SUBMITTED BY:
Department: Biology and Wildlife
Prepared by: Matt Olson
Email Contact: matt.olson@uaf.edu

College/School: Natural Science and Mathematics
Phone: 474-2766
Faculty Contact: Matt Olson

1. COURSE IDENTIFICATION:
Dept: BIOL
Course #: F445/ F645
No. of Credits: 4

COURSE TITLE: Molecular Evolution

2. ACTION DESIRED:
Change Course [X] If Change, indicate below
Drop Course

NUMBER
PREQUISITES [X] TITCLE [X] DESCRIPTION [X]
CREDITS (including credit distribution)
CROSS-LISTED [X] Dept.
STACKED (400/600) [X] Dept.
OTHER (please specify)

Course fee eliminated
Course will no longer be cross-listed with CHEM

3. COURSE FORMAT
NOTE: Course hours may not be compressed into fewer than three days per credit. Any course compressed into fewer than six weeks must be approved by the college or school's curriculum council. Furthermore, any core course compressed to less than six weeks must be approved by the core review committee.

COURSE FORMAT:
(check one)
1 2 3 4 5 6 weeks to full semester

2 hour Lecture + 3 hour Computer Lab per week during the fall semester

OTHER FORMAT (specify)
Mode of delivery (specify lecture, field trips, labs, etc)

4. COURSE CLASSIFICATIONS: (undergraduate courses only. Use approved criteria found on Page 10 & 17 of the manual. If justification is needed, attach on separate sheet.)

H = Humanities N = Natural Science S = Social Sciences
W = Writing Intensive, Format 7

Will this course be used to fulfill a requirement for the baccalaureate core? YES [X] NO

IF YES, check which core requirements it could be used to fulfill:
O = Oral Intensive, Format 6

Natural Science, Format 8

Received

NOV 11 2008

Dean's Office
College of Natural Science & Mathematics
5. COURSE REPEATABILITY:
   Is this course repeatable for credit?  [ ] YES  [x] NO
   Justification: Indicate why the course can be repeated
   (for example, the course follows a different theme each time).
   How many times may the course be repeated for credit?  0 TIMES
   If the course can be repeated with variable credit, what is the maximum number of credit hours that may be earned for this course? [ ] CREDITS

6. CURRENT CATALOG DESCRIPTION AS IT APPEARS IN THE CATALOG: including dept., number, title and credits

   BIOL F445 Molecular Evolution
   4 Credits  Offered Spring Odd-numbered Years
   Structure, function and evolution of hereditary molecules (nucleic acids). Special fees apply. Prerequisites: BIOL F362. (Cross-listed with CHEM F445. Stacked with BIOL F645; CHEM F645.) (3+3)

7. COMPLETE CATALOG DESCRIPTION AS IT WILL APPEAR WITH THESE CHANGES: (Underline new wording strike-through old wording and use complete catalog format including dept., number, title, credits and cross-listed and stacked.) PLEASE SUBMIT NEW COURSE SYLLABUS. For stacked courses the syllabus must clearly indicate differences in required work and evaluation for students at different levels.

   BIOL F445 Molecular Ecology and Evolution
   4  3 Credits  Offered Spring Fall Odd-numbered Years
   Structure, function and evolution of hereditary molecules (nucleic acids). Special fees apply. An introduction to theory and computational techniques used to analyze and interpret DNA sequence variation among populations and closely related species. Prerequisites: BIOL F362 and BIOL F481. (Cross-listed with CHEM-F445. Stacked with BIOL F645; CHEM F645.) (3+3) (2+3)

8. IS THIS COURSE CURRENTLY CROSS-LISTED?
   [x] YES  [ ] NO
   (Requires written notification of each department and dean involved. Attach a copy of written notification.)

9. GRADING SYSTEM:
   [x] LETTER:  [ ] PASS/FAIL:

10. ESTIMATED IMPACT
    WHAT IMPACT, IF ANY, WILL THIS HAVE ON BUDGET, FACILITIES/SPACE, FACULTY, ETC.
    The budget will decrease dramatically because the course will no longer support a wet lab. The lab will be a computer lab which has minimal cost and can be accommodated by the current computer lab in the Biology and Wildlife Department.

11. LIBRARY COLLECTIONS
    Have you contacted the library collection development officer (ffklj@uaf.edu, 474-6695) with regard to the adequacy of library/media collections, equipment, and services available for the proposed course? If so, give date of contact and resolution. If not, explain why not.
    [x] Yes  [ ] No
    This course is an upper division course and I am familiar with the resources needed. The library already provides adequate resources and additional resources, such as GenBank, are web-based.
12. **IMPACTS ON PROGRAMS/DEPTS:**

What programs/departments will be affected by this proposed action? Include information on the Programs/Departments contacted (e.g., email, memo)

Biology and Wildlife and Chemistry and Biochemistry. Chemistry no longer feels this is appropriate for their curriculum.

13. **POSITIVE AND NEGATIVE IMPACTS**

Please specify positive and negative impacts on other courses, programs and departments resulting from the proposed action.

**Positive:** This will bring the Course Description more in-line with how the course is now being taught. A wet lab has not been taught with this course for several years and a computer lab has been substituted. This is because most students can learn wet lab techniques easily in the laboratory, but additional instruction and mentoring is required to master the computational aspects of DNA sequence analysis. The changes are designed to keep this course up-to-date with cutting edge science in this arena. The $100 fee for the course will be eliminated and save students money.

**Negative:** None. BIOL F453 already teaches a wet lab course in DNA sequencing and marker techniques, so this will not be missed by the curriculum.

**JUSTIFICATION FOR ACTION REQUESTED**

The purpose of the department and campus-wide curriculum committees is to scrutinize course change and new course applications to make sure that the quality of UAF education is not lowered as a result of the proposed change. Please address this in your response. This section needs to be self-explanatory. If you ask for a change in # of credits, explain why; are you increasing the amount of material covered in the class? If you drop a prerequisite, is it because the material is covered elsewhere? If course is changing to stacked (400/600), explain higher level of effort and performance required on part of students earning graduate credit. Use as much space as needed to fully justify the proposed change and explain what has been done to ensure that the quality of the course is not compromised as a result.

The main change is a reduction in the number of credit hours for this course. The lecture and the computer lab go together hand-in-hand, building upon one another. Every semester the lecture gets well ahead of the laboratory and the course ends up being disjointed. I end up having to turn lectures into lab sessions. The material is very technical. The course is designed so students are able to work through the theory during the lecture and then apply what they have learned in a computer lab setting. The new 2+3 (lecture + lab) structure will be best suited to the current pace and structure of the course. The extent of the theoretical material covered in lecture will be reduced somewhat to accommodate fewer lecture hours.

I also would like to add BIOL F481 Principles of Evolution as a prerequisite. Students without this course are not prepared to delve into the evolutionary-based thinking required to be successful in this course.

The title change is meant to aid students in determining the course material. Molecular Evolution and Molecular Ecology are two different fields and we discuss aspects of both in the course material.

The course description is updated to aid students in determining the course content.

**APPROVALS:**

- **R. D. Boone**
  - Signature, Chair,
  - Program/Department of:
  - Richard Boone, Chair, Biology & Wildlife Department
  - Date 11/16/08

- **Diane Wagner**
  - Signature, Chair, College/School Curriculum Council for:
  - Diane Wagner, Chair, CNSM Curriculum Council
  - Date 11/16/08

- **Joan Braddock**
  - Signature, Dean, College/School of:
  - Joan Braddock, Dean, College of Natural Science and Mathematics
  - Date 12 Nov 08
Offerings above the level of approved programs must be approved in advance by the Provost.

ALL SIGNATURES MUST BE OBTAINED PRIOR TO SUBMISSION TO THE GOVERNANCE OFFICE.

Signature, Chair, UAF Faculty Senate Curriculum Review Committee
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<tr>
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**CHEM/BIOl F445/F645  Molecular Ecology and Evolution**

**ADDITIONAL SIGNATURES: (If required)**

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<tr>
<th>Signature, Chair, Program/Department of:</th>
<th>Date</th>
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<tr>
<td>John Keller, Chair, Chemistry Department</td>
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<tr>
<td>Joan Braddock, Dean, College of Natural Science and Mathematics</td>
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</table>
Prerequisite: BIOL F362 Principles of Genetics & BIOL F481 Principles of Evolution introductory courses Statistics will also be very helpful.

Meeting times: Lectures M, W 10:30-11:30  IRV 208
Lab      T  2:00-5:00  IRV 303

Instructors:
Matt Olson: office  WRRB 230
               phone  474-2766
               email  matt.olson@uaf.edu
Office hours: Wednesday 11:30-12:30 or by appointment.

TA: office: TBA
    lab: TBA
    phone: TBA
    email: TBA
Office Hours: TBA

Course Description: This course is an introduction to theory and computational techniques used in to analyze and interpret DNA sequence variation among populations and closely related species. This vibrant and fast-developing discipline has implications for sciences ranging from global change biology to anthropology and forensics. The lecture will cover many of the major topics in molecular ecology and evolution including DNA sequence curation and alignment, phylogenetic analysis, and population genetics. It will focus on two complementary and interdependent issues: (1) the reconstruction of the evolutionary histories of genes and organisms, and (2) the evolution of hereditary molecules. The first reflects on molecular phylogenetics and coalescent theory, whereas the second deals with the rates at which DNA and proteins evolve and the effects of selection, drift, gene flow, and mutation on patterns of DNA and protein variation. The laboratory will be a hands-on introduction to computational techniques in molecular evolution. We’ll use a mish-mash of different programs to introduce techniques for data manipulation and analysis.

Course goals: By the end of this course students will have a general knowledge of the issues facing the field of molecular ecology and evolution. The computer lab is designed to give undergraduates hands-on experience and an opportunity to develop an original scientific project. For undergraduates, this will be a capstone experience that is meant to allow students to draw from their diverse academic backgrounds and experience the creative side of biological research. For graduate students, this course is meant to be a beginning. It will offer an opportunity to integrate an aspect of molecular evolution into your current research and will give you perspective for future forays in the field.
Course format and student assessment: The course will generally consist of lectures on Mondays, computer labs on Tuesdays, and lectures or discussions on Wednesdays. See the class schedule for assigned readings.

There are several good books in the field of molecular evolution but none is very good at integrating molecular evolution with bioinformatics and genomics. I will be assigning readings from different texts and the primary literature. The supplemental texts below will be available on reserve in the Biology library.

Supplemental texts. We will have readings from some of these. They are all on reserve in the library.

*Avise's book is a classic in molecular ecology.

*comprehensive overview of phylogeny construction


*a good laboratory notebook that covers several molecular and analytical techniques useful for systematics

*This book is a very readable and approachable treatise covering the theoretical and empirical effects of adaptive evolution on gene sequence evolution. We'll be reading the entire book through the semester.

*This is probably the best reference text for molecular evolution, but it can be very mathematical and difficult at times. It is now out of print. The text covers phylogenetics, coalescent theory, and higher level mechanisms for molecular evolution such as gene duplication and transposition.

*a good text for learning phylogenetic theory

*this is a very thorough lab notebook covering all types of molecular techniques from PCR to cloning to working with RNA and proteins and beyond. A must for any molecular evolution laboratory. We won't use this much this semester.*


*perhaps the most thorough and readable text covering the theory of the coalescent process*

When more than one reading is suggested, there may be some overlap in topics covered in different books. This is meant to give you options because you may find certain discussions of topics to be more lucid than others.

**Grading:**
- Participation/Homework: 25%
- Exams: 50%
- Project: 25%

**Homework:** To help you synthesize and learn to apply the issues covered in lecture and lab, homework will be assigned most weeks. This homework will be due the following week. You may work on the homework alone or in small groups, but if you work in a small group you should contribute equally. Late homework will be marked down 10% for each week it is late.

**Exams:** There will be two take home exams.

**Projects:** You will be expected to devise a computational based project whereby you will develop a hypothesis, analyze data and present it in a poster session at the end of the course. Data can be derived from your personal data or from sequences downloaded from an online database. For graduate students, this should not be simply an analysis of data that you are collecting for your thesis. Rather it should treat an issue that is separate from the main focus of your thesis topic. Graduate students are expected to work alone; undergraduates can work in pairs, if you wish. A 2 page Project Proposal is due on October 26. More details on the organization of proposals will be provided as the deadline nears.

**Participation in discussions:** At various times we will be reading and discussing current literature. Participation in discussions during the semester is expected. In the context of this course, “participation” is defined as contributing substantive comments during discussions.

**Overall Course grades will be determined as follows:**

<table>
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<tr>
<th>Numerical Score</th>
<th>Grade</th>
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<tbody>
<tr>
<td>90.0-100%</td>
<td>A</td>
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<tr>
<td>80.0-89.9</td>
<td>B</td>
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<tr>
<td>70.0-79.9</td>
<td>C</td>
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Students with Disabilities:
Needs of students with disabilities will be accommodates following University policies. Any student needing accommodation of a disability should provide me with a letter from the Office of Disability Services. The Office of Disability Services also requires students contact them at least 3 days in advance of any exam for which they need special arrangements. Please talk to instructor privately if you have questions or require assistance. The UAF Center for Health and Counseling also provides disability services: http://www.uaf.edu/chc/disability.html.

Important Course Policies:
Plagiarism and fabrication of data are unacceptable practices in this course, science, and your creative life in general. All of your work should be your own and only your own unless it is explicitly assigned and completed as a group. Plagiarism, data fabrication, or cheating will result in immediate removal from the course, delivery to the Dean of Student Affairs and the University Disciplinary and Honor Code Committee, and a course grade of “F”. See pages 100-101 of the fall 2009 class schedule to review the University’s guidelines for the Students Code of Conduct.
<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Readings</th>
<th>Lab (IRV 303)</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>Introduction – Sequencing, History/Preview</td>
<td>HA Ch 1; Hughes ch1</td>
<td>Sequerencer/Aligner</td>
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<td>Sept 6-7</td>
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<td>Week 2</td>
<td>Organization and structure of DNA</td>
<td>HA Ch 2; Li pp. 23-34; PH pp46-57, 63-88</td>
<td>Linkage/Phase</td>
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<td>Sept 12-14</td>
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<td>Week 3</td>
<td>Techniques for detecting molecular variation</td>
<td>HMM 51-67, 205-221, 249-281, 321-339; Avise Ch 3</td>
<td>Genbank &amp; web resources; cDNAs</td>
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<td>Sept 19-21</td>
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<tr>
<td>Week 4</td>
<td>Forces of evolution/Estimating nucleotide</td>
<td>Hughes ch2; Li Ch2; Li 79-91</td>
<td>DNAsp/PAUP*</td>
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<td>Sept 26-28</td>
<td>substitution</td>
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<td>Week 5</td>
<td>Alignment &amp; database searching</td>
<td>HA ch 6; Li 91-96; PH 135-144</td>
<td>Alignment, Blast, Blat</td>
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<td>Oct 3-5</td>
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<td>Week 6</td>
<td>Exam: take home  Oct 10-12</td>
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<td>Oct 10-12</td>
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<td>Week 7</td>
<td>Neutral Theory and the coalescent</td>
<td>Hughes Ch 3; Li ch 9 237-248</td>
<td>Coalescent simulations</td>
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<td>Oct 17-19</td>
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<td>Week 8</td>
<td>DNA polymorphism in populations</td>
<td>Read &amp; Discuss Cork &amp; Puruggunan 2005</td>
<td>DNAsp/SITES</td>
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<td>Oct 24-26</td>
<td>Project Proposals Due Oct 26</td>
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<tr>
<td>Week 9</td>
<td>DNA polymorphism in populations</td>
<td>Read &amp; Discuss Tiffin et al. 2004, Clark et al. 2004</td>
<td>Structure</td>
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<td>Oct 31-Nov 2</td>
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<td>Week 10</td>
<td>Linkage disequilibrium/ DNA polymorphism in</td>
<td>Read &amp; Discuss Nordborg et al. 2005, Rosenberg and Nordborg 2002</td>
<td>DNAsp</td>
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<td>Nov 7-9</td>
<td>populations</td>
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<tr>
<td>Week 11</td>
<td>Population structure I</td>
<td>TBA</td>
<td>AMOVA</td>
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<td>Nov 14-16</td>
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<tr>
<td>Week 12</td>
<td>Population structure II</td>
<td>TBA</td>
<td>Structure</td>
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<td>Nov 21-23</td>
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<tr>
<td>Week 13</td>
<td>Phylogeny and Phylogeography</td>
<td>TBA</td>
<td>Coalescent/PAUP*</td>
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<td>Nov 28-30</td>
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<tr>
<td>Week 14</td>
<td>Mon: Genomics</td>
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<td>Poster Session</td>
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<td>Dec 5-7</td>
<td>Exam Hand out Dec 7-&gt; due Dec 12</td>
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<td>Tuesday Dec 6</td>
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HA = Higgs and Attwood; HMM = Hillis, Moritz, & Mable; PH = Page and Holmes; F = Felsenstein.