar Description of Course:

Recent research in transition state theory; specificity in enzyme catalyzed reactions, the use of recombinant DNA techniques to describe and modify enzyme catalysis, the function of enzymes in organic solvents, and the development of new catalytic activities through monoclonal antibody techniques.

Nature of Course: Lecture

Prerequisites (or special instructions):

BISC 321 and either BICH 321 (or BICH 301) or BICH 322 (or BICH 302).

What course (courses), if any, is being dropped from the calendar if this course is approved? N/A

2. Scheduling

How frequently will the course be offered? once per year

Semester in which the course will first be offered? 95-1

Which of your present faculty would be available to make the proposed offering possible?

T. Borgford

3. Objectives of the Course

To study protein and enzyme structures, functions and catalysis at an advanced level.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas?

Faculty: none

Staff: none

Library: The following journal is requested: Current Opinion in Structural Biology.

Audio Visual: none

Space: none

Equipment: none

5. Approval

Date

FEB. 18, 1993

9 March 93

Mar 25/93.

[Signature]

[Signature]

[Signature]

Department Chair

Dean

Chair SCUS

**SIMON FRASER UNIVERSITY
BIOCHEMISTRY CURRICULUM COMMITTEE
MEMORANDUM**

To: Dr. R. Heath
From: Dr. T. Borgford, Chair of the Biochemistry Curriculum Committee
Subject: Grading Schemes for New Biochemistry Courses
Date: February 17, 1993

The purpose of this memorandum is to explain the grading schemes for students in each of the seven new Biochemistry courses proposed in SCUS 93-6.

- 1) Students in the lower division courses BICH 221, 222, 321 and 322 will be evaluated by two midterm examinations, each comprising 25% of the final grade, and an end of term examination comprising 50% of the final grade.
- 2) Students in the upper division courses BICH 421, 422 and 423 will be evaluated on the basis of a combination of oral presentations and term papers worth 50% of the final grade, plus an examination worth 50% of the final grade.

Dr. Thor Borgford

SIMON FRASER UNIVERSITY

W.A.C. BENNETT LIBRARY

MEMORANDUM

To: Dr. T. Borgford	From: Ralph Stanton Collections Librarian
Subject: Library Requirements for Biochemistry Curriculum	Date: March 4, 1993

I have read the documentation you supplied me with regarding the seven new course offerings (BICH 221, 222, 321, 322, 421, 422, 423) in Biochemistry. We recognize that the historical inadequacies of our collection cannot be corrected on the backs of single courses and that it is often difficult to assign specific collection gaps to particular courses. Nevertheless, we believe it is important to take the opportunity provided by these assessments to analyze and evaluate the existing collections as carefully and completely as possible within the time constraints allowed. Our dual intention is to inform the community about the relative strengths and weaknesses of the collection and to define appropriate support for these particular courses.

In assessing our library holdings in each case I compared holdings of the three University libraries in B.C. for major subject headings associated with the course. The findings for this part of the process is given under each course number and more details are included in the attached worksheets. In virtually all subjects our holdings are substantially superior to the University of Victoria's but generally inferior to UBC's.

Using Library of Congress subject classification numbers derived from the subject headings list I compared our holdings to our peer group on the OCLC/AMIGOS CD-ROM system. We compared only for materials held by at least 20% of the libraries in our peer group and only for items published in the last five years of AMIGOS' holdings. *In other words our analysis is based on a very conservative sampling of the possible universe of titles in these LC numbers.* Since the topics of the courses are interrelated and there is some overlap in LC numbers between courses I report these findings at the end of the course sequence.

29
B
5 Mar 1993

All courses are for three credit hours. Periodical indexes are adequate for all courses. Here are our findings:

BICH 221 Cellular Biology and Biochemistry

This course replaces BICH 201 Cell Biology. It will be offered 3 times a year and the enrollment is about 200 students per semester. Our holdings are substantially inferior to those of UBC in five of the seven subject headings. The greatest gaps are for *Cells*, UBC has 159 titles and we have 48, *Energy Metabolism* 121 to 46, and *Cell Differentiation* 84 to 56.

We think that the data shows that the monograph collection is not adequate in this area. However, the serials collection appears to be adequate for this course.

BICH 222 Introduction to Molecular Biology and Biochemistry

This is described as an "original" course, it will be offered three times a year to about 200 students per semester. Of the seven subject headings identified we are substantially inferior to UBC in four. The greatest gaps are in *Proteins* 219 to 113, and *Amino Acids* 61 to 26.

We think that the data shows that the monograph collection is not adequate in this area. However, the serials collection appears to be adequate for this course.

BICH 321 Intermediary Metabolism

This course replaces BICH 301 The Structure and Reactivity of Biomolecules. It will be offered twice a year to 75 - 100 students per offering. Of the seven subject headings identified we are substantially inferior to UBC in two; *Biochemistry* 828 to 321. (the difference is less than apparent because we use Biological Chemistry where we have 331 titles) and *Metabolism* 226 to 62.

We think that the data shows that the monograph collection is not adequate in this area. However, the serials collection appears to be adequate for this course.

Page 3
Dr. T. Borgford
March 4, 1993

BICH 322 Molecular Physiology

This course replaces BICH 302 Genetic Analysis. It will be offered twice a year to between 75 and 100 students per offering. Of the seven subject headings identified our holdings were inferior in all seven: The greatest gaps were in *Immunology* 247 to 74, *Hormones* 140 to 55, *Nervous System* 251 to 76 and *Cancer Cells* 63 to 20.

The course proposal form suggests the journals *Bioessays* (\$362.18) and *Current Opinion in Cell Biology* (\$527.22) as necessary for this course.

We think that the data shows that the monograph collection is not adequate in this area. With the two added titles, the serials collection will be adequate for this course.

NOTE: the three following courses have previously been taught as special topics courses under the 420 number. Special topics courses, to date, have normally been created without reference to the need for Library resources.

BICH 421 Nucleic Acids

This course will be offered once per year to between 20 and 30 students. Our holdings are inferior to UBC's in three of the four subject headings.

The course proposal form requests the journal *Current Opinion in Genetics and Development* (\$527.22) as necessary for this course.

We think that the data shows that the monograph collection is not adequate in this area. With the added title, the serials collection will be adequate for this course.

BICH 422 Biomembranes

This course will be offered once per year to between 20 and 30 students. For the subject heading Membranes - Biology our holdings are close to UBC's, in the subject heading Lipids they have 90 we have 2. We think that the data shows that the monograph collection is not adequate in this area. Serials are adequate for this course.

BICH 423 Protein Structure and Function

This course will be offered once per year to between 20 and 30 students. Our holdings are inferior to UBC in the four subject headings identified; *Enzymes* 270 to 133, *antibodies, monoclonal* 37 to 8, *Proteins* 231 to 113 and Recombinant DNA 42 to 25.

The course proposal form requests the journal *Current Opinion in Structural Biology* (\$598.69) as a necessary addition.

We think that the data shows that the monograph collection is not adequate in this area. With the addition of one title, the serials collection should be adequate for this course.

SUMMARY OF AMIGOS FINDINGS.

In this summary we have not included an estimate of the number of existing library materials which should be duplicated due to the high use evidenced during title searches for this survey and the large enrolments in these courses.

Given the large number of students enrolled in these courses we think our estimates are modest. We should also note that the Library budget line for Biological Sciences has increased substantially in recent years due mainly to the rising cost of scientific serials. A serials review has recently been conducted for this Department so the current complement of serials is appropriate.

Our interrogation of the AMIGOS system confirms the impression gained from the comparison with UBC. Our holdings show a consistent deficit.

We investigated 30 Library of Congress call numbers or call number ranges using the latest five year holdings for titles owned by 20% or more of a peer group of 45 large academic libraries with holdings less than 1,000,000 monographs. This choice of peer group is consistent with the conservative approach we have taken with this analysis; our real peer group is the one above i.e. greater than 1,000,000 monographs. We found a total of 487

Page 5
Dr. T. Borgford
March 4, 1993

items. Of these SFU lacks 179. Of these 27 were thought to be irrelevant so the total missing is 152.

The per volume cost (based on actual costs during the 1991-1992 year) of titles in this field is \$118.65. We would like to purchase a percentage of the missing 152 items, say 50 at a one time cost of \$5,932.50.

We also need to pick up some of the material we are not now collecting. We estimate this number to be 30 per year (derived by dividing the 152 number by 5 (years)). The recurring cost is \$3,559.50. We hope the additional books purchased will be useful for other courses in the Department.

SUMMARY OF COSTS

One Time Costs:

Monographs	\$5,932.50
Cost per course	847.50
Cost per student	3.51

Recurring Costs, Per Year:

Monographs	\$3,559.50
Serials	2,015.31
Total	<hr/> \$5,574.81
Cost per course	\$796.40
Cost per student	\$ 3.30

Page 6
Dr. T. Borgford
March 4, 1993

RECOMMENDATION

We believe the recurring costs are essential for the adequate support of these courses. Both the Department and the Library have stated that four journals are required. This would cost \$2,015.31 per year including binding costs (\$287.90 per course or \$1.19 per student).

We believe it is essential to increase monograph purchases in this area by about 30 volumes per year in order to avoid the inevitable compounding of past problems in future years. This would cost \$3,559.50 (\$508.50 per course or \$2.11 per student).

In addition it would be highly desirable, although perhaps not essential for these particular courses, to fill 50 of the significant gaps in the monograph collection at an additional, one time, cost of \$5,932.50 (\$847.50 per course or \$3.51 per student).

Attachment 1, 3 pages



RS/eg

c.c. Sharon Thomas
Ted Dobb

COURSE ASSESSMENT WORKSHEET

COURSE No.: BICH 221

<u>L.C. SUBJECT HOLDINGS</u>	<u>UVIC</u>	<u>SFU</u>	<u>UBC</u>
Cells	13	48	159
Catalysis	18	87	111
Energy Metabolism	10	46	121
Chloroplasts	2	17	21
Membranes (Biology)	39	82	91
Cell Interaction	11	32	38
Cell Differentiation	16	56	84
TOTAL	<u>109</u>	<u>368</u>	<u>625</u>

COURSE ASSESSMENT WORKSHEET

COURSE No.: BICH 222

<u>L.C. SUBJECT HOLDINGS</u>	<u>UVIC</u>	<u>SFU</u>	<u>UBC</u>
Chemical Equilibrium	8	40	38
Proteins	27	113	219
Amino Acids	9	26	61
Polypeptides	0	4	3
Chromosomes	14	52	72
Eukaryotic Cells	10	22	22
Protein Biosyntheses	0	19	32
TOTAL	<u>68</u>	<u>276</u>	<u>447</u>

35

COURSE ASSESSMENT WORKSHEET

COURSE No.: BICH 321

<u>L.C. SUBJECT HOLDINGS</u>	<u>UVIC</u>	<u>SFU</u>	<u>UBC</u>
Biological Chemistry	3	331	17
Bioenergetics	31	71	86
Biochemistry	87	20	828
Metabolism	16	62	226
Physiological Chemistry	1	28	16
Carbohydrate Metabolism	0	5	13
Photosynthesis	23	64	85
TOTAL	<u>161</u>	<u>581</u>	<u>1271</u>

COURSE ASSESSMENT WORKSHEET

COURSE No.: BICH 322

<u>L.C. SUBJECT HOLDINGS</u>	<u>UVIC</u>	<u>SFU</u>	<u>UBC</u>
Immunology	32	74	247
Muscle Contraction	8	28	47
Hormones	14	55	140
Nervous System	24	76	251
Cancer Cells	5	20	63
Cancer - Somatic Aspects	6	2	32
Cancer - Molecular Aspects	0	1	7
TOTAL	<u>89</u>	<u>256</u>	<u>787</u>

COURSE ASSESSMENT WORKSHEET

COURSE No.: BICH 421

<u>L.C. SUBJECT HOLDINGS</u>	<u>UVIC</u>	<u>SFU</u>	<u>UBC</u>
Genetic Regulation	23	25	38
Genetic Transcription	3	7	27
Nucleic Acids	19	57	93
Catalysis	19	87	111
TOTAL	<u>64</u>	<u>176</u>	<u>269</u>

COURSE ASSESSMENT WORKSHEET

COURSE No.: BICH 422

<u>L.C. SUBJECT HOLDINGS</u>	<u>UVIC</u>	<u>SFU</u>	<u>UBC</u>
Lipids	13	2	90
Membranes - Biology	39	82	91
TOTAL	<u>52</u>	<u>84</u>	<u>181</u>

COURSE ASSESSMENT WORKSHEET

COURSE No.: BICH 423

<u>L.C. SUBJECT HOLDINGS</u>	<u>UVIC</u>	<u>SFU</u>	<u>UBC</u>
Enzymes	49	133	270
Antibodies - Monoclonal	7	8	37
Recombinant DNA	17	25	42
Proteins	27	113	213
TOTAL	<u>100</u>	<u>279</u>	<u>562</u>