

SIMON FRASER UNIVERSITY

S.84-27

MEMORANDUM

To..... SENATE.....

From..... SENATE COMMITTEE ON UNDERGRADUATE
STUDIES.....

Subject..... CURRICULUM CHANGES - BIOLOGICAL
SCIENCES.....

Date..... 16 MARCH 1984.....

Action undertaken by the Senate Committee on Undergraduate Studies at its meeting of March 20, 1984 gives rise to the following motion:

MOTION #1: "That Senate approve and recommend approval to the Board of Governors, as set forth in S.84-27 the proposed new courses

BISC 321-3 - Introduction to Molecular Biology
BISC 421-3 - Biotechnology
BISC 427-3 - Biology of the Bees
BISC 434-3 - Paleoecology and Palynology"

Subject to the approval of the courses by Senate and the Board of Governors, the Senate Committee on Undergraduate Studies approved waiver of the normal two semester time lag requirement in order that BISC 321-3 may be first offered in Fall 84-3 and BISC 421-3 may be first offered in Spring 85-1.

MOTION #2: "That Senate approve and recommend approval to the Board of Governors, as set forth in S.84-27 the proposed changes to the Cellular and Molecular Biology stream"

FOR INFORMATION:

Acting under delegated authority at its meeting of March 20, 1984 the Senate Committee on Undergraduate Studies approved title change, description change, prerequisite change for BISC 424-4

FROM: BISC 424-3 Marine Biology

Contemporary topics in marine biology with emphasis on the ecology of planktonic and benthic organisms. Field trips are normally a requirement of this course.
Prerequisite: BISC 306 or 326. BISC 300 is recommended.

TO: BISC 424-3 Marine Biology and Oceanography

Contemporary topics in marine biology including descriptive oceanography with emphasis on the ecology of benthic and planktonic organisms. Field trips are normally a requirement of this course.
Prerequisite: BISC 306 or 326. BISC 329 is recommended.

SIMON FRASER UNIVERSITY

MEMORANDUM

SCUS 84-10

H. Evans

Secretary to Senate

Subject... FACULTY OF SCIENCE
RECOMMENDATIONS TO SCUS

From... P. Dobud
Administrative Assistant
to the Dean of Science

Date... March 6, 1984

The following items, described in the enclosed documentation, have been approved by the Faculty of Science. Could you please place these items on the Agenda of the next SCUS meeting for consideration and approval?

(c) Department of Biological Sciences

- (i) That the following new courses be approved as part of the Biological Sciences course offerings:

BISC 321-3 Introduction to Molecular Biology
BISC 421-3 Biotechnology
BISC 427-3 Biology of the Bees
BISC 434-3 Paleoecology and Palynology

(Paper F-84-4)

- (ii) To approve the title change and calendar description change for BISC 424-4:

FROM: BISC 424-3 Marine Biology

Contemporary topics in marine biology with emphasis on the ecology of planktonic and benthic organisms. Field trips are normally a requirement of this course.
Prerequisite: BISC 306 or 326. BISC 300 is recommended.

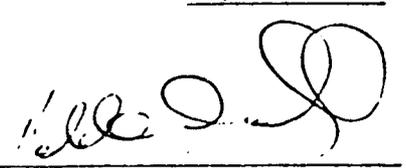
TO: BISC 424-3 Marine Biology and Oceanography

Contemporary topics in marine biology including descriptive oceanography with emphasis on the ecology of benthic and planktonic organisms. Field trips are normally a requirement of this course.
Prerequisite: BISC 306 or 326. BISC 329 is recommended.

(Paper F-84-5)

- (iii) That the revision of the Upper Division requirements to the Cellular and Molecular Biology stream be approved as stated in Paper F-84-6.

/mqj


P. Dobud

SIMON FRASER UNIVERSITY

MEMORANDUM

To..... Dr. A. G. Sherwood,.....
Chairman, Faculty of Science
..... Undergraduate Curriculum Committee..

From..... K. K. Nair, Chairman,.....
..... Dept. of Biological Sciences,.....

Subject..... NEW UNDERGRADUATE COURSES.....

Date..... October 21, 1983.....

At a meeting of the Department, the following new courses have been approved.

BISC 321 Introduction to Molecular Biology
BISC 421 Biotechnology
BISC 427 Biology of the Bees
BISC 434 Paleoecology and Palynology.

F-84-4

In addition, the Department approved the title change and calendar description of BISC 424, Marine Biology & Oceanography, to reflect more accurately the true nature of the course.

F-84-5

Since the proposed BISC 321 and BISC 421 are to be included in the Cellular and Molecular stream, it is imperative that appropriate calendar revisions be made, and the enclosed revision replaces the one ^{on} pages 108-109.

F-84-6

I would appreciate it very much if your Committee could approve these courses. The report on the availability of books and journals for the above courses will be forwarded to you as soon as we receive it from the Librarian.


K. K. Nair

KKN/ms
Encls.

MEMORANDUM

To..... Dr. J. Cochran, Dean,
..... Faculty of Science
Subject..... WAIVER OF 2 SEMESTER WAITING PERIOD
..... FOR COURSES BISC 321-3 and 421-3

From..... K. K. Nair, Chairman,
..... Dept. of Biological Sciences
Date..... 84-03-08

At the Faculty of Science meeting on March 5th courses BISC 321-3 and 421-3 were approved.

I would appreciate if you would endorse our request for a waiver of the 2 semester waiting period for offering courses following Senate approval. We would like to offer the courses as indicated below:

1. BISC 321-3, Introduction to Molecular Biology
First semester of offering: 84-3
2. BISC 421-3, Biotechnology
First semester of offering: 85-1

I would appreciate your recommending to the Registrar's Office at the 2 semester waiting period be waived for these courses.

Thank you.

/ct

K. K. Nair

I recommend that the 2 semester waiting period be waived for these courses. They were approved at the Faculty of Science Meeting on Monday, March 5/84. Thank you.
John Cochran

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: BIOLOGICAL SCIENCES

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

Title of Course: Introduction to Molecular Biology

Calendar Description of Course: Modern Molecular Biology: the study of gene structure and evolution, DNA replication, and the regulation of gene expression in bacteria and higher organisms.

Nature of Course Lecture/Tutorial

Prerequisites (or special instructions): BISC 301 (or BICH 302),
BISC 302 is recommended.

What course (courses), if any, is being dropped from the calendar if this course is approved: None.

2. Scheduling

How frequently will the course be offered? Once/year

Semester in which the course will first be offered? 84-3

Which of your present faculty would be available to make the proposed offering possible? Team taught: Baillie, Honda and Smith.

3. Objectives of the Course : There has been an explosion of new information in the young field of molecular biology, which is finding wide application in many areas of biology, medical sciences and the biotechnology industry (including the new recombinant DNA technology). The basic information necessary is not provided in BISC 301, 302 or in BICH courses, while BISC 401 and 402 are intended to give an advanced treatment of the subject (comparable to that given at other Canadian universities). As proper preparation for the latter, and to introduce students to this area (as there is too much to attempt to cover in present courses), this course is being proposed.
4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty No immediate requirements. Course would be enhanced if future appointments have expertise in applying molecular biology to
Staff more classical biological problems.

Library

Audio Visual

Space

Equipment

5. Approval

Date: Oct 21, 1983

[Signature]
Department Chairman

MAR 05 1984

[Signature]
Dean

[Signature]
Chairman, SCUS

Review of macromolecules--structure and function
Review of cell structure and function--prokaryotes vs eukaryotes
Methodology: Genetics, Biochemical techniques, Recombinant DNA technology
DNA: Structure and Replication
DNA: Recombination and Repair
Transcription and RNA processing
Protein Synthesis and post-translational events
Gene regulation in prokaryotes-- the lac operon etc.
Gene regulation: the problem in eukaryotes
Viruses as model systems
The molecular biology of organelles
Molecular biology and studies on evolution
Special topics: early development, antibody diversity, cancer

Reference list

- Watson, J.D. The Molecular Biology of the Gene, 3rd ed., Menlo Park Calif., Benjamin (1976).
Stryer, L. Biochemistry, 2nd ed., San Francisco, Freeman (1981)
Alberts, B. et al. The Molecular Biology of the Cell, New York, Garland (1983).
Freifelder, D. Molecular Biology, Science Books Inter. Van Nostrand Rinehold Co., New York (1983).

Also various scientific journals and reference texts presently held in the library.

NEW COURSE PROPOSAL FORM1. Calendar InformationDepartment: Biol. Sci.Abbreviation Code: BISC Course Number: 421 Credit Hours: 3 Vector: 2-0-4Title of Course: Biotechnology

Calendar Description of Course: Laboratory with accompanying lectures to give practical experience in the application of industrial microbiology and the new recombinant DNA technology.

Nature of Course Lecture/LaboratoryPrerequisites (or special instructions): BISC 321, BISC 303, or permission of instructor.

What course (courses), if any, is being dropped from the calendar if this course is approved: None.

2. SchedulingHow frequently will the course be offered? once/yearSemester in which the course will first be offered? 85-1Which of your present faculty would be available to make the proposed offering possible? Honda/Albright3. Objectives of the Course Biotechnology and the new recombinant DNA methodology

are rapidly finding wide applications in various areas of biology (from taxonomy to evolutionary studies), and in the "real world" of industrial microbiology, pharmaceuticals etc. The purpose of this course, following the theoretical background of BISC 3XX, is to provide practical, hands-on laboratory experience with technical aspects of industrial microbiology and recombinant DNA technology.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty

Staff

Library Ref. list attached.

Audio Visual

Space

Equipment Required equipment already available.5. ApprovalDate: Oct 21, '83Department Chairman**MAR 05 1984**DeanChairman, SCUS

BIOTECHNOLOGY

SECTION I:

Introduction to biotechnology - what is it?

Relevant properties of cells useful in biotechnology.

Research and industrial culture collections.

Fermentation systems.

Batch and continuous microbial cultures.

Industrial uses of immobilized cells and enzymes.

Bacterial and fungal metabolic pathways useful for industrial product formation.

Ways to enhance desired product formation by microorganisms.

SECTION II:

Overview of molecular biology in eukaryotes vs prokaryotes DNA manipulations: enzymes, gels, hybridization, blots etc.

Plasmid vectors: properties, construction, cloning protocols.

Phage vectors: properties, construction, cloning protocols etc.

Phage vectors: M13

DNA sequencing

Cloning strategies: probes, selection, gene synthesis, characterization etc.

Expression of eukaryotic genes in bacteria.

REFERENCE LIST

Maniatis, T. et al. Molecular Cloning (A Laboratory Manual), New York, Cold Spring Harbor Laboratory (1982).

Scientific American. Industrial Microbiology and the Advent of Genetic Engineering. San Francisco, Freeman (1981).

Also various scientific journals and reference texts presently held in the library.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: BIOLOGICAL SCIENCES

Abbreviation Code: BISC Course Number: 427 Credit Hours: 3 Vector: 2-0-4

Title of Course Biology of the Bees

Calendar Description of Course:

An introduction to the biology of bees, emphasizing the evolution of social behavior and the morphological, physiological, behavioral, and ecological mechanisms which are involved in apoid sociality.

Nature of Course Lecture and Laboratory

Prerequisites (or special instructions): BISC 317 or Departmental consent

What course (courses), if any, is being dropped from the calendar if this course is approved: none.

2. Scheduling

How frequently will the course be offered? Every two years.

Semester in which the course will first be offered? ~~Fall~~ 86-1 *[Signature]*

Which of your present faculty would be available to make the proposed offering possible? Dr. M. L. Winston

3. Objectives of the Course

- 1. Introduce students to natural history of the 20,000 species of bees
- 2. Use bees to illustrate the evolution of social behavior in insects
- 3. Examine bees from morphological, physiological, behavioral and ecological perspectives.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

- Faculty none
- Staff none
- Library none
- Audio Visual none
- Space none
- Equipment none

5. Approval

Date: Oct 21, 1983

MAR 05 1984

[Signature]
Department Chairman

[Signature]
Dean

Chairman, SCUS

BIOLOGY OF THE BEES BISC 427

The Biology of Bees has been offered twice as a Special Topics course (BISC 471 and 472), with enrolments of 9 (82-1) and 15 (83-1). This course will increase the elective curriculum for students in the Ecology stream, particularly for those interested in Entomology and Behavioral Ecology. Since this course is oriented towards basic bee biology and not beekeeping it does not overlap with BISC 00x: Apiculture, an Introduction to Bees and Beekeeping, which is offered every other year.

The lectures will emphasize the broad range of social behavior found among the bees and adaptations for sociality (schedule attached). The subjects which will be discussed include systematics, evolution, morphology, physiology, development, communication, reproduction, genetics, caste and division of labor, nectar and pollen, and two lectures on more applied aspects of apiculture such as pollination and honey production. The laboratories will consist of the following:

- Systematics (three weeks): identification of families and important genera of bees; evolutionary relationships between bee groups.
- Morphology (three weeks): external and internal anatomy, emphasizing structure and function.
- Honey analysis and handling (two weeks): analysis of honey properties, including sugar content, water, trace elements, and impurities; field trip to B.C. Honey in New Westminster to see honey packing facility.
- Pollen analysis (1 week): identification of pollen types, determining honey floral profile from pollen; nutritional quality; pollen trapping.
- Communication systems (2 weeks): dance language of the honey bee; chemical communication in bumblebees and honeybees; recruitment to nectar and pollen resources.
- Reproductive behavior (1 week): swarming in honey bees.

BIOLOGY OF THE BEES BISC 427

Instructor: Mark Winston
Room B 8274, phone 291-4459

Texts: The Hive and the Honey Bee (HH)
The Social Behavior of the Bees (CDM)

Grading: A midterm and final

Lectures and Reading Assignments: Journal articles on reserve, see attached.

Introduction: History of Beekeeping	HH 531-558, 1-18
Systematics of Apoidea, Biology of Social Bees	CDM 1-59
Nesting Biology; Caste	HH 39-74; Seeley & Morse, 1976
Morphology	HH 75-124
Development	HH 65-73, CDM 95-107; Beetsma 1979
Nutrition	HH 125-156; Haydak 1970
Communication: Dance Language	HH 195-204; CDM 152-180
Communication: Pheromones	Gary 1974
Communication: Other	Gould et. al., 1978
Division of Labor	HH Chp.7; CDM 119-130; Free 1965
Seasonality & Absconding	CDM 203-205; Heinrich, 1981
Reproduction: Swarming	Winston, 1980
Reproduction: Mating	HH 250-252, 559-572
Genetics	HH Chp.6, Rothenbuhler et.al, 1968
Nectar and Honey	HH Chp.8, 17 (13-15 optional)
Pollen and Pollination	HH Chp.20
Diseases and Pests	HH Chp.21
Management	HH Chp.12
Africanized bees; temperate vs. tropical	
Current research; employment opportunities	

Relevant Library material (all in S.F.U. Library)

Journals

J. Apicultural Research
American Bee Journal, Apicultural Abstracts
Bee World
Insectes Sociaux
Psyche
J. Economic Entomology
Annals Entomological Society of America
Canadian Entomologist
Behavioral Ecology and Sociobiology
Science

Oecologia

J. Kansas Entomological Society
Apidologie
Gleanings in Bee Culture

Books

The Social Behavior of the Bees
The Insect Societies
Honey, a Comprehensive Survey
Pollen: Biology, Biochemistry, and Management
Contemporary Queen Rearing
Insect Pollination of Crops
Anatomy and Dissection of the Honeybee
The Dance Language and Orientation of Bees
Anatomy of the Honey Bee
Bumblebee Economics
The Social Organization of Honeybees
The Behavior and Social Life of Honeybees

C.D. Michener
E. O. Wilson
E. Crane
R.G. Stanley and H.F. Liskens
Harry Laidlaw
J.B. Free
H. A. Dade
K. v. Frisch
R.E. Snodgrass
B. Heinrich
J.B. Free
C. R. Ribbands

THE BIOLOGY OF BEES

Reserve List

All for 4 hour loan:

The Hive and the Honey Bee, edited by Dadant and Sons, Hamilton, Illinois, USA.

Michener, C.D. 1974. The Social Behavior of the Bees. Harvard University Press, Cambridge, Mass. USA.

Laidlaw, H. H., 1979. Contemporary Queen Rearing. Dadant and Sons, Hamilton, Illinois, USA.

Journal Articles

Seeley, T. D. and R. A. Morse, 1976. The nest of the honey bee (Apis mellifera L.) Insectes Sociaux 23:495-512.

Beetsma, J. 1979. The process of queen-worker differentiation in the honeybee. Bee World 60:34-39.

Haydak, M. H. 1970. Honeybee nutrition. Annual Review Entomology. 15:143-156.

Gary, N. E., 1974. Pheromones that affect the behavior and physiology of honeybees. In Pheromones, Martin C. Birch, editor. North Holland Publishing Co. London.

Gould, J. L., J. L. Kirschvink, and K. S. Deffeyes, 1978. Bees have magnetic remanence. Science 201:1026-1028.

Free, J. B., 1965. The allocation of duties among worker honeybees. Symp. Zool. Soc. London. 14:39-59.

Heinrich, B., 1981. The regulation of temperature in the honeybee swarm. Scientific American 244:147-160.

Rothenbuhler, W. C., J. M. Kulincevic, and W. E. Kerr, 1968. Bee genetics. Annual Review Genetics 2:413-438.

Winston, M. L. 1980a. Swarming, afterswarming and reproductive rate of unmanaged honeybee colonies. Insectes Sociaux 27:391-398.

Winston, M. L. and O. R. Taylor, 1980b. Factors preceding queen rearing in the Africanized honeybee in South America. Insectes Sociaux 27:289-304.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

1. Calendar Information Department: Biological Sciences
Abbreviation Code: BISC Course Number: 434 Credit Hours: 3 Vector: 2-0-4
Title of Course: Paleoecology and Palynology

Calendar Description of Course:

The principles of Paleoenvironmental reconstruction, emphasizing the study of pollen grains, spores, and other microfossils in solving problems of paleobiology and earth history.

Nature of Course Lecture / Laboratory

Prerequisites (or special instructions): Minimum 60 credit hours with BISC 102, BISC 204. Some background in botany, biogeography, or earth sciences is desirable.

What course (courses), if any, is being dropped from the calendar if this course is approved: NONE

2. Scheduling

How frequently will the course be offered? Once every two years

Semester in which the course will first be offered? ~~1985~~ 1986-3 *[Signature]*

Which of your present faculty would be available to make the proposed offering possible? R. W. Mathewes

3. Objectives of the Course

To familiarize students with the structure and identification of pollen and spores, and to demonstrate how these and other microfossils can be used in reconstructing past environments. Laboratory sessions and field excursions will allow students to gain first hand experience with sampling and analytical techniques in pollen analysis. The development of an appreciation for the importance of historical phenomena in assessing present-day biological processes and patterns is an overall objective.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty none

Staff none

Library none

Audio Visual none

Space none

Equipment Minor equipment only -- small centrifuge and field equipment to be constructed in machine shop. About \$3,000.

5. Approval

Date: Oct 21, 1983

Khawari
Department Chairman

MAR 05 1984

J.F. Cochran
Dean

Chairman, SCUS

<u>Week</u>	<u>Lectures</u>	<u>Laboratory</u>
1.	Introduction. History and scope of palynology. Relationship of paleoecology to ecology.	Introduction to laboratory equipment, chemicals, and techniques; Microscopy.
2.	Structure and Function of pollen grains and spores; morphology and taxonomy	Pollen and spore identification I: Spores and Gymnosperm Pollen
3.	Principles of Pollen Analysis; production, dispersion, sedimentation, and preservation.	Pollen and spore identification II: Angiosperm Pollen
4.	Pollen Diagrams; construction and interpretation	Quantitative pollen analysis of selected materials (i.e., soil, peat, sediment, honey).
5.	The role of Plant Macrofossils in paleoecological investigations	Identification and analysis of plant macrofossils
6.	Terrestrial Animal Remains in paleoecological investigations.	The scanning electron microscope (SEM) the study of microfossils
7.	Paleolimnology -- Reconstructing lake histories.	<u>Local Field Trips</u> to collect samples and <u>Projects</u> will continue until semester end.
8.	Paleoclimatic interpretation from biological data.	
9.	Archaeological applications of palynology	
10.	Pollen and Geology--coal and oil exploration.	
	Discussion of selected case histories in paleoecology and palynology, including:	
11.	Paleoecology of extinctions - dinosaurs and ice-age megafauna.	
12.	The connections between paleoecology and evolution. Cenozoic history of vegetation in western N.America.	
13.	Ice-age effects on the distributions of plants and animals. Biotic succession and environmental history.	

Proposed Grading: Lab Exam - 20% Final Exam - 30%
 Mid Term - 20% Project - 30%

Required Texts:

1. Faegri, K. and Iversen, J. 1975. Text-book of pollen analysis, Hafner, New York.
2. Kapp, R.O. 1969. How to know pollen and spores. Wm.C.Brown Co., Iowa.
3. McAndrews, J.H., A.A. Berti, and G. Norris 1973. Key to the Quaternary pollen and spores of the Great Lakes Region. Royal Ontario Museum.

Journals in S.F.U. Library

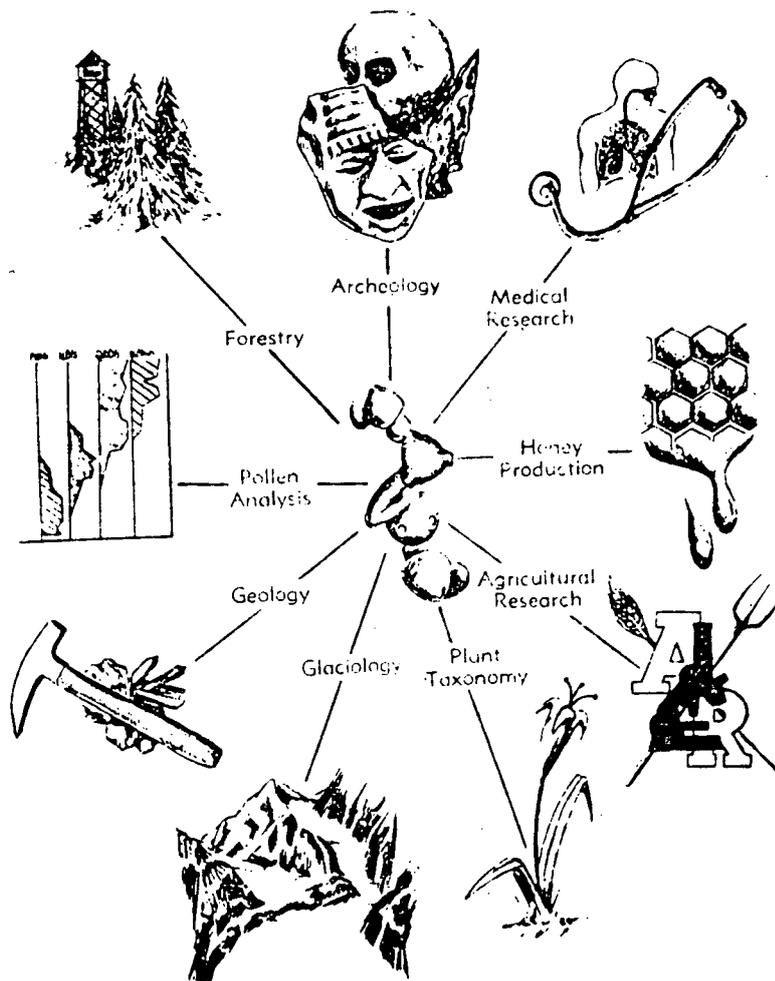
A) Most Important

Grana (formerly Grana Palynologica)
Pollen et Spores
Quaternary Research
Review of Paleobotany and Palynology

B) Selected secondary journals (many others carry occasional articles)

Canadian Journal of Botany
Canadian Journal of Earth Sciences
Journal of Biogeography
Journal of Ecology
New Phytologist
Paleobiology
Palaeogeography, Palaeoclimatology, Palaeoecology

Books: Enough titles are available (for reserve) to offer the course.



Some important applications of palynology.
KAPP (1969)

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

CALENDAR STATEMENT
UPDATE ONLY

NEW COURSE PROPOSAL FORM

1. Calendar Information

Department: BIOLOGICAL SCIENCES

Abbreviation Code: BISC Course Number: 424 Credit Hours: 3 Vector: 2-0-4

Title of Course: Marine Biology & Oceanography

Calendar Description of Course:

Contemporary topics in marine biology including descriptive oceanography with emphasis on the ecology of benthic and planktonic organisms. Field trips are normally a requirement of this course.

Nature of Course Lectures with labs and field trips

Prerequisites (or special instructions): BISC 306 or 326.
BISC 329 is recommended.

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

NOTE: This is a Title and Description change to reflect more accurately the content of this course.

2. Scheduling

How frequently will the course be offered?

Semester in which the course will first be offered?

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

3. Objectives of the Course

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty

Staff

Library

Audio Visual

Space

Equipment

5. Approval

Date: Oct 21, 1983

MAR 05 1984

Khuari
Department Chairman

J.F. Cochran
Dean

Chairman, SCUS

RATIONALE

In the past few years, especially since an aquatic component was no longer offered in BISC 300, it has been necessary to provide students of Marine Biology BISC 424 with a minimum background in descriptive oceanography. An introduction to physical and chemical characteristics and processes in the oceans is required for an understanding of current topics dealing with the ecology of marine organisms. The proposed change of title and calendar description simply reflects the true nature of the course as it is now offered.

Relevant Course Outline:

The new course material takes up approximately one third of the lecture time while the remaining two thirds of the course consists of autecological and synecological aspects of marine life.

The oceanographic portion includes the following topics:
properties of seawater; oceans and currents; temperature, salinity and oxygen distributions; water masses and temperature-salinity diagrams; waves and shore processes; B.C. coastal waters; tides.

REVISION

to

CELLULAR & MOLECULAR BIOLOGY STREAM

(See pages 108-109)

	<u>Semester Hours</u>
<u>Lower Division Core</u>	50
<u>Upper Division Requirements</u>	
BISC 301-3 Biochemistry - Intermediary Metabolism	3
302-3 Genetic Analysis	3
303-3 Microbiology	3
305-3 Animal Physiology)	
OR)	3
347-3 Plant Physiology)	
306-3 Invertebrate Biology)	
OR)	3
316-3 Vertebrate Biology)	
321-3 Introduction to Molecular Biology	3
326-3 Biology of Non-Vascular Plants)	
OR)	3
337-3 Comparative Morphology, Distribution and) Evolution of Vascular Plants	
329-3 Introduction to Experimental Techniques	4
400-3 Evolution	3
401-3 Biochemistry - Regulatory Mechanisms	3
402-3 Molecular Genetics	3
405-3 Cell Physiology	3
421-3 Biotechnology	3
429-3 Experimental Techniques I: Separation Methods	3
455-3 Endocrinology	3
Upper Division Total -----	46
Electives	<u>24</u>
TOTAL SEMESTER HOURS	<u>120</u>