**NEW COURSE PROPOSAL**

**PROGRAM AREA** _________ **BIOLOGY**

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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.**

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<th>Units</th>
<th>Hours per Unit</th>
<th>Benchmark Enrollment</th>
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<tr>
<td>Lecture</td>
<td>3</td>
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<td>15</td>
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<td>Seminar</td>
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<td>Laboratory</td>
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<td>Activity</td>
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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**

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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.]


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