CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS

NEW COURSE PROPOSAL

DATE FEBRUARY 15, 2006
PROGRAM AREA BIOLOGY

1. Catalog Description of the Course. *[Follow accepted catalog format.]*

Prefix BIOL **Course#** 203 **Title** QUANTITATIVE METHODS FOR BIOLOGY **Units** (3)
3 **hours** Lecture **per week**
☒ **Prerequisites** A passing score on the entry level mathematics exam (ELM) or MATH 105 or equivalent.
☐ **Corequisites**
Description This course introduces students in the biological sciences to the quantitative skills and technological tools necessary to evaluate the literature and carry out original research in the discipline. Topics include the principles of biological sampling design, hypothesis generation for biological experiments, collection of observational and experimental data, statistical analysis and interpretation of biological data, and the presentation of results. Laboratories will emphasize microcomputer technology and software applications likely to be encountered in the biological sciences.

	Graded	
☒ **Gen Ed**	☐ **CR/NC**	☐ **Repeatable for up to units**
Categories B3		
☐ **Lab Fee Required**	☒ **A - F**	**Total Completions Allowed**
	☐ **Optional (Student's choice)**	☐ **Multiple Enrollment in same semester**

2. Mode of Instruction.

	Units	**Hours per Unit**	**Benchmark Enrollment**	**Graded Component**	**CS #** (filled in by Dean)
Lecture	3	1	24	☒	
Seminar				☐	
Laboratory				☐	
Activity				☐	

3. Justification and Learning Objectives for the Course. (Indicate whether required or elective, and whether it meets University Writing, and/or Language requirements) *[Use as much space as necessary]*

Justification: This is a required course for biology majors and will introduce students to the quantitative skills and technological tools necessary to evaluate the literature and carry out original research in the life sciences.

Learning Objectives:
Upon completion of this course students will be able to:
(Press enter for the next bulleted item)

- choose an appropriate sampling scheme and/or experimental design for a given biological question
- select and apply the appropriate analytical methods to biological data
- demonstrate the necessary computer skills for biological data management, analysis and graphical presentation
- evaluate critically the primary literature in observation and experimental biology

4. Is this a General Education Course YES ☒ NO ☐

If Yes, indicate GE category and attach GE Criteria Form:

A (English Language, Communication, Critical Thinking)
A-1 Oral Communication ☐
A-2 English Writing ☐
A-3 Critical Thinking ☐
B (Mathematics, Sciences & Technology)
B-1 Physical Sciences ☐
B-2 Life Sciences – Biology ☐

B-3 Mathematics – Mathematics and Applications ☒
B-4 Computers and Information Technology ☐
C (Fine Arts, Literature, Languages & Cultures)
C-1 Art ☐
C-2 Literature Courses ☐
C-3a Language ☐
C-3b Multicultural ☐
D (Social Perspectives) ☐
E (Human Psychological and Physiological Perspectives) ☐
UD Interdisciplinary ☐

5. Course Content in Outline Form. *[Be as brief as possible, but use as much space as necessary] (Press enter for the next bulleted item)*

- History of the logical use of statistics and tests in biological research
- Descriptive statistics
- Estimation: parameters, distributions, standard error, confidence intervals, resampling methods
- Hypothesis testing and decision error
- Correlation and simple linear regression
- Power analysis: choosing the best experimental design for particular hypotheses
- Comparing groups or treatments
- Analysis of covariance
- Analyzing frequencies
- Principle components and correspondence analysis
- Controls, sampling strategies and scales of observation in spatially and temporally variable systems
- Fixed versus random factors in experiments and the consequences for analysis and interpretation
- Replication and pseudoreplication for experiments in natural systems
- Graphical exploration of data
- Presentation of results

Does this course overlap a course offered in your academic program? YES ☒ NO ☐
If YES, what course(s) and provide a justification of the overlap? BIOL 202. The proposed course, BIOL 203, is an application-oriented introduction to the sampling, analysis and interpretation of biological diversity. It is designed specifically for biology students and will address issues relevant to biological data analysis. While the proposed course will introduce some statistical concepts and methods taught in the more general MATH 202, it will emphasize the methods and interpretive difficulties students are most likely to encounter in the current biological literature, from molecular genetics to ecological field studies. To this end, BIOL 203 will offer expanded coverage in areas such as descriptive statistics, measures of central tendency, hypothesis testing, P-values, decision errors, power, and checking assumptions. In addition, special emphasis will be placed on the practical aspects of sampling and experimental design, as well as the presentation of empirical data in scientific papers, posters, and oral presentations. This course was designed to replace BIOL 202 as a major requirement. If BIOL 203 is approved, BIOL 202 will be discontinued.

Does this course overlap a course offered in another academic area? YES ☐ NO ☒
If YES, what course(s) and provide a justification of the overlap?
Signature of Academic Chair of the other academic area is required on the consultation sheet below.

6. Cross-listed Courses (Please fill out separate form for each PREFIX)
List Cross-listed Courses

Signature of Academic Chair(s) of the other academic area(s) is required on the consultation sheet below

Department responsible for staffing: Biology

7. References. *[Provide 3 - 5 references on which this course is based and/or support it.]*

(Press enter for the next number)

1. Quinn, Gerry. P. and Michael. J. Keough. 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press. ISBN: 0521811287.
2. Zar, Jerrold H. 1998. Biostatistical Analysis, 4th edition. Prentice Hall. ISBN: 013081542X.
3. Fowler, Jim. 1998. Practical Statistics for Field Biology, 2nd edition. John Wiley & Sons. ISBN: 0471982962.
4. Rohlf, F. James and Robert R. Sokal. 1994. Biometry, 3rd edition. W. H. Freeman. ISBN: 0716724111.

8. List Faculty Qualified to Teach This Course.

Biology faculty

9. Frequency.

a. Projected semesters to be offered: Fall ☒ Spring ☐ Summer ☐

10. New Resources Required. YES ☐ NO ☒

If YES, list the resources needed and obtain signatures from the appropriate programs/units on the consultation sheet below.

a. Computer (data processing), audio visual, broadcasting needs, other equipment)

b. Library needs

c. Facility/space needs

11. Will this new course alter any degree, credential, certificate, or minor in your program? YES ☒ NO ☐

If, YES attach a program modification form for all programs affected.

Amy Denton — Proposer of Course

23 November 2005 — Date

Approvals

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Program Chair Date

_____

General Education Committee Chair Date

_____

Curriculum Committee Chair Date

_____

Dean Date

GE CRITERIA APPROVAL FORM

Course Number and Title: **BIOL 203. Quantitative Methods for Biology (3)**
Faculty Member(s) Proposing Course: Amy Denton

Indicate which of the following categories would be satisfied by this course by marking an "X" on the appropriate lines.
Courses may be placed in up to two GE categories as appropriate. Upper Division Interdisciplinary GE courses may be placed in two categories plus the UDIGE category.

	A1: Oral Communication
	A2: English Writing
	A3: Critical Thinking
	B1: Physical Sciences
	B2: Life Sciences
X	B3: Mathematics
	B4: Computers and Technology
	C1: Fine Arts
	C2: Literature
	C3: Languages & Cultures
	D: Social Perspectives
	E: Human Psychological & Physiological Perspectives
	Upper Division Interdisciplinary GE

Lab Included? Yes _____ No __X____

Please provide a brief explanation of how the proposed course meets <u>each</u> of the criteria for the selected General Education categories.

1. promote the understanding and appreciation of the methodologies of math or science as investigative tools and the limitations of mathematical or scientific endeavors.

This course will introduce students to the quantitative skills and technological tools necessary to evaluate the literature and carry out original research in the life sciences.

2. present mathematical or scientific knowledge in a historical perspective and the influences of math or science on the development of world civilizations, both past and present

Students will discover the various approaches biologists take to understand the natural world, and recognize that some of the natural sciences rely heavily on detailed observation and analysis of existing evidence, while others are primarily experimental in their approach. With either approach, conclusions are often more robust with the application of statistics and appropriate experimental design. This course will promote an understanding of the impact quantitative tools have had in the historical development of scientific knowledge and technology through the discussion of seminal research papers that trace the application of statistics and improved experimental design/sampling schemes to biological questions.

3. **apply inductive and deductive reasoning processes and explore fallacies and misconceptions in the mathematical or scientific areas.**

This course will teach students to apply statistical and quantitative problem-solving skills to biological questions, with special emphasis on descriptive statistics, measures of central tendency, hypothesis testing, P-values, decision errors, power, and checking assumptions. Through the material presented in BIOL 203, students learn to distinguish fact from matters of judgement, reach independent conclusions based on sound inferences drawn from properly analyzed information, and apply critical thinking skills to interpret and evaluate critically scientific data and the results and conclusions presented in scientific and popular literature.

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4. **(B-3) Mathematics and Applications: promote an understanding of mathematical ideas and problem solving skills.**

Lectures will focus on the quantitative skills associated with proper experimental design, statistical analysis, data interpretation, and presentation of results. The one-hour weekly activity period and problem sets assigned during the activity will introduce statistical software applications likely to be encountered in the biological sciences (SPSS, for example). The goal is to provide students the opportunity to practice selecting and applying the appropriate statistical tool for a given research problem, and interpreting results obtained using these methods.