SIMON FRASER UNIVERSITY

OFFICE OF THE VICE-PRESIDENT, ACADEMIC

MEMORANDUM

To: Senate

From: D. Gagan, Chair
Senate Committee on Academic Planning

Subject: Proposed Master of Environmental Toxicology Program
(Reference: SCAP 97-46, SGSC Oct. 27/97)

Date: November 10, 1997

Action undertaken by the Senate Committee on Graduate Studies and the Senate Committee on Academic Planning gives rise to the following motion:

Motion:

"that Senate approve and recommend to the Board of Governors as set forth in S.97 - 83 , the proposed Master of Environmental Toxicology Program including:

New courses:
- BISC 651-3 Environmental Toxicology Tests I: Ecological Effects-Based Toxicity Tests
- BISC 655-3 Environmental Toxicology Seminar
- BISC 656-0 Master of Environmental Toxicology Project
- BISC 657-0 Co-op Practicum I
- BISC 658-0 Co-op Practicum II
- BISC 854-3 Ecotoxicology
- BISC 855-3 Biochemical Toxicology
- BISC 856-3 Industrial Biotechnology

For Information:
Acting under delegated authority of Senate, SGSC approved revisions as follows:

Change of title: BISC 650, 652
Change of number: BISC 654

SCAP 97 - 46

SIMON FRASER UNIVERSITY

MEMORANDUM

To: Alison Watt, Director
Secretariat Services

From: B.P. Clayman
Vice-President, Research/
Dean of Graduate Studies

Subject: Proposed Master's in Environmental Toxicology

Date: October 29, 1997

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The proposed Master's in Environmental Toxicology was approved by the Senate Graduate Studies Committee, at its Meeting on October 27, 1997, and is now being forwarded to the Senate Committee on Academic Planning for approval.

B.P. Clayman
Vice-President Research/
Dean of Graduate Studies

m m /
attach.

SIMON FRASER UNIVERSITY

DEAN OF GRADUATE STUDIES

Memorandum

TO:	B. P. Clayman Dean, and Chair, Senate Graduate Studies Committee	**FROM:**	Phyllis Wrenn Associate Dean Chair, ACNGP
SUBJECT:	Proposal for **Master's in Environmental Toxicology**	**DATE:**	July 14, 1997

I am pleased to report that the Assessment Committee for New Graduate Programs (ACNGP) has approved and recommends to the SGSC for approval the proposal for a **Master's in Environmental Toxicology**. The first draft of the proposal was received on August 2, 1996.

You will note that only three of the customary four reports from external reviewers of the proposal are included. Attempts to obtain the outstanding report were unsuccessful.

Please place this proposal on the agenda of the next meeting of the SGSC. By copy of this memorandum, I am inviting M. Smith or his designate to attend this meeting as a representative of the proposed program.

P. Wrenn M. Wrenn

Encl.

c: M. Smith, Chair, Biological Sciences
M. McGinn

PROPOSAL FOR MASTERS IN ENVIRONMENTAL TOXICOLOGY

08 November 1995	Approved "in-principle" by Senate Committee on Academic Planning
26 March 1996	Approved by Faculty of Science
02 August 1996	Received by Dean of Graduate Studies
01 October 1996	Reviewed by Assessment Committee for New Graduate Programs
17 December 1996	Received revised version by Dean of Graduate Studies
14 February 1997	Reviewed by Assessment Committee for New Graduate Programs
28 February 1997	Received revised version by Dean of Graduate Studies
21 March 1997	Sent revised version to four External Reviewers by Dean of Graduate Studies
16 May 1997	Received External Reviewers' reports (3) by Dean of Graduate Studies
04 June 1997	Sent External Reviewers' reports to Department of Biological Sciences by Dean of Graduate Studies
23 June 1997	Received Departmental of Biological Sciences response to External Reviewers' reports by Dean of Graduate Studies
14 July 1997	Approved by Assessment Committee for New Graduate Programs

TABLE OF CONTENTS

Environmental Toxicology - What Is It?

Environmental toxicology (ET) is a new and rapidly developing field which is concerned with the fate and toxicological effects of contaminants on the environment. The environmental toxicologist draws on a variety of scientific disciplines to describe, measure, explain and predict the severity and frequency of adverse effects on living organisms due to environmental toxicant exposure. As a broadly based and interdisciplinary science, ET uses a variety of techniques to study the fate of and impact of contaminants on the environment and provides powerful tools for assessing the risks associated with the presence of these contaminants.

Environmental Toxicology at SFU

As a result of increasing concern about environmental pollution, an undergraduate ET program was initiated by the Department of Biological Sciences, SFU. On behalf of the Department, the late Dr. Oloffs, a pesticide toxicologist, submitted to the Universities Council of B.C. a proposal for an ET program which was approved on June 22, 1981. Funds were provided separately by the B.C. government for the salaries of two faculty positions and a 1/2 time secretary for a period of four years. Dr. Law was hired in 1982 as an associate professor and Dr. Farrell was hired in 1984 as an assistant professor. In 1985 the funding for the ET program was incorporated into the general University budget. Dr. Nicholson was hired to replace Dr. Oloffs after he passed away.

Currently, the ET teaching program consists of two sub-programs: a minor and a post baccalaureate diploma (PBD). Calendar descriptions are presented in Appendix I. Both of these programs are classified as undergraduate programs, although the minimal admission requirements for the PBD is a B.Sc. degree. At the inception of the ET teaching program at SFU, there were very few formalized toxicology training programs in Canada. At present, the universities of Toronto, Guelph, Saskatchewan, and Montreal offer M.Sc and/or Ph.D. degrees in toxicology.

The ET undergraduate program at SFU has become increasingly popular among students due to its high quality and relevance. For example, student enrollments for Environmental Toxicology I and II courses have exceeded 150 and 50 students per year, respectively for the last five years. The core curriculum for the undergraduate ET

program includes courses from the Departments of Biological Sciences, Chemistry, Geography and Kinesiology. Since ET draws its knowledge mainly from the biomedical and environmental sciences, the ET undergraduate program has integrated resources across campus.

In 1989, a task force on environmental science and toxicology was struck by Dr. Colin Jones, Dean of Science to examine possible directions for environmental science and toxicology development. Among the recommendations made by the task force was a recommendation to establish a professional graduate training program in environmental toxicology at the Master's level (MENTOX) (see Appendix II).

In the past few years, several faculty members with teaching and research interests in ET have joined SFU. These include Drs. Gobas (Department of Resource and Environment Management), Bendell-Young, Kennedy and Moore (Department of Biological Sciences). The ET faculty has expressed a desire to offer a cohesive course program for graduate students. Discussions began in 1991 and we have now developed a proposal for what we believe to be an outstanding MENTOX program. The proposed program encompasses a reorganization of existing courses in the undergraduate ET program and the addition of several new courses developed by the newly appointed ET faculty members.

Proposed MENTOX Course Program

1. Program objectives.

The main objectives of the MENTOX program are (1) to meet the need for additional trained environmental toxicologists, a need identified as an emerging provincial and national problem (see "National and regional need") and (2) to develop and maintain high standards of research and education in toxicology.

This proposal requests that Senate designate MENTOX as a "professional degree". This professional degree will provide the MENTOX graduates with training in basic and applied sciences and with skills for the working environment. A professional MENTOX program would be preferable to a MENTOX program with a heavy research component, since the career goals of a significant number of prospective students would not be met by a primarily research-

oriented M.Sc. or Ph.D. degree in toxicology. Moreover, although toxicology practitioners are in great demand by governments, industries and consulting firms, only a few toxicology researchers are required by universities, government institutes and companies in Canada.

Eligibility for the certification examination of the American Board of Toxicology, Inc. can be met through the Master of Environmental Toxicology program and four years of work experience.

The MENTOX program at SFU will be offered on a full- or part-time basis. Students enrolled in the MENTOX program will also have the option of participating in the co-operative education program.

2. Relationship of the proposed MENTOX program to the role and mission of SFU.

It is both timely and appropriate to establish a MENTOX program at SFU since it will be qualified for funding by the SFU Academic Enhancement Fund (AEF) and the Canadian Network of Toxicology Centres (CNTC). The AEF was established at SFU to fund new programs, curricula and initiatives. The CNTC received $14.1 million from Canada's Green Plan in April 1992 to develop and maintain toxicology education and research in Canada. At present, the CNTC consists of the Centre for Toxicology at the University of Guelph, the Toxicology Research Centre at the University of Saskatchewan, and the Centre Intreuniversitaire de Recherché en Toxicologie de l'Universite de Montreal et de l'Universite du Quebec a Montreal. SFU is not a centre of CNTC since, until recently, SFU had only 2.5 academic appointments in toxicology (see above). Moreover, SFU toxicologists have only recently begun to organize themselves into an identifiable, academic unit. Upon creation of a MENTOX program, the Centre for Environmental Toxicology at SFU (to be formed later) will establish itself as an active member of the CNTC.

We are hopeful that with the establishment of MENTOX and a Centre for Environmental Toxicology at SFU, it will be easier to attract federal funding in this area. However, the MENTOX program is not dependent on these funds.

In 1990, the Ministry of Advanced Education, Training and Technology of B.C. sponsored a workshop each at the Okanagan

College (May, 1990) and BCIT (September, 1990) to discuss current environmental science/study programs at B.C. Community Colleges. One of the workshop findings is that nearly all B.C. Community Colleges offer an undergraduate or PBD program in environmental science/study. Some of the colleges such as BCIT also have obtained degree-granting status in this area. However, graduates of these programs have found it difficult to locate an appropriate discipline for advanced training at B.C. universities. The proposed MENTOX program at SFU will provide an opportunity for post-graduate training of these students. In addition MENTOX graduates will have the expertise and formal academic qualifications which will enable them to return to the Community College environment in an instructional capacity. It should be pointed out that although UBC and UVic also offer environmental science/study programs, UVic does not appear to be taking any initiative in the area of toxicology while UBC's toxicology program is designed mainly for medical practitioners (e.g. drug toxicology, occupational health). In contrast to the medical approach at UBC, the proposed MENTOX program at SFU will emphasize an ecosystem approach to toxicology.

Not only does the Department of Biological Sciences at SFU already have an excellent undergraduate teaching program in ET, it also has achieved an impressive track record in mounting and operating interdisciplinary, professionally oriented programs which liaise with industry and are driven by industry needs. The well-established Master of Pest Management program would be enhanced by a professional, Master degree in ET. In addition, the creation of a MENTOX program would provide a research and teaching focus for the faculty currently engaged in ET research and would facilitate the interchange of ideas and resources among faculty and students.

3. Program organization.

Because of the preponderance of biological science courses in the MENTOX curriculum and the history of ET development at SFU, the Department of Biological Sciences will be the home department for MENTOX. Other participating departments could include Resource and Environment Management, Chemistry, Earth Sciences, Kinesiology and Mathematics and Statistics (see Appendix III, Letters from participating departments).

4. Rationale for the proposed curriculum.

The multi-disciplinary and professional nature of MENTOX addresses a variety of training demands not encountered in the more traditional scientific disciplines. MENTOX will attract students having training in various scientific disciplines. Students may opt to continue in their undergraduate specialty, perhaps exploring new technologies, as they undertake advanced training and research in toxicology. Alternatively they may choose to apply their undergraduate and graduate expertise to the problems of an entirely different discipline. In either case, the trainee should be exposed to a broad cross-section of toxicological knowledge in order to obtain an appreciation for and familiarity with the terminology as well as descriptive, mechanistic and predictive (assessment of risk) dimensions of the science. It is likely that he/she will have to practice in or research on one or more of these dimensions of toxicology. Therefore, more than in any other scientific discipline, versatility should be of prime importance in a toxicological training program even though it is recognized that, for a given individual, the practice of toxicology cannot possibly encompass all facets of the field. Therefore, the broader goal in a graduate training program should balance conceptual development with multifaceted technological training. The challenge of a graduate training program in environmental toxicology is to organize the existing scientific and technological training programs into an integrated format wherein the trainees obtain an understanding of the roles of the various participating disciplines in the characterization and solution of toxicological problems. As with the minor and PBD programs, the MENTOX program will combine the ecological effects-based and human health effects-based approaches of toxicological training.

Before entering MENTOX, the student should possess a good basic knowledge of chemistry and biological or biomedical sciences at both the macro and micro levels. This background may or may not include introductory, descriptive courses in toxicology. Given the variable background of prospective students, there must be a flexible component to admission. The overall aim of the training program will be to make the trainee fully aware of the various steps of the toxicological process including (a) the characterization of the toxicant and its source (toxicity tests; hazard identification), (b) the transport of the toxicant from the source to the target (environmental fates of chemicals), (c) the characterization of the target (target species; target organ of toxicity; biochemical toxicology), (d) the study of the

action and fate of the toxicant in the target (absorption, distribution, metabolism, and elimination of toxicants by living organisms; toxicodynamics), (e) the intervention at the individual level (treatment of poisoning; contaminated site remediation) and (f) the intervention at the population level (prevention program; regulatory measures; population risks).

Therefore, foundation courses in the descriptive, mechanistic and predictive dimensions of toxicology will be required of all students enrolled in the MENTOX program. Ancillary courses to broaden the horizons of the trainee or to overcome deficiencies and/or "gaps" in knowledge essential for a toxicologist should be available.

5. Admission requirements.

University admission requirements are given in the calendar in the section on General Regulations (Graduate Programs). The minimum requirements for admission to MENTOX is a B.Sc. degree with a cumulative grade point average of at least 3.0 from a recognized university, or the equivalent. In addition, the program requires that, for clear admission, the applicant must have CHEM 250 (Organic Chemistry II), BICH 221 (Cellular Biology and Biochemistry), BISC 312 and BISC 313 (An Introduction to Environmental Toxicology I and II) or equivalent courses. Applicants who lack some of the prerequisites may be admitted to the program but will be required to make up the deficiencies prior to graduation. The proportion of students admitted in this way will be small. Professional experience relevant to ET can be considered in the case of applicants who do not meet formal admission standards.

6. Degree requirements.

Each MENTOX student must choose a senior supervisor after admission, in consultation with the director of the program. In accordance with university regulations, a supervisory committee must be formed by the beginning of the third semester of full-time equivalent enrollment.

Every MENTOX program will include the following courses.

Core Courses

BISC 650-3 Environmental Risk Assessment: Human Health Risk Assessment and Ecological Effects-Based Risk Assessment
BISC 651-3 Environmental Toxicology Tests I: Ecological Effects-Based Tests
BISC 652-3 Environmental Toxicology Tests II: Mammalian Toxicity Tests
BISC 654-3 Food and Drug Toxicology
BISC 655-3 Environmental Toxicology Seminar
BISC 855-3 Biochemical Toxicology
STAT 650-5 Quantitative Analysis in Resource Management and Field Biology
BISC 656-0 Master of Environmental Toxicology Project.

As part of the degree requirements, MENTOX students must complete a project on a specific aspect of ET. One full semester will be allocated to this project, which will be based on original library, laboratory or field research. In addition to submission of a report at the completion of the project, the student will make an oral presentation to at least the Supervisory Committee and one other faculty member.

Elective Courses

One of:
BISC 854-3 Ecotoxicology
REM 610-5 Management of Contaminants in the Environment
EASC 613 Groundwater Hydrology

At least 6 credits chosen from the following:

BISC 856-3 Industrial Biotechnology
BISC 846-3 Insecticide Chemistry and Toxicology
REM 612-5 Simulation Modelling in Natural Resource Management
KIN 851-3 Recent Advances in Experimental Carcinogenesis
BISC 883-3 Special Topics in Environmental Toxicology

Although we do not anticipate that many students would enter MENTOX following the Post-Baccalaureate Degree program in Environmental Toxicology at SFU, those that do will have taken three required courses:
Environmental Risk Assessment (BISC 650, using the new MENTOX course numbers), Food and Drug Toxicology (BISC 654), and Environmental Toxicology Tests II (BISC 652). These students would

substitute three approved graduate courses in consultation with the director of the program and their advisor. Suggested areas would include Biological Sciences, Chemistry, Earth Sciences, Resource Management, and Kinesiology.

Co-operative Education Option

The MENTOX co-op option will differ from the regular MENTOX program only in the addition of two 1-semester co-op practicum courses BISC 657-0 and BISC 658-0 (see Appendix V) and the evaluation of the co-op work report. The MENTOX co-op option would only be available to Canadian citizens and permanent residents of Canada. The work report will be evaluated by the supervisory committee and the Employment Supervisor on a satisfactory/unsatisfactory basis and this grade will appear on the transcript. Successful completion of the practica will be recognized by a co-op certificate. Award of the MENTOX degree is not contingent on satisfactorily completing the practica. Students must register for the co-op option no later than the beginning of the penultimate semester prior to the beginning of the first work term (i.e. 8 months). Registration will be subject to the mutual agreement of the supervisory committee and the student, as approved by the Director of the MENTOX program.

7. Student Enrollment and Impact on Teaching Resources.

The MENTOX faculty members recognize that an expansion of the toxicology training program, while critical, is strictly limited in terms of student enrollment. We estimate that 7 or 8 new students per year can be expected in the initial years of the program. With the present faculty in Environmental Toxicology, we project that a maximum of 10-15 students could be admitted per year when the program is fully established.

MENTOX should have a minimal effect on the teaching resources of the Department of Biological Sciences. As detailed in the beginning of Appendix V, outlines of new or revised graduate courses proposed for the MENTOX program, there will only be a few new courses:

1. The MENTOX project (BISC 656-0) will be supervised by each student's senior advisor as part of the MENTOX program.
2. Co-op Practicum I and II are new courses, but will not require any teaching resources.

3. The Environmental Toxicology Seminar course is a new course, but a seminar series is presently being offered in the Environmental Toxicology group. Therefore, this will not represent new teaching effort.
4. The one new regular course that will be offered as part of the MENTOX program is BISC 651, Environmental Toxicology Tests I.

Appendix VI is a schedule for these courses during a two-year cycle, and how these courses would be covered by the teaching loads of the faculty in the Environmental Toxicology program. Several of these courses are presently being taught as part of the Post Baccalaureate Program, as advanced undergraduate courses that will be offered in conjunction with graduate courses, or as part of the regular graduate program. The teaching loads in Appendix VI, assuming that the MENTOX program is initiated, can be compared to the present and future teaching loads of these faculty, as published for 96-98 by the Course Planning Group of the Department of Biological Sciences, in April, 1996. The schedules for Drs. Law, Nicholson, and Farrell are unchanged. Dr. Moore's does not change substantially, because she presently teaches Industrial Biotechnology (BISC 856 under the proposed MENTOX numbering system) as a special topics course at the undergraduate and graduate level every second year. The schedules for Drs. Bendell-young and Kennedy change only in the addition of BISC 651, because they teach Ecological Toxicology (BISC 854 under the MENTOX system) and Biochemical Toxicology (BISC 855 under the MENTOX system) every other year as special topics at the undergraduate and graduate level. This analysis recapitulates our statement that the only new course that will take new teaching resources is BISC 651, because the other courses are presently being taught as part of the ENTOX PBD or as special topics. This addition of one course can be covered with minimal effect on the teaching resources of the department.

8. Student Support

The students are expected to be self supporting during the period of course work. Financial support for a MENTOX student during completion of BISC 656-0, Master of Environmental Toxicology Project, is at the discretion of the supervisor. However, the co-op sponsor is expected to support the student when the student works in the co-op sponsor's laboratory or office.

Need for the Program

1. Evidence from undergraduate ET enrollment.

Undergraduate enrollment in ET (minor and PBD programs) provides good evidence of considerable student interest in a new MENTOX program. Faculty members involved with ET teaching and research receive numerous enquiries each year, both from potential students and from students currently enrolled in the PBD program who wish to obtain more advanced training. Perhaps the best indication of the need for more ET professionals comes from the PBD graduates of ET; these students are fully employed, although most of them were unemployed science graduates at the time of admission to the PBD program.

2. National and regional need.

The environment industry is almost completely driven by government policy, regulation and legislation ("Creating the future" A Strategic Plan for the Environment Industry of B.C., published by B.C. Science Council, 1991). For example, the passage of the Toxic Substances Control Act in the U.S. created an immediate need for more than 1,000 toxicologists, who simply were not available. No one knows exactly how many toxicologists are practising in Canada; the number probably is fewer than 200 full-time professional toxicologists with postgraduate training. Since there are about 100,000 man-made chemicals now in use, ranging from pesticides to food preservatives and from cosmetics to pharmaceuticals, the need for a pool of professionally trained toxicologists capable of generating and interpreting toxicological studies has become critical. The implementation of the Canadian Environmental Protection Act already is hampered by a shortage of Canadian toxicologists. The harmonization of environmental laws among Canada, Mexico and the U.S. as required by the North America Free Trade Agreement (NAFTA) will require more Canadian toxicologists. The National Contaminated Site Remediation Program for the remediation of high priority contaminated sites (Canadian Council of Ministers of the Environment, 1989) also created a need for professionally trained toxicologists. The enactment of the Waste Management Amendment Act in B.C. (Bill 26) and the update of Environmental Protection and Enhancement Act of Alberta in 1993 further exacerbated the shortage of professionally trained toxicologists.

It should be pointed out that the magnitude of B.C. environment industry is presently unknown. However, estimates generated in 1987 indicated the annual sales from the B.C. environment industry was about $114.4 million, including exports of $67.6 million; the main export markets were the United States and the Asia Pacific region, accounting for 46% and 37%, respectively (Asia Pacific Initiative, March 1988). It is also estimated that there are about 1,500 contaminated sites which may require remediation action in B.C. (G. Fox, B.C. Ministry of Environment. Personal Communication). Many more such sites are likely to be identified when the site profiles required by Bill 26 are evaluated. According to Bill 26 the time frame for site remediation will depend on a determination of whether the site presents "an imminent and significant threat or risk to human health or ... the environment." Input from ET professionals is essential to this risk assessment process. Therefore, "...the small number of environmental professionals and a lack of education and training opportunities..." ("Creating the future" A Strategic Plan for the Environment Industry of B.C. 1991) has been cited as one of the major reasons why B.C.'s environment industry has not reached its potential.

Clearly, current training programs are inadequate to cope with the anticipated demand for environmental toxicologists. The province and the nation are gravely in need of a new training program in ET (see support letters in Appendix VII).

3. International reputation.

B.C. has a diverse and relatively unpolluted ecosystem which can exist as an attractive model for international clients. Vancouver was also the site of three international meetings for environmental industry and technology, Globe 90, 92 and 94. The Globe 94 meeting was attended by over 400 international exhibitors in environmental industry and all Pacific Rim environment ministers.

SFU is strategically located to provide environmental education and research initiatives to the Asia-Pacific countries which, after several years of unprecedented economic growth, have begun looking seriously for knowledge and technology of environmental protection. For example, an undergraduate environmental science/toxicology program was launched by the Chinese University of Hong Kong in 1993. MENTOX faculty have also made research and teaching contacts with universities in the Philippines, Indonesia,

Singapore, South Korea, India and China. Using its international reputation and expertise, the SFU MENTOX program would play a significant role in enhancing student, faculty and scientific exchanges between Asia-Pacific countries and Canada.

Resource Requirements

Budget summary per annum

1. Salaries for sessionals This would allow flexibility in offering courses to meet the need of the MENTOX program for specialized and focussed courses from local industry and government. Possible combinations of courses would be two lecture, two laboratory, or one lecture and one laboratory course ($19,690).	$19,690
2. Salary for secretary Part-time Secretary, 2 days per week CUPE 3338, Sec. 1, Gr. 5	$15,000
3. Teaching assistantship	$ 0.0
4. Field trips and invited speakers	$4,500
5. Office supplies and program advertisement	$2,000
6. Equipment for teaching	$8,675*
Total	$49,865

*This will be reduced by 50% after offering the courses for the first time.

Details of proposed expenditures:

1. Faculty: No new tenure-track positions will be required to launch the MENTOX program since Drs. Bendell-Young and Kennedy already have been appointed to the ET program. However, two sessionals will be required to offer highly specialized and focused courses using non-faculty experts from local industry and government agencies. The estimated cost of the sessionals is $20,000 per annum.

2. Support personnel: One teaching assistant per course will be required to assist in BISC 651-3 (Environmental Toxicology Tests I) and BISC 652-3 (Environmental Toxicology Tests II). A part-time secretary (2.0 days per week) will be required to assist in administration and correspondence with students. The estimated cost of the secretary (Grade 5) including fringe benefits is approximately $15,000 per annum.

3. Teaching assistantships: No teaching assistantships will be required by the students of the MENTOX program since they will be self-supporting. However all graduate students are eligible for teaching assistantships under TSSU guidelines. Students may also receive support under the MENTOX co-op option (from a faculty member or the employment supervisor).

4. Field trips and invited guest lectures: Field trips for students to visit various federal and provincial government laboratories ($2,500 per annum). Travel and honorarium costs for invited speakers are approximately $2,000 per annum.

5. Long distance telephone, fax, photocopies and MENTOX program brochure and advertisement: $2,000 per annum.

6. Equipment: The following equipment will be required for teaching of BISC 651-3 Toxicity Tests I and BISC 652-3 Toxicity Tests II for the first year: computer programs for toxicity tests ($1,000); shaking water-bath incubator ($3,000); 20-gallon glass aquaria ($1500); quartz cells for spectrofluorometer ($375); glass homogenizers for tissues ($500); optical grids for cell counts ($300); video cassettes for toxicity tests demonstration ($2,000)

APPENDIX II

RECOMMENDATIONS OF THE FACULTY OF SCIENCE TASK FORCE ON ENVIRONMENTAL SCIENCE AND TOXICOLOGY

SUMMARY PAGE

Terms Of Reference

The task force was struck by Dr. Colin Jones, Dean of Science in June 1989 to review possible directions for development in the area of Environmental Science and Toxicology (EST). We are to take a broad view in our approach and consult with other Faculties. A proposal for the establishment of a program will emerge which need not necessarily be linked to the Fraser Valley Initiative, although such a link is not excluded.

In developing this report the committee (1) reviewed the existing programs related to Environmental Science and Toxicology, & Environmental Studies at SFU, (2) talked with interested members of the Departments of Biology, Chemistry, Mathematics and Statistics, Communications, Geography, Kinesiology and the Natural Resources Management Program, (3) reviewed calendar descriptions of Environment Science, Toxicology and Environmental Studies programs in Canada, U.S.A., and England (4) and made site visits to the Universities of California Davis, Waterloo, Guelph, and Toronto to examine their programs. A draft version of this report was distributed to members of the Departments of Biological Sciences, Chemistry, Physics, and Mathematics and Statistics for comments. These comments were considered by the committee and appropriate revisions were made to arrive at the final report contained herein.

Final Recommendations

1. Consolidate and strengthen the environmental toxicology programs (BSc minor and post baccalaureate diploma) that currently exist in Biological Sciences. This will require new resources.

2. Develop a comparable BSc minor in the Chemistry Department which focuses on toxicant analysis and environmental monitoring. This will require new resources.

3. Create an Institute of Environment Science and Toxicology (IEST) which has a director, a budget, the ability to hire and promote faculty and has as its objectives to (a) develop a core of focussed and vigorous research on environmental problems and their solutions, (b) train graduate students in traditional MSc and PhD degree research, (c) act as a pool of advisors with expertise in environmental matters at the local, provincial and federal levels, and (d) develop an inventory of environmentally related projects, courses and interests at SFU. This will require new resources.

4. Establish a professional graduate training program in environmental science and toxicology at the masters level (MENTOX). This will require new resources.

5. Interface the Environmental Science and Toxicology program with existing programs related to the environment within the Faculty of Science and across the campus (e.g. BERG, MPM and NRM). This would be the responsibility of the director of IEST.

6. Use the Environmental Science and Toxicology program at SFU as a template for the Fraser Valley Campus to ensure compatibility and optimum utilization of resources. This could be the responsibility of the director of IEST.

7. Use the Institute as a future base for a Western Canada Centre for Environmental Science and Toxicology.

APPENDIX III

LETTERS FROM PARTICIPATING DEPARTMENTS

SIMON FRASER UNIVERSITY

SCHOOL OF RESOURCE AND
ENVIRONMENTAL MANAGEMENT

FACULTY OF APPLIED SCIENCES

BURNABY, BRITISH COLUMBIA
CANADA V5A 1S6

Telephone: (604) 291-4659
Fax: (604) 291-4968

June 28, 1995

Dr. Francis Law
Department of Biological Sciences
Simon Fraser University

Dear Dr. Law:

This letter is to confirm that Dr. Frank Gobas will be able to participate in the proposed MENTOX program. As part of his participation, Dr. Gobas will allow 5 to 7 MENTOX students per year to enroll in his courses REM 612 and REM 610, as long as it does not preclude REM students from registering in these two courses.

Based on current developments regarding the creation of new computer labs in the Faculty of Applied Sciences, it is expected that there will be no problems securing the required computer access for both REM and MENTOX students. It is therefore anticipated that there will be no problems for MENTOX students to enroll in REM 610 and REM 612 on a regular basis.

If you would like to discuss this in more detail, please contact Dr. Gobas directly.

Thank you very much.

Sincerely yours,

Dr. J. Chadwick Day
Director

JCD/jr

SCHOOL OF KINESIOLOGY

SIMON FRASER UNIVERSITY

Office of the Director

MEMORANDUM

TO: Dr. Francis Law, Department of Biological Sciences

FROM: Dr. Andy Hoffer

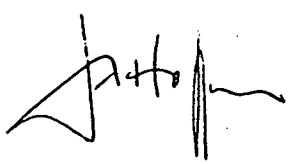
DATE: 9 May, 1995

RE: KIN 851

As per your request I am pleased to confirm that Biological Sciences graduate students will be welcome to enroll in the course KIN 851 "Recent Advances in Environmental Carcinogenesis" when that course is offered.

As you are aware, this course is offered by Dr. Miriam Rosin who is currently on sabbatical at Johns Hopkins University. It is my understanding that Dr. Rosin is also agreeable to this arrangement.

With best regards,



c.c. Dr. Miriam Rosin

SFU SIMON FRASER UNIVERSITY

MEMORANDUM

To: Francis Law Biological Sciences	Date: May 11, 1995 From: Katherine Heinrich, Chair Department of Mathematics & Statistics
Subject: STAT 650	

We will without question be able to accommodate 5-7 students from the Masters Degree in Environmental Toxicology each time the course is offered. We are pleased to be able to support your program in this way.

KH:jc
enclosure

cc: M. Fankboner
R. Routledge
C.H.W. Jones

APPENDIX IV

OUTLINES OF GRADUATE COURSES CURRENTLY AVAILABLE FOR THE MENTOX PROGRAM

BIOLOGICAL SCIENCES 650
INDUSTRIAL TOXICOLOGY

PROFESSOR: Dr. F. Law Office: B8265

PREREQUISITES: BISC 313 Environmental Toxicology II

COURSE DESCRIPTION:

The management of chemical risks is increasingly important to all manufacturing facilities, as well as regulators and others. This course introduces industrial chemicals commonly found in B.C. industries. It emphasizes those aspects of risk assessment principles and procedures that are crucial to professionals who assess the human health and environmental risks caused by toxicant exposures involved in the manufacture, development, distribution, and clean-up of industrial chemicals.

LECTURE TOPICS:

Mutagenicity and carcinogenicity of industrial chemicals

Toxic chemicals in pulp and paper mill effluent

Chlorophenols and other halogenated aryl derivatives

Toxic chemicals from the petroleum industry: polycyclic aromatic hydrocarbons

Legislation and risk

Importance of quantitative risk assessment for environmental and occupational health

Overview of the Superfund risk assessment process (RI/FS process)

COURSE TEXT: None

PERCENTAGE DISTRIBUTION OF MARKS: Project 50%; Final 50%

STAT 650 Course Outline

Instructor: R. Routledge, Rm. TLX 10541, Ph. 291-4478.

Office Hours: Tue. 10:30-11:20, Wed. 2:30-3:20, Fri. 9:30-10:20.

Prerequisites

The material in this course ought to be accessible to students with a basic course in statistics somewhere in their background. Most of the class will probably have forgotten most of what they learned. Introductory lectures will provide a comprehensive review. The review will focus on the role of the basic inference techniques in scientific experimentation and sample surveys.

Objectives

Students successfully completing the course will have developed the following skills:

1. Facility with applying the standard techniques of statistical analysis, specifically including t-tests, the analysis of variance, regression model building, and chi-squared tests for frequency data.

2. Facility with assessing the applicability of these techniques to practical problems in biology and resource management.

3. An ability to assess a research proposal or report for adequacy of the experimental or survey design.

4. An ability to make an informed choice between competing designs and analysis techniques.

5. Familiarity with at least one computer package for performing statistical computations.

Organization

The course will consist mainly of lectures and weekly exercises. There will also be some discussion sessions and opportunities to design and run small experiments and surveys. There will be a mid-semester exercise, and a final, take-home examination. There is a lengthy list of references (attached), but no required text. I shall be handing out sets of prepared notes.

Evaluation

Students' progress toward meeting the above objectives will be assessed by means of the weekly exercise sets, the mid-semester exercise, and the final, take-home examination. The weighting scheme will be as follows:

Component	Weight
Weekly Exercises	30%
Mid-semester Exercise	20%
Final Examination	50%
Total	100%

This weighting scheme will be used to calculate a final percent score. Final percent scores will then be converted to letter grades according to the following standards. A grade of *B* signifies that, in the opinion of the instructor, the student has a good grasp of the basic concepts, and can apply them successfully in standard contexts. A grade of *A* signifies that, in the opinion of the instructor, the student has mastered the concepts to a sufficient degree to be able to mold them to fit slightly nonstandard applications. Everyone, for example, should be able to discuss the merits of the basic experimental designs discussed in class, and to analyze numerical results from each of these. Those of you meriting a grade of *A* should also be able to analyze the results of an experiment that for some reason did not quite fit one of the standard textbook descriptions.

The course will begin with a discussion of experimental design.

Our Starting Point

> "We argue that these methods need further consideration because the mental processes involved are not really understood and are virtually out of our control."

(Quoted out of context from Matter and Mannan, *J. Wildl. Manage.* **53:** 1172-1176 [1989].)

BIOLOGICAL SCIENCES 651
FOOD AND DRUG TOXICOLOGY

PROFESSOR: Dr. F. Law Office: B8265

PREREQUISITES: BISC 313 Environmental Toxicology II

COURSE DESCRIPTION:

An introduction to drug development

An introduction to pharmacokinetics

Case studies in forensic toxicology

Principles and treatment for drug overdose

Toxicities of salicylates and acetaminophen

An introduction to abused drugs

Toxicities of anti-cancer drugs

Chemotherapy in aquaculture

Drug and food allergies

Naturally occurring toxicants in food

Food contaminants

Mycotoxins

Food coloring and additive

The development of seafood consumption guidelines

COURSE TEXT: None

PERCENTAGE DISTRIBUTION OF MARKS:

Project 25%; Midterm 25%; Final 50%

BIOLOGICAL SCIENCES 652

PROBLEM ANALYSIS IN ENVIRONMENTAL TOXICOLOGY

PROFESSOR: Dr. R.A. Nicholson

Office: B9238
Lab: B7230
Phone: 291-4107

PREREQUISITES: BISC 650, BISC 651 or permission of the Department.

DESCRIPTION: This lecture and laboratory course will introduce the student to some of the central principles and methods used in toxicology. The laboratories will cover a variety of toxicological techniques including acute testing, assessment of hepatotoxicity, mutagenicity and teratogenicity. There are also compulsory visits to research establishments in the area.

REQUIRED TEXT: A.W. Hayes. 1989. *Principles and Methods of Toxicology,* Raven Press, ISBN 0-88167-439-7

It will be available in the bookstore early in January.

COURSE REQUIREMENTS AND GRADING:

The assessment will be based on grades for the laboratory reports and final examination which will cover the principles, methods and topics introduced in the lectures, laboratories and off-site visits.

BIOLOGICAL SCIENCES 846

INSECTICIDE CHEMISTRY AND TOXICOLOGY

PROFESSOR: Dr. R.A. Nicholson

Office: B9238
Lab: B7230
Phone: 291-4107

DESCRIPTION:

The aim of the course is to provide a comprehensive review of the chemistry, toxicology, metabolism and molecular basis of action of insecticides. Emphasis will be given to the organophosphorus insecticides, carbamates, avermectins and in particular the synthetic pyrethroids which have gained a position of prominence in crop protection and environmental health.

Resistance to pyrethroids has stimulated much interest recently and two sessions will be devoted to an examination of the physiological and biochemical mechanisms involved. The current status of pyrethroid resistance in economically important arthropods and approaches that have been proposed to counter resistance will also be reviewed.

The remainder of the course is aimed at providing the graduate student with an appreciation of the environmental behavior of insecticides, susceptibility of wildlife to insecticides and the toxicology and mode of action of recently discovered insecticides.

The course will consist of twelve 3 hour periods. Sessions in the first 3 weeks will consist of my lecture plus a discussion period. From week 4 onwards, sessions will also include a graduate student presentation (0.75 h; see below) plus discussion on this.

REQUIRED TEXT:

No specific book is recommended for this course however participants will be directed to selected readings where appropriate.

COURSE REQUIREMENTS AND GRADING:

Each student will be required to:

1) write a COMPREHENSIVE REVIEW PAPER dealing with an agreed area of insecticide toxicology and

2) present a 45 minute ORAL DELIVERY of the subject chosen for review.

Final grading will be based on the review paper (50%), the oral presentation (30%) and class participation (20%).

KINESIOLOGY 851-3

RECENT ADVANCES IN EXPERIMENTAL CARCINOGENESIS

Dr. M.P. Rosin
Office: K9638

COURSE OVERVIEW:

Carcinogenesis is a long-term, multifactorial process which involves the progressive accumulation of change in cells throughout a lifetime. Many of these changes are only now being identified at a molecular and/or cytological level using the tools of molecular epidemiology. This course will integrate current knowledge on the process of carcinogenesis in tissues in which cancer commonly occurs in individuals in North America, e.g. breast, colon, lung, bladder, skin, and cervix. Discussions will include the following: an overview of the histological/cytological changes occurring in each tissue during development of cancer, animal and human models for carcinogenesis in the tissue, and a overview of treatment options, pre-malignant lesions, biomarkers, and risk factors. The course will focus on new techniques being developed to identify individuals at risk to permit intervention at early stages in the development of the disease. The class format will consist of a combination of lectures and student presentations.

TIME:

The class will meet for 3 hours each week. The time of these meetings will be determined at the beginning of the semester, based on a schedule most appropriate to all participants.

TEXTBOOK:

The class will use current journal articles in the area of carcinogenesis.

EVALUATION:

Each student will be required to submit three major review papers and to present an oral presentation on each paper.

3 papers (@ 15% each)	45%
Presentations (@ 10% each)	30%
Class discussions	25%

MRM 610-5

GRADUATE COURSE

MANAGEMENT OF CONTAMINANTS IN THE ENVIRONMENT

Dr. Frank Gobas
School of Resource & Environmental Management

OBJECTIVE

The objective of this course is to provide students with theory and practical experience in assessing the environmental behaviour, toxicity and human health risks of chemical and contaminant emissions in the environment.

CONTENTS

The course consists of two parts. First, students are introduced to the following topics:

1. ENVIRONMENTAL PATHWAYS OF CHEMICALS & CONTAMINANTS:
   environmental partitioning, dynamics of environmental distribution, mass-balance, mechanisms of transport & transformation, fugacity, environmental modelling

2. EXPOSURE ASSESSMENT:
   mechanisms of chemical uptake & elimination in biological organisms, toxicokinetics, bioaccumulation, trophodynamics, structure-activity relationships

3. HAZARD & DOSE-RESPONSE ASSESSMENT:
   toxicity of chemical pollutants in biological organisms, dose-response relationships, toxicity of single & mixtures of chemicals, ecotoxicity, carcinogenesis

4. RISK ASSESSMENT:
   cancer potency factors, reference dose, quantitative risk assessment

In the second part of the course, students examine as part of a research project the scientific basis of environmental management practices, including the development of standards & human consumption guidelines & environmental quality criteria, chemical screening, (bio)monitoring, risk assessment, environmental abatement policies and others. The results of the research are presented in a workshop.

THEME

This year's theme for the research project is : TBA

REQUIRED READINGS

The course will make extensive use of the following 2 books:

"Multimedia Environmental Models" by D. Mackay
Lewis Publishers

"Quantitative Risk Assessment for Environmental & Occupational Health" by W.H. Hallenbeck and K.M. Cunningham
Lewis Publishers

Books are available in the SFU bookstore.

EVALUATION

Students are evaluated based on 1 midterm exam (35%), 1 research paper (45%) and contribution to class & workshop discussions (20%).

FORMAT

Classes consist of lectures, computer labs, research and a workshop

FIRST CLASS MEETING

Wednesday, September 8 at 10:30 am in Rm. SCB 8552.

REGULAR COURSE TIME

Wednesdays from 10:30 am to 12:20 pm and on Frdidays from 2:30 pm to 4:30 pm.

FOR MORE INFORMATION CALL : 291-4780 OR 291-5928

MRM 612

SIMULATION MODELLING IN NATURAL RESOURCES MANAGEMENT

Dr. Frank Gobas

OBJECTIVE

In virtually all areas of resource and environmental management, models are an important tool for making management decisions. Typically, resource management requires the comprehension of complex environmental and ecological systems in order to project management actions into the future. Simulation modelling is one of the most important tools to accomplish this and it is therefore an integral part of resources and environmental management.

The objective of this course is to provide resource managers with the expertise to build their own computer models to address various resource management problems. During the course we will explore model behaviour under various assumptions and under various simulated management actions. The course will further address the role of models in research and decision making. By the end of the course, students will be familiar with the use of modelling techniques in resource management.

COURSE DESCRIPTION

The course consists of lectures and a computer lab. The majority of the classes will be held in IBM computer lab, and will provide students with hands-on experience in the building and analysis of models on PCs using spreadsheets and a modern programming language (i.e. QuickBasic). The lectures address various aspects of modelling in resource management, including techniques to develop management models (see course outline). The accessibility of PCs and the programming software used in this course guarantees that skills obtained in this course can be applied later in your career.

PREREQUISITES

No prerequisites are required. Previous experience with computers is not necessary. Only minimal basic mathematical skills are required.

GRADES

Three credit assignments will be given. Two of the assignments (each 25% of the final mark) involve the building and analysis of a simulation model in a different area of resource management. In the final assignment (40% of final mark) students develop a model in their own area of interest. 10% of the final mark is based on contributions to class discussion.

To ensure fair comparisons among students, and to be consistent with university policy, deferred grades are given only under extreme and exceptional circumstances such as illness or death in family. A heavy workload is not a sufficient justification for a deferred grade. There are no exceptions to this policy. Students should schedule the writing of papers to spread the workload more evenly throughout the semester.

STANDARDS FOR GRADING

Grading of all students will be based on absolute rather than relative standards.

TEXT BOOKS & NOTES

A list of recommended readings & books is included. Notes and other readings will be provided.

QUESTIONS AND ASSISTANCE

I will be available to discuss any questions or concerns you may have regarding the course. At the start of the course I will consult with all students to decide on appropriate office hours.

LOCATION & TIMES

Classes are on thursdays from 1:30 pm to 3:20 pm and on fridays from 8:30 am to 10:20 am in the IBM teaching lab in the AQ. The first class will be held on monday January 6, 1994.

APPENDIX V

OUTLINES OF NEW OR REVISED GRADUATE COURSES PROPOSED FOR THE MENTOX PROGRAM:

BISC 650-3 Environmental Risk Assessment (Renamed from Industrial Toxicology)

BISC 651-3 Environmental Toxicology Tests I: Ecological Effects-Based Toxicity Tests (New Course)

BISC 652-3 Environmental Toxicology Tests II: Mammalian Toxicity Tests (Renamed from Problem Analysis in ET)

BISC 654-3 Food and drug Toxicology (Previously numbered BISC 651, Not a New Course)

BISC 854-3 Ecotoxicology (previously taught as BISC 883 Special topics in ET)

BISC 855-3 Biochemical Toxicology (Previously taught as BISC 883 Special Topics in ET

BISC 856-3 Industrial Biotechnology (Previously taught as BISC 859 Special Topics)

BISC 655-3 Environmental Toxicology Seminar (New Course)

BISC 656-0 Master of Environmental Toxicology Project (New Course)

BISC 657-0 Co-op Practicum I (New Course)

BISC 658-0 Co-op Practicum II (New Course)

NOTE: THE ABOVE COURSES ARE AT VARIOUS STAGES OF DEVELOPMENT. FOR EXAMPLE, BISC 854-3, BISC 652-3, BISC 856-3 AND BISC 650-3 ARE PRESENTLY AVAILABLE TO STUDENTS FOR CREDIT. NEW COURSES DEVELOPED SPECIFICALLY FOR THE MENTOX PROGRAM WILL INCLUDE BISC 651-3 ENVIRONMENTAL TOXICOLOGY TEST I, BISC 656-0 MASTER OF ENVIRONMENTAL TOXICOLOGY PROJECT, BISC 655-3 ENVIRONMENTAL TOXICOLOGY SEMINAR, BISC

657 CO-OP PRACTICUM I AND BISC 658-0 CO-OP PRACTICUM II. DETAILED OUTLINES OF THESE COURSES FOLLOW.

New Graduate Course Proposal Form

CALENDAR INFORMATION:

Department: Biological Sciences Course Number: 650 (To replace current BISC 650)

Title: ENVIRONMENTAL RISK ASSESSMENT

Description: This course emphasizes recent development in quantitative human health risk assessment and ecological effects-based risk assessment of environmental chemicals

Credit Hours: 3 Vector: 0-0-3 Prerequisite(s) if any: BISC 313

ENROLLMENT AND SCHEDULING:

Estimated Enrollment: 5-10 When will the course first be offered: 98-1

How often will the course be offered: once per year

JUSTIFICATION:

A graduate level course on environmental risk assessment is required as a core course within the proposed MENTOX program.

RESOURCES:

Which Faculty member will normally teach the course: F. Law

What are the budgetary implications of mounting the course: Unlikely to have any significant impact since it will replace the current BISC 650.

Are there sufficient Library resources (append details): Yes

Appended: a) Outline of the Course
b) An indication of the competence of the Faculty member to give the course.
c) Library resources

Approved: Departmental Graduate Studies Committee: [signature] Date: 96/3/15

Faculty Graduate Studies Committee: [signature] Date: 96/3/15

Faculty: CHW Jones Date: 26 March 96.

Senate Graduate Studies Committee: [signature] Date: 30 Oct/97

Senate: Date:

DEPARTMENT OF BIOLOGICAL SCIENCES
COURSE OUTLINE

BISC 650 : ENVIRONMENTAL RISK ASSESSMENT

DR. F. LAW

COURSE DESCRIPTION: This course will present a review of recent developments in human health effects-based risk assessment and ecological effects-based risk assessment of environmental chemicals. Risk is defined as the likelihood, or probability, that the toxic effects associated with a chemical or mixture of chemicals will be produced in populations of individuals under their actual conditions of exposure. This course will emphasize principles and procedures that are crucial to professionals who assess, manage and communicate chemical risks. The course will be split between a weekly lecture and different environmental risk assessment exercises.

LECTURE TOPICS:

Enviromental Risk Assessment: Quantitative Human Health Risk Assessment and Ecological Effects-Based Risk Assessment

Legislation Related to Risk Assessment of Environmental Chemicals in the U.S. and Canada

Basic Principles of Environmental Risk Assessment

Sources of Information about Environmental Risk Assessment

Overview of the of the Environment Risk Assessment Processes Recommended by the U.S. Environmental Protection Agency and the Canadian Council of Ministers

Reduction of Uncertainties in Environmental Risk Assessment using Monte Carlo Simulation and Physiologically Based Toxicokinetic Models

Risk Assessment, Risk Management, and Risk Communication

Case Studies in Environmental Risk Assessment

COURSE PREREQUISITES:

BISC 313 An Introduction to Environmental Toxicology II

EVALUATION:

Students are evaluated based on 1 research paper (50%), 1 final exam (30%) and contribution to class discussion (20%).

COURSE TEXTS:

D.J. Paustenbach. 1989. *The Risk Assessment of Environmental Hazards*, John Wiley & Sons, ISBN 0-471-84998-7

E. J. Calabrese and L. A. Baldwin. 1993. *Performing Ecological Risk Assessments*. Lewis Publishers, ISBN 0-87371-703-1

G. W. Suter II. 1993. *Ecological Risk Assessment*. Lewis Publishers, ISBN 0-87371-875-5

British Columbia, Ministry of Environment, 1993. Quantitative Human Health Risk Assessment. Phase I - Review of Methods and Framework Recommendation. British Columbia, Ministry of Environment, Victoria.

Environment Canada, 1992. A Framework for Ecological Risk Assessment at Contaminated Sites in Canada.

U.S. Environmental Protection Agency, 1989, Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual; Interim final, RAGS, OSWER 9285.7-01a, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency, 1991 Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual, Part B: Development of Risk-based Preliminary Remediation goals, RAGS, OSWER 9285.7-01B. U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency, 1991 Risk Assessment Guidance for Superfund, Vol. I: Human Health Evaluation Manual, Part C: Risk Evaluation of Remedial Alternatives, RAGS, OSWER 9285.7-01C, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency, 1989, Risk Assessment Guidance for Superfund, Vol. II: Environmental Evaluation Manual. Interim final. U.S. Environmental Protection Agency, Washington, D.C.

New Graduate Course Proposal Form

ALENDAR INFORMATION:

epartment: Biological Sciences Course Number: 651 (Replaces current BISC 651)

le: Toxicity Tests I. Ecological effects-based tests.

escription: This course provides the basic concepts and practical experience for the pplication of ecologically-based toxicity tests.

redit Hours: 3 Vector: 2-0-4 Prerequisite(s) if any: 313

NROLLMENT AND SCHEDULING:

stimated Enrollment: 5 - 10 When will the course first be offered: 97-3

ow often will the course be offered: once per year

USTIFICATION:

his course is needed to complement BISC 650, 'Problem Analysis in Environmental oxicology', which deals with mammalian systems. This course relates the concepts and ctical experience necessary in toxicological testing with non-mammalian species and t the ecosystem level.

ESOURCES:

ich Faculty member will normally teach the course: Dr. C.J. Kennedy/Dr. L. Bendell-Young

at are the budgetary implications of mounting the course: 1 TA = 3 Base Units

nitial start-up costs: Filters for microplate reader $450, Aquaria $1,100, Chemicals nd kits $1,000, Computer software $475, Glassware $400. Cost per semester: $750

e there sufficient Library resources (append details): Yes

pended: a) Outline of the Course
b) An indication of the competence of the Faculty member to give the course.
c) Library resources

ved: Departmental Graduate Studies Committee: [signature] Date: 96/3/15

Faculty Graduate Studies Committee: [signature] Date: 96/3/15

Faculty: [signature] Date: 26 March 96

Senate Graduate Studies Committee: [signature] Date: 30 Oct/97

Senate: 43. Date:

BISC 651
Toxicity tests I. Ecological effects-based tests
Course Outline

Instructors: Dr. Christopher J. Kennedy/Dr. Leah Bendell-Young

Course description:

This is a lecture/laboratory course which deals with the concepts and practical applications of various testing procedures used in the determination of ecological effects caused by toxicant exposure. The test systems examined cover single organism bioassays to computer simulated models of whole communities. In laboratory sessions students will gain practical experience in the logistical planning, execution, data aquisition and analysis of experiments. Ecologically-relevent endpoints which will be examined include acute lethality, organism performance and reproduction, and population and community alterations.

Prerequisites:

The course is designed for the advanced undergraduate or graduate student with a good background in environmental toxicology. Prerequisite: BISC 313.

Laboratory and Lecture Outline:

I. Acute lethality tests. Lectures: General principles, methodology for fish and invertebrates, examples of test data and statistical analysis, phytoplankton bioassays, early life stage tests, special considerations, legal aspects. Laboratory: Lethal Concentration 50 determination for a selected toxicant using a freshwater invertebrate, *Dapnia magna* according to government standard methodology.

II. Sublethal toxicity tests I. Lectures: Status and use of sublethal indicators, microbial toxicity studies, aquatic microbiology, microbial activities, microbial transformations and degredations. Laboratory: Effective Concentration 50 determination for a selected toxicant on microbial bioluminescence using the 'Microtox ' test for bacteria.

III. Sublethal toxicity tests II. Lectures: Status and use of sublethal indicators, Physiological, behavioral and performance indicators of sublethal effects, secondary stress tests, seawater challenge, disease challenge, respirometry, organ function assays. Laboratory: Determination of effects for a selected toxicant on the swimming ability of juvenile rainbow trout, *Oncorhynchus mykiss*.

IV. Sublethal toxicity tests III. Lectures: Reproductive indices and population effects, reproductive impairment and cycles, role of steroids, early life history and life cycle tests, chronic tests. Laboratory: Effects of a selected toxicant on reproduction in a freshwater invertebrate, *Dapnia magna*, using a life cycle test.

V. Modulating factors. Lectures: Unanticipated variation in toxicity tests and examples, test conditions, biotic modifiers including species sensitivity, temperate vs. tropical species, acclimation, nutrition, health and parasitism, life history and size effects. Laboratory: Effects of a selected toxicant on the stress biochemistry of two related species of Pacific salmon, coho salmon, *Oncorhynchus kisutch*, and rainbow trout, *Oncorhynchus mykiss*.

VI. Modulating factors. Lectures: Abiotic modifiers including water chemistry and matrices; temperature, pH, salinity, dissolved oxygen, hardness, and sediment effects. Laboratory: The acute toxicity fof a selected toxicant on a benthic invertebrate species, chironomids, will be examined under conditions of altered pH and sediment load.

VII. Effects on communites. Lectures: Ecosystem context for estimationg reductions in populations, species richness and diversity, simple model of population dynamics, community and population indicators of environmental degredation. Laboratory; a purchased computer program will be used to mathematically model invertebrate community structure in light of incorporated environmental stresses.

VIII. Biomonitoring. Lectures: Monitoring goals, chemical vs. biological monitoring, biological indicators of chemical exposure, field validation. Laboratory: The livers of exposed and unexposed juvenile rainbow trout will be examined for the induction of detoxification enzymes as indicators.

Required textbook:

No textbook is chosen at this time for this course

New Graduate Course Proposal Form

CALENDAR INFORMATION:

Department: BIOLOGICAL SCIENCES Course Number: 652 (TO REPLACE CURRENT BISC 652)

Title: ENVIRONMENTAL TOXICOLOGY TESTING II: MAMMALIAN TOXICOLOGY

Description: THE MAIN FOCUS OF THIS COURSE IS ON LABORATORY TESTING PROCEDURES CURRENTLY EMPLOYED IN THE TOXICOLOGICAL EVALUATION OF CHEMICALS

Credit Hours: 3 Vector: 2-0-3 Prerequisite(s) if any: BISC 313 (OR PERMISSION OF DEPARTMENT)

ENROLLMENT AND SCHEDULING:

Estimated Enrollment: 10-15 When will the course first be offered: 98-1

How often will the course be offered: ONCE PER YEAR

JUSTIFICATION:

A GRADUATE LEVEL COURSE COVERING THE AREAS DETAILED ON THE ACCOMPANYING SHEET IS REQUIRED AS A CORE COURSE WITHIN THE PROPOSED MASTER OF ENVIRONMENTAL TOXICOLOGY (MENTOX) PROGRAM.

RESOURCES:

Which Faculty member will normally teach the course: R. A. NICHOLSON

What are the budgetary implications of mounting the course: UNLIKELY TO HAVE SIGNIFICANT IMPACT BECAUSE IT WILL REPLACE THE CURRENT BISC 652 WHICH HAS A SIGNIFICANT LAB COMPONENT AND TA SUPPORT.

Are there sufficient Library resources (append details): YES

Appended: a) Outline of the Course
b) An indication of the competence of the Faculty member to give the course.
c) Library resources

Approved: Departmental Graduate Studies Committee: [signature] Date: 96/3/15

Faculty Graduate Studies Committee: [signature] Date: 96/3/15

Faculty: [signature] Date: 21 March 96

Senate Graduate Studies Committee: [signature] Date: 30 Oct/97

Senate: 46. Date:

BIOLOGICAL SCIENCES 652

ENVIRONMENTAL TOXICOLOGY TESTING II: MAMMALIAN TOXICIOLOGY

PROFESSOR: Dr. R. A. Nicholson

Office: B9238
Lab: B7230
Phone: 291-4107

COURSE DESCRIPTION:

This course provides a foundation in the basic principles and strategies involved in the toxicological evaluation of chemicals. Lectures will cover the use of animals in toxicological research, good laboratory practice (GLP) and current procedures for the assessment of chemicals as acute, chronic, reproductive, teratogenic and genetic toxicants. The course also focuses on organ-specific damage including neurotoxicity, nephrotoxicity and hepatotoxicity.

Laboratory exercises in the course are preceded by a visit to the SFU Animal Care Facility and are designed to provide opportunities to gain experience in formulating and testing hypotheses, making experimental observations, critical evaluation of data and writing of reports.

Visits locally to other laboratories involved in toxicological research form another instructive aspect of the course.

RECOMMENDED TEXT:

Principles and Methods of Toxicology 1994 (third edition) by A. W. Hayes. Publisher: Raven Press; ISBN 0-7817 0131-7

EVALUATION:

Final grade will be based on laboratory reports and the final two hour examination which will cover the materials introduced in lectures, laboratories and off-site visits.

LECTURE TOPICS:

Use of Animals in Research and Good Laboratory Practice
Acute and Chronic Toxicity Testing
Detecting Adverse Effects of Environmental Toxicants on Liver
Eye and Dermal Testing of Toxicants
Genetic toxicology
Reproductive and Developmental Toxicology
Neurotoxicological Assessment
Evaluation of Chemically-induced Damage to Kidney

LABORATORIES AND ASSOCIATED REQUIREMENTS:

Visit to SFU Animal Care Facility

Acute toxicity testing using insects as a model (identification of compound-specific symptoms and determination of LD_{50})

Assessment of serum enzyme activity as a means to identify liver damage

Histological examination of liver samples prepared from solvent-exposed animals

Ames mutagenicity test on several environmental chemicals

Teratogenic assessment of Trypan Blue in the rat

LIBRARY RESOURCES:

Relevant books

Toxic substances and human risk (Tardiff and Rodricks)
Toxicology of the eye, ear and other special senses (Hayes)
Biochemical basis of chemical carcinogenesis (Grainau)
Developmental toxicology (Kimmel and Buelke-Sam)
Developmental toxicology (Snell)
Advances in teratology (Woolam)
Toxicology of the newborn (Kacew and Reasor)
Toxicology of the liver (Plaa and Hewitt)
Neurotoxicology (Abou-Donia)

Articles in the following journals will be drawn upon as required

Toxicology and Applied Pharmacology
Food and Cosmetics Toxicology
Fundamental and Applied Toxicology
Journal of Pharmmacology and Experimental Therapeutics
Science
Mutation Research
Demography
Lancet
Journal of Neurochemistry

New Graduate Course Proposal Form

CALENDAR INFORMATION:

Department: Biological Sciences Course Number: 654

Title: FOOD AND DRUG TOXICOLOGY

Description: To change current BISC 651 Food and Drug Toxicology to BISC 654.
Only course number is changed. Course contents remain unchanged

Credit Hours: 3 Vector: 0-0-3 Prerequisite(s) if any: BISC 313

ENROLLMENT AND SCHEDULING:

Estimated Enrollment: 5-10 When will the course first be offered: 98-1

How often will the course be offered: once per year

JUSTIFICATION:

A core course of the MENTOX program.

RESOURCES:

Which Faculty member will normally teach the course: F. Law

What are the budgetary implications of mounting the course: Unlikely to have any significant impact since it will replace the current BISC 651.

Are there sufficient Library resources (append details): Yes

Appended: a) Outline of the Course
b) An indication of the competence of the Faculty member to give the course.
c) Library resources

Approved: Departmental Graduate Studies Committee: [signature] Date: 96/3/15

Faculty Graduate Studies Committee: [signature] Date: 96/3/15

Faculty: C.H.L. Jones Date: To Head SL

Senate Graduate Studies Committee: [signature] Date: 30 Oct/96

Senate: 49. Date:

New Graduate Course Proposal Form

CALENDAR INFORMATION:

Department: Biological Sciences Course Number: 854-3

Title: Ecotoxicology

Description: The proposed course will detail the physochemical factors that influence contaminant behaviour in aquatic and terrestrial ecosystems

Credit Hours: 3 Vector: 0-0-3 Prerequisite(s) if any:

BISC 101; CHEM 102; CHEM 103; BISC 312; BISC 414-3 is recommended.

ENROLLMENT AND SCHEDULING:

Estimated Enrollment: 20 When will the course first be offered: 97-3

How often will the course be offered: Once every trimester

JUSTIFICATION:

The proposed course will provide an ecological perspective on current problems in environmental toxicology. This course is intended to introduce graduate students plus those students enrolled within the Masters of Environmental Toxicology programme to the important physicochemical factors that need to be understood to allow for an evaluation of the fate and effects of contaminants on aquatic and terrestrial systems.

RESOURCES:

Which Faculty member will normally teach the course: Dr. Leah Bendell-Young

What are the budgetary implications of mounting the course: minimal cost-- some support for the proposed laboratory section may be required

Are there sufficient Library resources (append details): YES

Appended: a) Outline of the Course
b) An indication of the competence of the Faculty member to give the course.
c) Library resources

Approved: Departmental Graduate Studies Committee: [signature] Date: 96/3/15

Faculty Graduate Studies Committee: [signature] Date: 96/3/15

Faculty: [signature] Date: 26 March 96

Senate Graduate Studies Committee: [signature] Date: 30 Oct 96

Senate: 50. Date:

NEW COURSE: BISC 854-3 Ecotoxicology

Graduate level course/ undergraduate enrolment permitted with permission from instructor.

LECTURER: Dr. Leah Bendell-Young

OBJECTIVE

Ecotoxicology is "the study of the fate and effects of contaminants on ecosystems". Research within the field of ecotoxicology involves the study of how abiotic (i.e. the physico-chemical factors which influence the fate of contaminants within ecosystems) and biotic (i.e., organism biology) factors ultimately determine the impact of a contaminant on a particular receiving environment.

Fundamental to the study of ecotoxicology is an understanding of ecosystem structure and function. Once the basic principles of a particular ecosystem are known, the movement or behaviour of a contaminant can be followed through this system. Further, unique systems can be compared (e.g., acidified versus circumneutral lakes; polymictic, anaerobic, shallow lakes versus deep, dimictic, aerobic lakes; acidic, sphagnum bogs versus circumneutral, grass fens) and through such ecosystem comparisons, the dominant physico-chemical factors which influence the fate of a contaminant can be elucidated.

Hence, the objective of this course is two-fold: 1/ To provide students with a background into the structure and function of various types of ecosystems and once the basic ecosystem function is understood, to contrast the movement of a contaminant (either inorganic or organic) through these specific ecosystems. 2/ To provide students with a background on some of the various biological factors that will influence the effect of a contaminant on a particular organism (e.g., growth rate, size, reproductive status, trophic level).

PREREQUISITES

BIO 101 102, CHEM 101, 102, BIO 312. (Also recommended but not required: BIO 472.

MARKING SCHEME

1/ Student seminar	30%
2/ Student paper	30%
3/ Final exam	40%

The student seminar will be approximately half-hour in length and will involve the presentation of the term paper.

TEXT

At present there is no required text for this course. The following is recommended; Aquatic Ecotoxicology: Fundamental concepts and methodologies. Vol I and Vol II. Editors: Alain Boudou and Francis Ribeyre. However, due to its prohibitive price, the student will not be expected to purchase this text.

Supplemental material will be provided throughout the course.

TENTATIVE COURSE OUTLINE

1/ General introduction: Ecotoxicology as an emerging multidisciplinary science.

2/ Basic concepts in ecosystem structure and function.

a/ Freshwater lakes
b/ Saline lakes
c/ Rivers (River Continuum Concept)
d/ Wetlands (bogs and fens, muskegs and marshes)
e/ Estuaries

3/ An evaluation of the abiotic factors which influence the behaviour of contaminants through a particular ecosystem; a comparative approach. Some examples of comparisons to be made include:

the geochemical cycling of metals (Cd, Pb, Zn, Cu, Al, Mn, and Fe) in acid versus circumneutral lakes

geochemical cycling of metals in meso versus oligo-saline lakes

trace metal cycling in bog versus fen type wetlands

4/ An evaluation of the biotic factors which influence the effect of a contaminant on associated biota. Examples of some of the biological factors to be discussed include;

growth rates (allometric considerations)
stage of life history
trophic level
food chain length

New Graduate Course Proposal Form

CALENDAR INFORMATION:

Department: Biological Sciences Course Number: 855

Title: Biochemical Toxicology

Description: This course examines the biodynamics and actions of toxicants on several key biological systems within living organisms at the biochemical and molecular levels.

Credit Hours: 3 Vector: 3-2-0 Prerequisite(s) if any: 301, 313

ENROLLMENT AND SCHEDULING:

Estimated Enrollment: 5-10 When will the course first be offered: 97-3

How often will the course be offered: every second year

JUSTIFICATION:

There exists at this time no course which will provide students with a fundamental background in toxicant dynamics and actions at the biochemical and molecular level. Understanding of these underlying processes at this level is a necessary requirement for most of the courses in environmental toxicology at the graduate level.

RESOURCES:

Which Faculty member will normally teach the course: Dr. C.J. Kennedy

What are the budgetary implications of mounting the course: None

Are there sufficient Library resources (append details): Yes

Appended: a) Outline of the Course
b) An indication of the competence of the Faculty member to give the course.
c) Library resources

Approved: Departmental Graduate Studies Committee: [signature] Date: 96/3/15

Faculty Graduate Studies Committee: [signature] Date: 96/3/15

Faculty: C.H.W. Jones Date: 26 March 96

Senate Graduate Studies Committee: [signature] Date: 3 Oct 96

Senate: 53. Date:

BISC 855
Biochemical toxicology
Course Outline

Instructor: Dr. Christopher J. Kennedy

Course description:

This course deals with the biodynamics and actions of toxicants within living organisms at the biochemical and molecular levels. The biochemistry of xenobiotic biotransformation and factors which alter an organisms response to toxicants are examined in detail. Mechanisms of toxicant action are examined in key biological systems including membranes, enzymes, proteins, nucleic acids and integrated systems such asenergy metabolism. Chemical carcinogenesis and immune responses and the application of biochemical methods in investigating the mechanisms of toxicant action will also be discussed.

Prerequisites:

The course is designed for the advanced undergraduate or graduate student with a good background in biochemistry, physiology and environmental toxicology. Prerequisites: BISC 305, BISC 301 and BISC 313 or equivalents.

Outline:

I. Introduction to the basic concepts of biochemical toxicology. History, inception, general biochemical description of three phases of toxicant action: exposure, toxicokinetics including absorption, distribution and excretion and the toxicodynamic phase including toxicant-receptor interactions including antidotes.

II. Metabolic fate of xenobiotics. Phase I reactions: concepts, microsomal monooxygenations, flavin-containing monooxygenations, nonmicrosomal oxidations, cooxidation reactions, reduction reactions, hydrolysis. Phase II reactions: concepts, glycosides, glucuronides, sulfation, methylation, acylation, glutathione transferase, lipophillic conjugation, phase II activation. Factors affecting metabolism; biological, chemical and environmental.

III. Energy metabolism and oxidative phosphorylation. Review of energy metabolism, effects of toxicants on energy reserves and pathways of energy production. Oxidative phosphorylation and respiration, photophosphorylation and photosynthesis, ATP availability and metabolism, perturbations of energy transducing membranes.

IV. Effects on membranes. Membrane composition, reactive metabolite formation, free radicals, lipid peroxidation, solubilizing, pores and transport, integrity, membrane fluidity.

V. Enzymes and cofactors. Enzyme function and kinetics. Detoxification enzyme systems. Key biochemical systems and receptors. Effects on specific enzymes, synthesis, cofacators.

VI. Protein and nucleic acid metabolism. Nucleic acid and protein metabolism, DNA metabolism, DNA repair, inhibition of DNA replication and plymerases, RNA

metabolism and effects on RNA polymerases, protein metabolism, enzyme induction and inhibitors of synthesis.

VIII. Mechanisms of chemically-induced injury and cellular protection mechanisms. Covalent binding, glutathione, redox cycling, oxidative cell injury, bio-reduction, prevention, antidotes, repair.

IX. Minerals, electrolytes and acid-base equilibria. Biochemistry of osmoregulation in mammals and aquatic organisms. Toxicant effects on transport epithelia and mechanisms. Renal and branchial toxicity. Acid-base balance effects.

X. Carcinogenisis. Historical perspective, cancer, classes of chemical carcinogens, somatic mutation theory, oncogenes and cellular transformation, tumor suppressor genes, epigenetic mechanism of carcinogenesis, multistage carcinogenesis, tumor promoters.

XI. Immune aspects. Introduction to the mammalian and piscine immune systems. Effects of toxicants on defense mechanisms. Allergic reactions. Specific immune system tests.

XII. In vitro methods in biochemical toxicology: perfused organs, cell cultures, isolated cells, microsomes

Required textbook:

No textbook is chosen at this time for this course

NEW GRADUATE COURSE PROPOSAL FORM

CALENDAR INFORMATION:

Department: BIOSCIENCES Course No.: 856

Title: Industrial Biotechnology

Description: This course is intended to provide students with the theory and hands-on experience of several commonly-used biotechnological techniques.

Credit Hours: 3 units Vector: 2-0-6 Pre-requisite(s), if any: BISC 221 & 303
BISC 329 recommended
undergraduate enrollment with permission of the instructor

ENROLLMENT AND SCHEDULING:

Estimated Enrollment: 20 When will the course first be offered: 97-3

How often will the course be offered: Once every 4-6 semesters, depending on enrollment

JUSTIFICATION:

Previously offered as BISC 423 - dropped from calendar as faculty member had other commitments. At present, there are no upper-level courses in microbiology which offer students experience in an integrated set of biotechnology techniques based upon current industry requirements. This course will be useful to students in the proposed Masters of Environmental Toxicology program, graduate students with an interest in microbiology as well as engineering students involved in biotechnology.

RESOURCES:

Which Faculty member will normally teach the course: Dr. M. Moore

What are the budgetary implications of mounting the course: Lab Instructor, Lab space, Lab supplies.

Are there sufficient Library resources (append details)? Yes

Appended: a) Outline of the Course
b) An indication of the competence of the Faculty member to give the course.
c) Library resources

Approved: Departmental Graduate Studies Committee: [signature] Date: 96/3/15

Faculty Graduate Studies Committee: [signature] Date: 96/3/15

Faculty: C.A.W. Jones Date: 26 March 96

Senate Graduate Studies Committee: [signature] Date: 23 Oct/97

Senate: 56. Date:

BISC 856 (formerly 423)
Tentative Course Outline

Dr. M. Moore
Ms. N. McGregor

Objectives and Rationale for Offering this Course

The objectives of this course are to introduce students to the theoretical and practical aspects of a variety of techniques currently used both in the biotechnology industry and in research institutes. The topics were selected in extensive consultation with Canadian academic institutions as well as biotechnology industries. Students taking this course will gain expertise in areas of biotechnology that can be used in many subdisciplines e.g. biochemistry, environmental toxicology, microbiology. In addition to rounding out their academic training, Industrial Biotechnology will also provide students with hands on experience in novel laboratory techniques and give them the experience of working in groups in technical development and troubleshooting. A clear need for personnel trained in such areas has been identified by the Canadian Biotechnology Council and the BC Science Council.

At present, the Dept. of Biological Sciences at SFU has only one Microbiology course (BISC 303) and there are numerous requests each semester for a 4th year course which would build upon the material covered in BISC 303. This course will therefore build upon material presented in BISC 303. Our department had offerred an Industrial Biotechnology course in the past but it has not been given for several years as the previous instructor has not been available to teach the course.

Who can enrol?

Industrial Biotechnology will be offerred as a fourth year course but will be available to graduate students with special permission. The course requirements for graduate students will be more rigourous than for the undergraduates; graduate students will be required to present a seminar and a term paper on a topic selected by them (in consultation with the instructor). Material presented in both the theoretical and practical components of the course is designed to complement other biotechnology courses such as BISC 431 (Molecular Biotechnology) and BISC 457 (Plant Molecular Biology and Biotechnology).

Course content

Lectures:
The course will have two lectures per week which will discuss the theoretical basis of various techniques (see below) and current applications in research and industry. Selected guest speakers from industry will be invited to give a lecture on their area. Some time will be set aside at regular intervals (e.g. once per month) for troubleshooting as well as for formal group presentations of the data.

BISC 856 (formerly 423)
Tentative Course Outline

Dr. M. Moore
Ms. N. McGregor

Laboratory:
This will be the main emphasis of the course; however, the laboratory exercises are not simply demonstrative. Instead, the entire semester's laboratory program will constitute a research project for the entire class as is discussed below. Briefly, the students will be isolating soil bacteria using enrichment cultures and testing their abilities to oxidize toluene, a soil pollutant. They will then identify and characterize the isolates while comparing it to a laboratory strain of *Pseudomonas putida*, pWWO, which carries the *tol*-metabolic plasmid. They will use a recombinant *tol*-plasmid (obtained by us) which has the GUS reporter gene to transfect selected bacterial strains. They will then reinoculate various soils and attempt to recover their genetically-engineered strains from the soils.

Week	Laboratory Exercise
1	Introduction - Laboratory practices Preparation of plates/shake flasks
2	Plating/selecting organisms Begin biochemical/morphological tests to identity organisms along with lab strain of *P. putida* - manual testing, Biolog (automated) testing
3	Chemical analysis of toluene oxidation - thin layer chromatography, gas chromatography
4	Dispersal of engineered lab strain of *P. putida* to contained soils
5	Quantification of selected hydrocarbons in water/media samples using ELISA
6	Growth in the fermenter of the 'best' oxidizers - culture optimization, pH, pO2, media selection
7	Culture optimization II
8	Culture storage techniques
9	Recovery of lab strain of *P. putida* from soils which were previously inoculated - plating and DNA isolation

10	Detection and quantification of luminescent recombinants in spread plates illuminated at optimal wavelength, Colony lifts and filter preparation for hybridization
11	Hybridization of filters with fluorescently-labelled plasmid-specific probes; chemiluminescent detection on film
12	spare

Prerequisites

Students are required to have completed BICH 221, BICH 222, BISC 303 and one undergraduate analytical chemistry course at the second year level.

Student Evaluation

The students will meet regularly to present their results (in groups) and to discuss and troubleshoot the laboratory exercises. Individually, they will be required to hand in written lab reports for at least 4 of the exercises. A midterm and a final exam will be used to assess their knowledge of the material presented in the lectures.

Text

It is expected that the students will use a variety of materials photocopied from the current biotechnological literature; however, at present we are also evaluating several new texts for their suitability for this course.

First Offering

It is hoped that this course will be offerred beginning 95-3. Development time has been allotted to Ms. McGregor in 94-3 and 95-2 for the purposes of setting up the laboratory exercises.

New Graduate Course Proposal Form

CALENDAR INFORMATION:

Department: Biological Sciences Course Number: 655

Title: Environmental Toxicology Seminars

Description: A structured series of seminars on the recent developments of environmental toxicology

Credit Hours: 3 Vector: 3-0-0 Prerequisite(s) if any: NA

ENROLLMENT AND SCHEDULING:

Estimated Enrollment: 10 When will the course first be offered: 98-1

How often will the course be offered: ~~Once per year~~

JUSTIFICATION:

A required component of an integrated group of courses for the MENTOX program.

RESOURCES:

Which Faculty member will normally teach the course: Any faculty in the MENTOX program

What are the budgetary implications of mounting the course: Travel and accommodation budget for visitors; publication costs

Are there sufficient Library resources (append details): NA

Appended: a) Outline of the Course
b) An indication of the competence of the Faculty member to give the course.
c) Library resources

Approved: Departmental Graduate Studies Committee: [signature] Date: 96/3/15

Faculty Graduate Studies Committee: [signature] Date: 96/3/15

Faculty: C.H.J. Jones Date: 26 March 96

Senate Graduate Studies Committee: [signature] Date: 30 Oct/96

Senate: 60. Date:

BISC 655

ENVIRONMENTAL TOXICOLOGY SEMINARS

A structured series of seminars which are designed to keep step with the development of environmental toxicology and the MENTOX program.

No library facilities required.

New Graduate Course Proposal Form

CALENDAR INFORMATION:

Department: Biological Sciences **Course Number:** 656

Title: Master of Environmental Toxicology Project

Description: One semester experience in a university or commercial laboratory according to student's interests

Credit Hours: 0 **Vector:** NA **Prerequisite(s) if any:** Acceptance into program

ENROLLMENT AND SCHEDULING:

Estimated Enrollment: 10 **When will the course first be offered:** 98-2

How often will the course be offered: Every semester

JUSTIFICATION:

Students will gain experience and expertise in a specialized area of their interest.

RESOURCES:

Which Faculty member will normally teach the course: Any faculty in the MENTOX program

What are the budgetary implications of mounting the course: none

Are there sufficient Library resources (append details): Yes

Appended: a) Outline of the Course
b) An indication of the competence of the Faculty member to give the course.
c) Library resources

Approved:

Departmental Graduate Studies Committee: [signature] Date: 96/3/15

Faculty Graduate Studies Committee: [signature] Date: 96/3/15

Faculty: CHH. Jones Date: 26 March 96

Senate Graduate Studies Committee: BPC Date: 30 Oct/96

Senate: 62. Date:

BISC 656 COURSE OUTLINE

MASTER OF ENVIRONMENTAL TOXICOLOGY PROJECT

A requirement of the Master in Environmental Toxicology programme is a project on an aspect of environmental toxicology. The topic chosen in consultation with the Supervisor, may be based on reading and research associated with problem analysis or based on original research in the laboratory.

CALENDAR INFORMATION:

Department: BIOLOGICAL SCIENCES Course Number: 657

Title: CO-OP PRACTICUM I

Description: FIRST WORK EXPERIENCE FOR MENTOX STUDENTS

Credit Hours: 0 Vector: 0 Prerequisite(s) if any: Completion of Professional Paper

ENROLLMENT AND SCHEDULING:

Estimated Enrollment: 5/year When will the course first be offered: 1998

How often will the course be offered: Each semester where there is a demand

JUSTIFICATION:

Would attract high quality graduate students by offering good long term employment opportunities

RESOURCES:

Which Faculty member will normally teach the course: n/a

What are the budgetary implications of mounting the course: Nil. To be administered from the MENTOX office.

Are there sufficient Library resources (append details): n/a

Appended: a) Outline of the Course
b) An indication of the competence of the Faculty member to give the course.
c) Library resources

Approved: Departmental Graduate Studies Committee: [signature] Date: 96/3/15

Faculty Graduate Studies Committee: [signature] Date: 96/3/15

Faculty: [signature] Date: 26 March 96

Senate Graduate Studies Committee: [signature] Date: 30 Oct/96

Senate: 64. Date:

New Graduate Course Proposal Form

CALENDAR INFORMATION:

Department: BIOLOGICAL SCIENCES Course Number: 658

Title: CO-OP PRACTICUM II

Description: SECOND WORK EXPERIENCE FOR MENTOX STUDENTS

Credit Hours: 0 Vector: 0 Prerequisite(s) if any: Completion of Professional Paper

ENROLLMENT AND SCHEDULING:

Estimated Enrollment: 5/year When will the course first be offered: 1998

How often will the course be offered: Each semester where there is a demand

JUSTIFICATION:

Would attract high quality graduate students by offering good long term employment opportunities

RESOURCES:

Which Faculty member will normally teach the course: n/a

What are the budgetary implications of mounting the course: Nil. To be administered from the MENTOX office.

Are there sufficient Library resources (append details): n/a

Appended: a) Outline of the Course
b) An indication of the competence of the Faculty member to give the course.
c) Library resources

Approved: Departmental Graduate Studies Committee: [signature] Date: 96/3/15

Faculty Graduate Studies Committee: [signature] Date: 96/3/15

Faculty: [signature] Date: 26 March 96

Senate Graduate Studies Committee: [signature] Date: 30 Oct/97

Senate: 65. Date:

Proposed Course Scheduling for MENTOX

	Year 1			Year 2		
Courses	Fall	Spring	Summer	Fall	Spring	Summer
BISC 656 ET Project	X	X	X	X	X	X
BISC 651 ET Test I	X			X		
BISC 855 Bioch. Toxicol.				X		
BISC 854 Ecol. Toxicol.	X					
BISC 856 Ind. Biotech.				X		
BISC 655 ET Seminar	X			X		
BISC 657 Co-op Practicum I	X	X	X	X	X	X
BISC 658 Co-op Practicum II	X	X	X	X	X	X
BISC 650 Env. Risk Ass.		X			X	
BISC 654 Food & Drug Tox.		X			X	
BISC 652 ET Test II		X			X	
BISC 846 Insect. Chem.		X			X	
BISC 856 Ind. Biotech.					X	
MRM 610 Mngt. of Contam.	X			X		
MRM 612 Sim. Modelling		X			X	
KIN 851 Exp. Carcinogen.		X			X	
STAT 650 Quant. Anal.	X			X		

Proposed Teaching Loads for MENTOX Faculty Members in Department of Biological Sciences

	Fall	Spring	Summer
Bendell-Young	BISC 651 ET Test I (every 2nd year) BISC 854 Ecol. Tox. (every 2nd year)	BISC 329	R R
Kennedy	BISC 651 ET Test I (every 2nd year) BISC 855 Biochem. Tox. (every 2nd year)	BISC 445	R
Law	BISC 313	BISC 650 Env. Risk BISC 654 Food/Drug	R
Moore	BICH 221 (every 2nd year) BISC 856 Ind. Biotech (every 2nd year)	BISC 313	R
Nicholson	BISC 432	BISC 652 ET Test II BISC 846 Ins. Chem.	R
Farrell	BISC 312	BISC 101	R

Note that BISC 854 Ecological Toxicology will be taught by Dr. Bendell-Young and BISC 856 Industrial Biotechnology will be taught by Dr. Moore in conjunction with BISC 471, Special Topics in Biology.

APPENDIX VII

LETTERS OF SUPPORT FROM INDUSTRY AND REGULATORY AGENCY:

(1) Mr. Don Fast, Executive Director, Environmental Protection Department, B.C. Ministry of Environment.

(2) Mr. R. Wilson and Dr. G. Brown, CanTox Inc. Consultants in Toxicology, Health and Environmental Sciences.

(3) Mr. A. Lewis, Triton Environmental Consultants Ltd.

Province of
British Columbia
Ministry of
Environment,
Lands and Parks

BC Environment

Environmental Protection Division
777 Broughton Street
Victoria
British Columbia
V8V 1X5

Telephone: 387-9993
Facsimile: 356-9836

JUN 2 4 1994

File: 69000-10

Dr. Francis Law
Professor, Environmental Toxicology
Simon Fraser University
Dept. of Biological Sciences
Burnaby, B.C. V5A 1S6

Dear Dr. Law:

Re: Proposal for a Master of Environmental Toxicology Program - Department of Biological Sciences, Simon Fraser University

As requested, we have now reviewed the above mentioned proposal which you recently sent to us.

We are pleased to support the program as proposed. Like yourself, we believe that such a program aimed at producing graduates with toxicological skills and expertise demonstratively relevant to the needs of regulatory agencies and environmental industry is sorely needed.

Your proposed program which emphasizes the timely production of professionally oriented, as opposed to more traditional academically oriented graduates seems both innovative and pragmatic to us. We agree that such graduates would help to rectify the current and acute shortage of trained toxicologists within the field of environmental management.

Completion of the courses detailed within your proposed program should produce graduates who possess an exemplary scope and depth of toxicological knowledge. It is our opinion that in any graduate degree program, candidates should be required to not only demonstrate their ability to assimilate knowledge, but also apply that knowledge in novel circumstances. In this latter respect, we view your proposed requirement for the completion of a "Master of Environmental Toxicology Research Paper" and a subsequent oral examination on the chosen topic, as an essential component of the degree.

In closing, I would like to take this opportunity to encourage you in your

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continued pursuit of a professional Master of Environmental Toxicology degree program for your university. Thank you for providing us the opportunity to comment.

Yours very truly,

Don A. Fast
Executive Director
Environmental Protection Department

CANTOX INC.

Consultants in Toxicology
Health and Environmental Sciences

666 Burrard Street, Suite 1300, Vancouver, British Columbia, Canada, V6C 3J8, TEL: (604) 688-8255, FAX: (604) 688-2419

April 15, 1994

Dr. Francis Law
Department of Biological Sciences
Simon Fraser University
Burnaby, B.C.
V5A 1S6

Dear Dr. Law:

It was a pleasure to meet with you the other week. It certainly seems as though you are conducting some very interesting and relevant research projects.

As you are aware, CanTox is a leading Canadian company in the areas of toxicology, health and environmental sciences. CanTox has offices in Vancouver, Calgary, Mississauga and Halifax. We have a staff of over 60 individuals in our four offices with highly qualified professionals with experience that encompasses diverse areas of human and aquatic toxicology, environmental fate and modelling, human health and environmental risk assessment and risk communication.
We have had the chance to review your proposal for the Master of Environmental Toxicology Program. It is opinion that the program would produce graduates who would be valuable to companies such as CanTox Inc. Many of the proposed subjects are directly applicable to the work that CanTox conducts on a daily basis. The most notable example would be the modelling course teaching stochastic risk assessment procedures. However, the courses teaching various aspects and applications of toxicology would also provide fundamental and important knowledge required by scientists at CanTox. The Master of Environmental Toxicology program would definitely give students an edge in securing a position in a company such as ours. We are sure that if the proposed program is accepted we will look forward to interviewing some of the graduates as prospective employees (CanTox already employs two recent graduates from your post baccalaureate diploma program).

We wish you the best in receiving authorization for your program.

Yours sincerely,
CanTox Inc.

Ross Wilson

Ross Wilson, M.Sc.
Scientist

Ross Wilson for: Gord Brown, Ph.D.
Senior Scientist

TRITON
Environmental Consultants Ltd.

#120 - 13511 Commerce Parkway
Richmond, B.C., Canada V6V 2L1
Telephone: (604) 279-2093
Fax: (604) 279-2047

September 25, 1994

Reference: 9001/WP 6214

Department of Biological Sciences
Simon Fraser University
Burnaby, B.C.
V5A 1S6

Attention: Dr. F. Law
Professor

Dear Sir:

Re: Proposed Master of Environmental Toxicology Program (MENTOX)

We are pleased that Simon Fraser University is considering training students in toxicology the graduate level. Environmental consulting requires the assessment of impacts of toxic materials on the environment. In the past two years roughly 25% of Triton's contracts dealt with some aspect of the effects of deleterious materials on the aquatic environment. This is probably a good gauge of the importance of this field to the environmental business as a whole, as Triton is one of B.C.'s largest environmental consulting firms, with over 50 full-time staff.

Triton employs Baccalaureate graduates in some of these contracts, but primarily as assistants. We require more highly-trained individuals to lead these projects because the analyses are complex, and frequently involve primary research into some aspect of the behavior or effect of a toxicant. Often our contracts require expert testimony, and a Master's graduate is more credible than a Baccalaureate. Furthermore, the assessment of contaminated sites incurs a liability to our firm, and the direct experience that would be given through training at a Master's level would increase both our confidence and that of our clients.

In general we find that Baccalaureate graduates require more training to reach an acceptable level of technical competence that Master's level graduates. As a result, MENTOX graduates would be more immediately employable in this field. The proposed curriculum would provide graduates with sufficient versatility to address a wide range of projects, but with sufficient detail to step immediately into project work. For example, the course "Environmental Risk Assessment: Human Health Risk Assessment and Ecological Effects-Based Risk Assessment" is directly applicable to an assessment we completed for a wood preserving company over the past three-years.

The Research Paper requirement of the proposed MENTOX program is of high value in the training of personnel to work in this field. Appropriate topics would prepare graduates to work in 'real' problems. We hope that research topics are focused on existing problems in the field and that MENTOX students are encouraged/required to liaise with or work in industry during their research.

I hope that the proposed MENTOX program is implemented at SFU. Although we recognize that other Provincial and American Universities have these programs, a B.C. program would be better-tailored to meet B.C. requirements, and B.C. graduates are more salable to our B.C. clients. Please contact me if you have any questions or need further information.

Sincerely,

Triton Environmental Consultants Ltd.

Adam Lewis, M.Sc., R.P.Bio.
Manager, Fisheries Consulting

APPENDIX VIII

SFU LIBRARY Resource Report (MENTOX proposal and Library Response)

SIMON FRASER UNIVERSITY
W.A.C. BENNETT LIBRARY
Memorandum

To: **Leah Bendell-Young** **From:** Sharon Thomas
Library

Re: **MENTOX Programme** **Date:** 07/16/96

Thank you for your thoughtful response to our assessment of library requirements for the MENTOX Programme. In view of your description of the programme as "not a research-driven Masters degree but rather a course oriented professional programme aimed at training professional students" we believe that the proposed $8,000 per year will cover those basic needs. As you know I was concerned about the long-term implications of this rather minimal level of service but I defer to your intention to use the Library only to "obtain specific information as determined by the MENTOX faculty".

Consequently I believe we can support the MENTOX Programme as described in your memorandum of June 12, 1996 with a recurring budget of $8,000.

Sharon Thomas

SIMON FRASER UNIVERSITY

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EPARTMENT OF BIOLOGICAL SCIENCES

BURNABY, BRITISH COLUMBIA V5A 1S6
Telephone: (604) 291-4475
Fax: (604) 291-3496

MEMORANDUM

To: Sharon Thomas, Ralph Stanton; W.A.C. Bennett Library

From: MENTOX Faculty; Leah Bendell-Young, Tony Farrell, Chris Kennedy, Francis Law, Margo Moore, Russell Nicholson, Dept. of Biological Science.

Re: Library Assessment of Masters Degree in Environmental Toxicology (MENTOX) Programme.

Date: June 12 1996.

The following memo is organized under four headings. The first provides a description of the proposed MENTOX programme. The second clarifies the budget that we have available for acquiring new library holdings relevant to the MENTOX programme. How the MENTOX faculty would like to see the library allocate these resources is detailed in the third section. The final section identifies journals already held by the library that are essential to the MENTOX programme.

1.0 What is MENTOX?

The goals of the programme are to provide students the required theory and methods needed to assess the fate, effects and risks of contaminants in the environment through a broadly based interdisciplinary science programme. It is not a research-driven Masters degree but rather a course oriented professional programme aimed at training professional students. At a maximum there will be 10 students/year. These students will not be required to access library resources as intensively as would a regular M.Sc. student, i.e., given that the professional degree is course driven, they will largely be required to obtain specific information as determined by the MENTOX faculty.

2.0 Available Budget.

The existing budget (in principle) for the MENTOX programme is as follows:

Salaries for sessionals	$20,000.00
Salary for secretary	$15,000.00
Field trips/invited speakers	$ 4,500.00
Office supplies/ Programme advertisement	$ 4,000.00
Equipment for teaching	$ 8,675.00 (Year 1)
	$ 4,337.50 (subsequent years)

Within this budget, no monies have been allocated for library resources. However, the Dean of Science has indicated that a total of $8,000.00 will be made available from two sources 1/ Monies released by terminating some Aquaculture holdings ($1290.00) and 2/ through Faculty of Science Funding ($6710.00). (see also appended letter from the Dean of Sciences (June 6/96).

Hence, we have available a maximum of $8,000.00 on a recurring basis to be allocated for new library holdings pertinent to the MENTOX programme. This represents close to 15% of our budget.

3.0 New library holdings required for the MENTOX programme.

The library already has substantial holdings directly and indirectly related to the area of Environmental Toxicology (see section 4.0).

Given these existing holdings the MENTOX faculty would like to see the following added to the library collection;

Monographs: Basic reference texts for the MENTOX programme would be required. Of the $8,000.00, $2,000.00 on a recurring basis will be allocated to acquiring basic reference texts as determined by MENTOX faculty.

Total: $2000.00

Journals: Journals required for the programme are as follows:

1/ Drug Metabolism and Deposition	$ 210.00
2/ Archives of Toxicology	$1880.00
3/ Trends in Biotechnology	$ 693.00
4/ Fundamental and Applied Toxicology	$ 612.00
5/ Neurotoxicology	(?)
6/ Ecotoxicology	$ 275.00

7/ Environmental Modelling and Assessment $ 300.00

Total: $6000.00

TOTAL recurring budget: $8,000.00

4.0 Existing library holdings relevant to the MENTOX programme.

Appended to this memo is a list of current library holdings. We have highlighted those journals that are of direct and indirect relevance to the MENTOX programme. The purchase of monographs and journals outlined in Section 3.0 will serve to strengthen a more than adequate literature base for those students enrolled in the MENTOX programme.

In conclusion, we hope that this will clarify library resources that are needed to support the MENTOX programme. Thank you for meeting with us and we look forward to working with you on this exciting new degree programme.

Sincerely

Dr. Leah Bendell-Young

Dr. Tony Farrell

Dr. Chris Kennedy

Dr. Francis Law

Dr. Margo Moore

Dr. Russell Nicholson

cc/ Mike Smith, Chair, Biological Sciences
Felix Breden, Chair, Graduate Committee
Colin Jones, Dean of Science

SIMON FRASER UNIVERSITY
MEMORANDUM

To: F. Breden, Chair
Faculty of Science
Graduate Studies Committee

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

Subject: Budget - Mentox

Date: June 6, 1996

==========

I would like to clarify the budget that could be available for Mentox. The present (1995-96) budget allocation to Biological Sciences for M.Aquaculture is as follows:

Non-salary	$15,000
Salary (technician)	$13,829
CFL II (Sessionals)	$21,171

With the elimination of the M. Aquaculture programme these monies are available, in principle, for Mentox.

The M.Aquaculture programme also had library holdings but I do not know what the value was (is).

With regard to the new library holdings required for Mentox, I would envisage four possible sources of funding:

i) Monies released by terminating some Aquaculture holdings;
ii) Reallocation of some of the above base budget monies from M. Aquaculture as library funding for Mentox;
iii) Reallocation by Biological Sciences of other base funding for this purpose;
iv) Faculty of Science funding.

The budget for Mentox has never been discussed or approved as such and we will eventually have to bite that bullet. Fortunately, we do have the base funding from M.Aquaculture to work from.

As I had suggested earlier, I believe a budget for new holdings for Mentox of ca. $8,000 would not seem unreasonable and those monies would have to be derived from i) to iv) above.

C.H.W. Jones

c. M.J. Smith
A.P. Farrell

Master of Environmental Toxicology Program

Location: B8265 Shrum Science Centre
Telephone: 291-4285
Fax: 291-3496
Director: Dr. F. C. P. Law BSc MSc (Alta), PhD (Michigan)

Faculty and Areas of Research

L. Bendell-Young	Ecotoxicology
T. Farrell	Physiology and Aquatic Toxicology
F. Gobas	Environmental Fate Modelling
C. Kennedy	Biochemical and Aquatic Toxicology
F. Law	Environmental Toxicology and Risk Assessment
M. Moore	Degradation of chemicals by microorganisms
R. Nicholson	Biochemical and Pesticide Toxicology
R. Routledge	Statistics
M. Rosin	Environmental Carcinogensis

Before entering the program students should have completed the following courses or their equivalents. These prerequisites may be waived by the Departmental Graduate Studies Committee under special circumstances on recommendation from the director of the program.

BISC	312-3 Environmental Toxicology I
BISC	313-3 Environmental Toxicology II
CHEM	250-3 Organic Chemistry II
BICH	221-3 Cellular Biology and Biochemistry

Each MENTOX student must choose a senior supervisor after admission, in consultation with the director of the program. In accordance with university regulations, a supervisory committee must be formed by the beginning of the third semester of full-time equivalent enrollment. As part of the requirements, students must complete a project on a specific aspect of environmental toxicology which may be based on original field, laboratory or library research. The student will be supervised on this project by the senior supervisor while enrolled in BISC 656-0, Master of Environmental Toxicology Project. In addition to submission of a report at the completion of the project, the student will make an oral presentation to at least the Supervisory Committee and at least one other faculty member.

This program may be taken on a part-time basis.

Program Requirements

Every MENTOX program will consist of a minimum of 32 semester hours of graduate credit, including the following courses:

Core Courses

BISC 650-3 Environmental Risk Assessment: Human Health Risk Assessment and Ecological Effects-Based Risk Assessment
BISC 651-3 Environmental Toxicology Tests I. Ecological Effects-Based Tests
BISC 652-3 Environmental Toxicology Tests II: Mammalian Toxicity Tests
BISC 654-3 Food and Drug Toxicology
BISC 655-3 Environmental Toxicology Seminar
BISC 855-3 Biochemical Toxicology
STAT 650-5 Quantitative Analysis in Resource Management and Field Biology

BISC 656-0 Master of Environmental Toxicology Project.

Elective Courses

One of:
BISC 854-3 Ecotoxicology
REM 610-5 Management of Contaminants in the Environment
EASC 613 Groundwater Hydrology

At least 6 credits chosen from the following:

BISC 856-3 Industrial Biotechnology
BISC 846-3 Insecticide Chemistry and Toxicology
REM 612-5 Simulation Modelling in Natural Resource Management
KIN 851-3 Recent Advances in Experimental Carcinogenesis
BISC 883-3 Special Topics in Environmental Toxicology

Co-operative Education Program

The Master of Environmental Toxicology Program has introduced a Co-operative Education option in the program in order to allow students to gain work experience outside the university. Award of the Master of Environmental Toxicology is not contingent on satisfactorily completing the Co-operative Education option.

Students registering in the Co-op program need to pay attention to the regulations governing minimum fee requirements (see Fees for Masters and Ph.D. students).

Professional Registration and Certification

Eligibility for the Certification Examination of the American Board of Toxicology, Inc. can be met through the Master of Environmental Toxicology program and four years of work experience.

Graduate Courses

BISC 650-3 Environmental Risk Assessment: Human Health Risk Assessment and Ecological Effects-Based Risk Assessment. Review of principles and procedures crucial to professionals involved in assessing, managing and communicating the risks of environmental chemicals.

BISC 651-3 Environmental Toxicology Tests I. Ecological Effects- Based Tests. Basic concepts and practical applications of various testing procedures used in the determination of ecological effects caused by toxicant exposure.

BISC 652-3 Environmental Toxicology Tests II. Mammalian Toxicity Tests. Foundation in the basic principles and strategies involved in the primary toxicological evaluation of chemicals using laboratory animals.

BISC 654-3 Food and Drug Toxicology. Comprehensive account of the toxic effects of drugs and chemicals that are added intentionally or unintentionally in one's diet.

BISC 655-3 Environmental Toxicology Seminar. Discussion of recent literature in environmental toxicology through student seminars.

BISC 656-0 Master of Environmental Toxicology Project. One semester of research experience in environmental industry or university according to the student's interests.

BISC 657-0 Co-op Practicum I. Practical experience in an environmental industry or a regulatory agency.

BISC 658-0 Co-op Practicum II. Practical experience in an environmental industry or a regulatory agency.

Appendix XI

SIMON FRASER UNIVERSITY

JUN 23 1997

DEPARTMENT OF BIOLOGICAL SCIENCES

BURNABY, BRITISH COLUMBIA V5A 1S6
Telephone: (604) 291-4475
Fax: (604) 291-3496

June 19, 1997

Dr. Phyllis M. Wrenn,
Associate Dean,
Office of the Dean of Graduate Studies,
Simon Fraser University,
Burnaby, B.C.

Dear Dr. Wrenn:

Re: MENTOX Proposal

Your memorandum dated June 4, 1997 and the comments of three of the four reviewers on the proposal for the Master of Environmental Toxicology have been passed on to me for response.

I am pleased that the reviewers' comments are very positive and I would like to take this opportunity to thank them for their constructive reviews. Let me address the response to each of the reviewers sequentially:

Dr. John Arnason

Overall Assessment. I disagree that the title "Master of Environmental Toxicology" is misleading. As indicated in the proposal, this is a "professional" degree which differs to the traditional MSc. degree offered by the Faculty of Science. Moreover, the proposed program does not have any management course. The title of "Masters in Environmental Toxicology Management" is confusing at SFU since it implies the program is offered by the School of Resource and Environmental Management. Also, the title implies environmental toxicology can be managed. This is incorrect.

Academic Merit. A formal management structure for the program was an integral part of the proposal. However, this was removed before the proposal was sent out for review.

Adequacy of Faculty and Resources. No response.

Demand Among Students. No response.

Demand Among Employers. No response.

Recommendations: (1) Name change. Please see responses in Overall Assessment. (2) I am in total agreement with Dr. Arnason that the program needs a formal governing structure especially the appointment of a director who will guide the development of the program and has the power to defend the interests of the MENTOX program.

Dr. Barry Blakley

Program Objectives. Dr. Blakley has expressed a reservation that the second objective of the proposal (to develop and maintain high standards of research and education in toxicology) will be met by the program.

My response: It should be remembered that all faculties contributing to the MENTOX program are active researchers in environmental toxicology. Consequently I expect a student to become involved in a discrete project within the current focus of a faculty member's research. Projects will be judiciously chosen to ensure feasibility while promoting a framework for intellectual challenge. I anticipate publishable results to arise from these projects in many cases. I believe that although the research component of MENTOX is relatively small, it will be of high quality, therefore I have to disagree with Dr. Blakley. I must also point out that since these faculties are involved in different areas of toxicology research and are presently located in different parts of the campus, the proposed MENTOX program will provide more opportunity for these faculties to meet and foster collaborative research opportunity.

Dr. Blakley also doubts that MENTOX students will be able to pass the ABT certification.

My response: The proposed MENTOX program includes courses in both mammalian toxicology and ecological toxicology areas. Mammalian toxicology courses in the program such as BISC 313, BISC 650, BISC 652, BISC 654 and BISC 846 will enable MENTOX students to pass the ABT certification.

Relationship of the Proposed MENTOX Program to the Role and Mission of SFU. Dr. Law is currently negotiating with the Canadian Network of Toxicology Centres (CNTC) on behalf of the MENTOX program of SFU to become the Pacific node of the CNTC.

Program Organization. The scenarios described by Dr. Blakley have plagued many toxicology training programs in North America. These potential problems underscore the importance of having a management structure and a director who have real power to administer the MENTOX program.

Admission Requirement. I agree physiology is one of the important components of toxicology. However, I do not feel that it should be a requirement for admission since it is impossible to incorporate all toxicology-related disciplines in the admission requirement. Furthermore, there are several physiology courses in the Department of Biological Sciences for MENTOX students to select as options.

Course Content. System toxicology, reproductive toxicology, teratology , and inhalation toxicology are taught in BISC 313, BISC 650 and BISC 654.

Student Enrolment. No response.

Teaching Resources. (a) Faculty Resources: No comment (b) Library Resources: I agree that the budget for the library is small. However, it is appropriate for the size of the MENTOX program. Moreover, MENTOX students are expected to make use of available services such as inter-library loans, electronic publications, and the Internet.

Dr. Fumio Matsumura

Major Comments

1. No response.

2. I agree that the addition of a bona fide chemist to the core faculty group would enhance the program in the future and I will discuss this with the Department of Chemistry.

3. No response.

4. The faculty members involved in MENTOX also accept traditional M.Sc. and Ph.D. students into their laboratories. In other words, students can choose between the MENTOX program or the traditional graduate research degree program. This would seem an appropriate level of flexibility.

5. I agree.

6. This is not entirely true. Mammalian toxicology courses such as BISC 313, BISC 650, BISC 652, BISC 654 and BISC 846 are terrestrial toxicology.

7. I did not go into details when describing the Co-operative Education Program since co-operative education is described thoroughly in the SFU calendar. Also it should be noted that the MENTOX degree is not contingent on satisfactory completion of the Co-operative Education Program.

Additional Comments

SFU does not have a Ph.D. minor program.

Sincerely yours,

Francis Law

Francis Law, Ph.D.
Professor, Environmental Toxicology Program

Université d'Ottawa · University of Ottawa

Faculté des sciences
Biologie

Faculty of Science
Biology

April 20, 1997

Dr. Phyllis Wrenn
Associate Dean of Graduate Studies
Simon Fraser University
Burnaby B.C.
V5A 1S6

Dear Dr. Wrenn:

Please find enclosed my assessment of your Masters of Environmental Toxicology Program. I think you have an excellent program and wish you every success.

Sincerely,

Dr. J.T. Arnason

Professor and Director,
Collaborative Program for Environmental and Chemical Toxicology
Ottawa Carleton Institutes

89.

30, rue Marie-Curie C.P. 450, Succ. A
Ottawa (Ontario) K1N 6N5 Canada

30 Marie Curie St., P.O. Box 450, Stn. A
Ottawa, Ontario K1N 6N5 Canada

(613) 562-5718 • Téléc./Fax (613) 562-5486

REVIEW:

SIMON FRASER UNIVERSITY'S PROPOSAL FOR A MASTERS OF ENVIRONMENTAL TOXICOLOGY

Overall assessment

This is an excellent program, which should receive support, but must not be sold as something it is not. The title, "Masters of Environmental Toxicology", is very misleading, since the program is clearly a management program, not a conventional advanced research degree (M.Sc.). The program will provide excellent training for regulators, consultants and managers in the field, but does not qualify students as researchers, even if the experimental research project option is selected, since there is insufficient emphasis on research projects and thesis. Furthermore, the lack of full guaranteed financial support clearly identifies it as a management program and not a conventional research M.Sc. in science. On the other hand, there is clearly a demand for this is the type of program from students and employers and it will be welcomed enthusiastically.

Academic Merit:

If considered as a Masters in Environmental Toxicology Management, the program will provide excellent training for managers in the field.

The proposed program recognizes the interdisciplinary nature of the field of environmental toxicology and will allow a number of B.Sc discipline graduates to be admitted to the advanced

degree. In particular, the admission requirements for undergraduate courses in chemistry, biochemistry & cell biology, and introductory toxicology are a sound basis for ensuring a minimum skill set has been acquired. The selection of core courses is excellent, especially the emphasis on risk analysis, toxicology tests, and statistics. The list of optional courses provides a great deal of flexibility.

The one semester project provides an opportunity for practical work in environmental toxicology in either a lab field or literature context. While not providing the experience or training of a research M.Sc., the project should aim for publication quality.

The only oversight in the organization of the program is the lack of a formal management structure for the program (see recommendations below)

Adequacy of faculty and resources

Many of the faculty proposed for this program are outstanding scientists and lend great credibility to the program. The proposed director, Professor Law has an international reputation in the field and there are several younger up and coming scientist participating in the program. Simon Fraser University has a long tradition in areas related to this field and has developed a good reputation in the area. The budget requested for the progam is modest.

Demand among students

There is clearly evidence of demand in B.C. based on undergraduate enrolments in environmental toxicology. We have noticed a strong demand for this area at our University

usually in the neighbourhood of several inquiries per week. It is perceived as an area that will lead to a position in the current difficult job market.

Demand among employers

Environmental toxicology is a rapidly growing field and it is one of the few areas in science where the demand for qualified graduates is higher than the supply. The federal and provincial governments are still hiring regulators and managers in this area, while engaged in reductions in laboratory scientists (this area as well). In addition there is a strong demand in the private sector for qualified individuals, for example, to do work in risk assessment, supervise regulation of chemical and biological products.

Recommendations:

1) Name Change. Change the name of the program to what it is: Masters of Environmental Toxicology Management. (Also the abbreviation MENTOX gives me the same uneasy feeling as the new name proposed by a major bank trying to pretend it isn't in Montreal). Make it clear to the applicants (in a positive way) that the program is not a conventional M.Sc. with a major research driven thesis, but that they will be prepared for regulatory, consulting and management careers.

2) Management structure. The program needs a formal governing structure. For example, a definite term for the director is required, and a procedure for the democratic nomination and selection of a new director. There should be an annual general meeting to review the program and a committee structure for quick approval of admissions.

April 9, 1997

Phyllis M. Wrenn
Associate Dean of Graduate Studies
Simon Fraser University
Burnaby, B.C. V5A 1S6

Dear Dr. Wrenn: Re: Proposed Master of Environmental Toxicology Program (MENTOX)

I reviewed your MENTOX proposal with great interest. In difficult times at most universities, few institutions are expanding into new areas. Toxicology may be an exception. At the University of Saskatchewan, we have a similar Postgraduate Diploma Program which is integrated with out postgraduate degree program in toxicology. At any particular time, about 20% of our graduate students in toxicology are registered in the Diploma program.

I will make comments primarily in the order of presentation in your proposal.

1. Program Objectives

There is definitely a need to train environmental toxicologists. There are similar programs in the U.S.A. that train 100-200 individuals at a time. In our program, the federal government and private industry hires most of our graduates. Most are recruited and hired before they fully complete all degree requirements. This is particularly true with M.Sc. students. Our Ph.D. students frequently have more difficulty finding a suitable position. Our PGD students also have little difficulty finding suitable employment.

Your second objective: to develop and maintain high standards of research and education in toxicology, is not specifically met by your program. There is no research component in the degree. The MENTOX program is not research oriented. The subsequent paragraph clearly states a heavy research component is not the major objective. This is basically the same objective of our PGD program.

In your situation, I would expect you will receive applications from physicians, government workers, individuals who presently work with consulting companies, etc., who wish to upgrade credentials in the area of occupational medicine, industrial hygiene, regulatory toxicology and environmental toxicology, in general. Your full- and part-time enrolment option is essential for individuals who do not enter the program directly from an undergraduate degree program.

You indicate that individuals will be eligible for ABT certification within four years of program completion. The areas covered by ABT examinations include more than environmental toxicology. I think they will have some difficulty passing the examinations with only an environmental toxicology background.

Toxicology Centre, University of Saskatchewan
44 Campus Drive, Saskatoon SK S7N 5B3 CANADA
Telephone: (306) 966-7441 Facsimile: (306) 931-1664

2. Relationship of the proposed MENTOX program to the role and mission of SFU

Your opening paragraph suggests that the MENTOX program will qualify for funding through the Canadian Network of Toxicology Centres (CNTC). The CNTC mandate is directed to fund public education and postgraduate education through specific research projects. The Guelph node of CNTC is responsible exclusively for the public education initiatives. Your proposed program has no specific objectives related to public education. Your graduate student training is not research oriented. Therefore, I doubt that you will be able to convince the Board of Directors of CNTC that your worthwhile initiative fits into the longstanding CNTC mandate.

3. Program Organization

On page 7, you indicate that the home department for MENTOX will be the Department of Biological Sciences. A variety of other departments will also participate. One question you need to consider is: Is this program multi-disciplinary or interdisciplinary? Toxicology is much better suited to an interdisciplinary format. Your model is multi-disciplinary. Today, you have a strong home department and other participating departments. The discipline of toxicology evolves and changes with time. Key champions of your cause will leave the university. Within 10-15 years, your current base may be seriously eroded. If a key person in chemistry retires, will his replacement wish to participate or have the necessary credentials to participate in the program? Based on our experience, the answer is a clear no.

If one department (Biological Sciences) serves as the dominant home unit in terms of funding, faculty resources, etc., eventually the interest or incentive for other departments to remain involved will be lost. You will lose the broad multi-disciplinary strengths of your program. The product may become a modified biological sciences program. Issues such as merit raises for faculty, departmental recognition of graduate students outside of the home department, resource allocations to outside the home department, will become dividing issues. Your proposed program crosses traditional departmental boundaries. This is an essential feature to maintain in the program. Present resource allocations at most universities, including SFU, do not cross these established boundaries. Eventually, the program will encounter difficulty maintaining the broad departmental base. Some formal mechanism must be in place to ensure all departments involved in the program receive resources and funding reflecting the level of involvement in the program.

4. Admission Requirements

Your admission requirements are reasonable, with one exception. Basic courses in Physiology are essential to a sound toxicology program. This should be included. Your admission requirements are flexible, perhaps too flexible. If a course is a prerequisite, it weakens the credibility of your program to suggest that it can be made up prior to graduation. We require students to upgrade deficiencies prior to entry.

5. Course Content

For the proposed program, the course options are very ambitious. They reflect the strengths of your faculty. Current toxicology directions at the present time have been strongly pointing towards endocrine disruptors and related environmental areas. Courses specifically in the area of systemic toxicology, reproductive toxicology and teratology are critical. Regulatory agencies and industry place expertise in these areas as a high priority. Your proposed program lacks in these areas and generally in the area of mammalian toxicology. Analytical toxicology and inhalation toxicology are also key disciplines related to environmental toxicology. There is also need for a specific Toxicology Seminar course to expand student backgrounds.

In our program, we also offer a course in problem solving associated with current toxicological problems. Problems may deal with an environmental impact situation, development of a TLV, legal cases, residues, air/water quality, etc. The problems we use are real problems for the most part. Various agencies hiring our graduates have requested to interview only students who have completed this course. Many job descriptions in both the public and private sectors reflect very closely the content and expectations of this course.

Faculty involved in the proposed program have a strong background in aquaculture. I am surprised there is no course in this specific area.

6. Student Enrolment

Your projected student enrolment seems reasonable. I suspect you will receive potentially 100 applications per year. There is a need for an Academic Coordinator and clerical support to handle the applications. Since you provide no stipend support, it is unlikely that foreign students will meet visa requirements for financial support. The program, basically, will consider only Canadian applicants.

7. Teaching Resources

The proposal indicates that few new courses are needed. The impact on teaching resources is minimal. In light of declining university resources, this may not be the case in future years.

(a) Faculty resources: There appears to be about 6 well qualified faculty participating in the program in a substantial way. Some might argue that this is below the critical mass necessary for long-term stability. The strengths of broad based programs such as proposed at SFU is a broad faculty base with a diversity of ideas, approaches, etc. The loss of only one or two key faculty could place the program in difficulty easily.

(b) Library resources: Toxicology journals and resource material are very expensive. The costs of toxicology journals are increasing more rapidly than other journal disciplines. Your total resource requirements of 50K could easily be spent entirely on journals. Your journal selection may still be inadequate even with this level of funding.

8. Proposed Courses

Most of the proposed courses appear interesting and useful. Many of the courses would make a valuable addition to our Toxicology Graduate Program. The Biological Sciences 651 course (Food and Drug Toxicology) covers a variety of important concepts. My concern is that there are too many topics for one course. We cover the same topics in several courses in more depth (forensic toxicology, nutritional toxicology, metabolic toxicology and subclinical toxicology).

BISC 846 and KIN 851 appear to be very interesting and appropriate courses. Risk-assessment, toxicity testing, and biostatistics appear to be areas which are well represented in your program.

Summary

Your ambitious proposal will fill a need in environmental toxicology. I would anticipate a strong demand by both students and prospective employers. You may wish to contact potential employers for input concerning courses as well. Resources to operate such a program will not be plentiful. Minimal resources, changing faculty, evolving needs of society, will be a constant challenge to the program's viability. With some minor modification, the proposed program should be successful in the immediate future. Long-tem stability and success are difficult to predict.

If you require further comment, please contact me. Best of success on your proposal. We were involved in a similar undertaking about two decades ago.

Sincerely yours,

Barry Blakley

Barry Blakley, DVM, Ph.D.
Professor
Academic Coordinator
Toxicology Graduate Program
University of Saskatchewan

BRB:ck

UNIVERSITY OF CALIFORNIA, DAVIS

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SANTA BARBARA SANTA CRUZ

INSTITUTE OF TOXICOLOGY AND ENVIRONMENTAL HEALTH
OLD DAVIS ROAD
(916) 752-1340
FAX: (916) 752-5300

DAVIS, CALIFORNIA 95616-8615

May 15, 1997

Dr. Phyllis M. Wrenn
Associate Dean of Graduate Studies
Simon Fraser University
Burnaby, British Columbia
Canada, V5A156

Dear Dr. Wrenn:

I have reviewed the document, entitled "Proposal for a master of Environmental Toxicology Program" and have the following comments to make:

Major Comments

1. The proposal is timely proposing to meet the growing need for students trained in your region. The background section (p 1-7) is well written, describing the rationale of this proposal. Particularly important was the "difference in emphasis" between UBC and FSU.
2. The faculty members involved are well qualified to do the job. They are respected scientists with solid track records both in teaching and research. An addition of a bona fide chemist to the core faculty group would enhance the program in the future.
3. The curriculum is solid. Students must work hard to get the degree. On the other hand, the requirement of one semester of research experience deems short, but this is not a PhD program. In view of other requirements which are also important, this research requirement is minimal but understandable.

4. While it is quite understandable that this program is clearly meant to train toxicology practitioners for governments, industries and consulting firms, it would be desirable to have an option for some students who do wish to continue to the PhD program (in other institutions, if not at FSU). Even in the above type of organizations, top positions are frequently occupied by PhD toxicologists. Some coordination with IEST or other institutions (e.g. Guelph, Saskatchewan, etc.) may be beneficial. In that case some applied courses could be dropped and additional basic courses could be offered to those students.

Technical Comments

5. I notice that chemical residue analysis, instrumentation, environmental reactions, photochemistry, etc. are not covered thoroughly. Probably, the lack of chemical and or environmental engineering expertise in this group. Certainly several faculty members are knowledgeable to be able to cover those areas, but in the future when the program develops and matures into a major unit an addition of a chemist would be desirable.
6. The courses are heavily slanted toward aquatic toxicology. How about some terrestrial toxicology (remember "Silent Spring" and birds?).
7. The portion describing co-operative Education Program is not thoroughly written. There are many questions remaining unanswered. For instance, are students expected to eventually take all the required courses in due course? Is there any residency requirement? What are the maximum years to be allowed to be enrolled in the program, etc.

Additional Comments

I am not familiar with your system. If you have PhD minor (or enrichment) program, it would be good to have some of those courses listed for those. If so, many ecologist, zoologists, limnologists, some engineers, pharmacologists, biochemists, etc., would benefit by attending those courses to become familiar with the environmental issues, approaches and risk assessment technologies.

I enjoyed reading the document, and I must congratulate the faculty to come up with a solid, and well thought out proposal and the upper administration of your university including your office and Dean of Science, Dr. Colin Jones for clear vision and the proactive decision making to adapt to the needs of the society and the students training.

Let me know if there is anything else you like to have my input on.

Sincerely,

Fumio Matsumura
Professor and Chair of Department of
Environmental Toxicology and
Director of the Center for Environmental
Health Sciences