CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS

NEW COURSE PROPOSAL

PROGRAM AREA _____BIOLOGY_____

1. **Catalog Description of the Course.** *[Include the course prefix, number, full title, and units. Provide a course narrative including prerequisites and corequisites. If any of the following apply, include in the description: Repeatability (May be repeated to a maximum of ___ units); time distribution (Lecture ___ hours, laboratory ___ hours); non-traditional grading system (Graded CR/NC, ABC/NC). Follow accepted catalog format.]*

BIOL 506. MOLECULAR EVOLUTION (4)
Three hours of lecture and three hours of laboratory per week.
Prerequisites: BIOL 400 or BIOL 401 or permission of instructor

This course will examine evolutionary change at the molecular level. Topics include: The driving forces behind the evolutionary process, the effects of the various molecular mechanisms on the structure of genes, proteins, and genomes, the methodology for dealing with molecular data from an evolutionary perspective and the logic of molecular hypothesis testing.

2. **Mode of Instruction.**

	Units	**Hours per Unit**	**Benchmark Enrollment**
Lecture	____3____	_____1___	____15____
Seminar	_____	_____	_____
Laboratory	____1____	_____3___	____15____
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]*

Molecular evolution is an elective course for graduate students in the Professional Master of Science Degree Program in Bioinformatics.
Students who successfully complete this course will be able to:

- Describe how molecular data can be used to construct a phylogenetic tree
- Characterize the rates and causes of nucleotide substitutions
- Explain how a gene/protein family arises
- Explain the mechanisms which underlie evolution at the molecular level

4. **Is this a General Education Course** **YES** **NO**
If Yes, indicate GE category:

A (English Language, Communication, Critical Thinking)	
B (Life Sciences)	
C (Fine Arts, Literature, Languages & Cultures)	
D (Social Perspectives)	
E (Human Psychological and Physiological Perspectives)	

5. **Course Content in Outline Form.** *[Be as brief as possible, but use as much space as necessary]*

I. Genes, Genetic Codes, and Mutation

Nucleotide Sequences
Genomes and DNA Replication
Genes and Gene Structure

Proteins and Translation
Mutation

II. Dynamics of Genes in Populations

Changes in Allele Frequencies
Natural Selection
Random Genetic Drift
Effective Population Size
Gene Substitution and Genetic Polymorphism
Genetic Polymorphism
The Driving Forces in Evolution

III. Evolutionary Change in Nucleotide Sequences

Nucleotide Substitution in a DNA Sequence
Number of Nucleotide Substitutions between Two DNA Sequences
Number of Amino Acid Replacements between Two Proteins
Alignment of Nucleotide and Amino Acid Sequences

IV. Rates and Patterns of Nucleotide Substitution

Rates of Nucleotide Substitution and causes of variation in substitution rates
Positive Selection
Patterns of Substitution and Replacement
Evaluation of the Molecular Clock Hypothesis
Rates of Substitution in Organelle DNA

V. Molecular Phylogenetics

The Use of Molecular Data in Phylogenetic Studies
Terminology of Phylogenetic Trees
Construction of Phylogenetic trees
Problems Associated with Phylogenetic Reconstructions

VI. Gene Duplication and Exon Shuffling

Gene Duplication
Formation of Gene Families and the Acquisition of New Functions
Dating Gene Duplications
Gene Loss
The Globin Superfamily of Genes
Prevalence of Gene Duplication, Gene Loss, and Functional Divergence
Exon Shuffling

VII. Evolution by Transposition

Transposition and Retroposition
Transposable Elements
Retroelements and Retrosequences
Genetic and Evolutionary Effects of Transposition
Horizontal Gene Transfer

VIII. Genome Evolution

Genome Size in Prokaryotes
Genome Size in Eukaryotes
Mechanisms for Global Increases in Genome Size
The Repetitive Structure of the Eukaryotic Genome
Mechanisms for Regional Increases in Genome Size
Chromosomal Evolution
Mechanisms for Changes in Gene Order and Gene Distribution among Chromosomes
GC Content in Bacteria
Compositional Organization of the Vertebrate Genome

Emergence of Nonuniversal Genetic Codes

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

Graur and Li (2000). *Fundamentals of Molecular Evolution, 2nd Edition*. Sinauer Associates, Inc.
Kumar and Nei (2000). *Molecular Evolution and Phylogenetics*. Oxford University Press.
Page and Holmes (1998). *Molecular Evolution: A phylogenetic approach*. Blackwell Science, Inc.
Hall (2001). *Phylogenetics trees made Easy: A how-to manual for molecular biologists*. Sinauer Associates, Inc.

7. List Faculty Qualified to Teach This Course.
Dr. Amy Denton

8. Frequency.
a. Projected semesters to be offered: Fall _____ Spring __X___ Summer _____

9. New Resources Required.
a. Computer (data processing), audio visual, broadcasting needs, other equipment
b. Library needs
c. Facility/space needs
Laboratories for this course will be conducted in the new Science building

10. Consultation.
Attach consultation sheet from all program areas, Library, and others (if necessary)

11. If this new course will alter any degree, credential, certificate, or minor in your program, attach a program modification.

___Nancy Mozingo_____31 October 2003_____
Proposer of Course Date