Biology 442/642 - Advanced Microbiology: 
Molecular Analysis of Microbial Diversity 
Fall 2002

When: 
Lecture: TR 11:30-12:30 
Lab: to be determined

Where: 
IRVII 138
IRVI 207

Instructor: 
Lee Taylor, PhD 
Office: 202 Arctic Health Research Building 
Phone: 474-6982 
Email: fllt@uaf.edu 
Office Hours: TR 2:00 – 3:00 (May change, depending on lab schedule, etc. – check BlackBoard!)

Teaching Assistant:
Matthew Bowser, Graduate Student 
Office: Irving 213 
Phone: 474-6677 
Email: fm1b@uaf.edu

Prerequisites: Contrary to what is stated in the course catalog, I am only requiring that you have taken 
Fundamentals of Biology I and II (Biol 105X and 106X) or equivalent courses.

Where to Get Information: Some information provided on this syllabus, especially times and places, MAY 
CHANGE during the semester. This course will have an associated BlackBoard web site, and I will 
make sure each student is registered and knows how to access the site. Check the BlackBoard site 
(http://classes.uaf.edu/) frequently to be sure you have the latest information!

Course Objectives:
• Gain appreciation of the diversity and importance of microorganisms
• Increase awareness of how little we know about microorganisms
• Learn to choose appropriate molecular methods for particular questions in microbiology
• Gain appreciation of the limitations and biases associated with these methods
• Understand how evolutionary trees are constructed and used
• Become familiar with our current view of the Tree of Life
• Improve skills in searching the scientific literature
• Improve ability to understand and critique primary scientific literature
• Improve scientific writing skills
• Improve oral presentation skills
• Gain hands-on familiarity with basic molecular-phylogenetic lab methods

Course Format: 
In general, I will give lectures on Tuesdays followed by student presentations and discussions on Thursdays. 
Separate reading assignments are to be completed BEFORE each session. Expect to read from 2-5 
chapters/reviews/journal articles per week. On Thursdays, students will be chosen to present the following 
week. 1-2 page thought-piece written assignments will also be given out on Thursdays, and will be due at the 
beginning of the following Tuesday’s lecture. There will be a 15-20 page term paper on a group of microbes of 
your choice. Deadlines and grading criteria are detailed below. The laboratory will meet for 3 hours twice a 
week. In the lab, we will collect samples early in the semester, then utilize a variety of methods to analyze 
those samples throughout the rest of the semester. Each student will carry their own sample through each step. 
Labs cannot be missed or made up, due to the sequential nature of the project. Grades for the laboratory will be 
based on your lab notebook and the group presentations at the end.
Required Text: 
None! But a number of readings will come from Brock Biology of Microorganisms by Madigan, Martinko and Parker, 9th edition. This was the textbook for Biol 342, and may be available used. Both the 8th and 9th editions will be on 2 hour reserve in the Bioscience Library, 102 Arctic Health. Other readings will be provided as handouts in class and/or pdf/Word documents on the BlackBoard site.

Grading Summary:

<table>
<thead>
<tr>
<th>Activity</th>
<th># assignments/points each</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussion participation</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>Thought pieces/problem sets</td>
<td>10 X 2 pts each</td>
<td>20</td>
</tr>
<tr>
<td>Class presentations</td>
<td>2 X 5 pts each</td>
<td>10</td>
</tr>
<tr>
<td>Term paper</td>
<td>10 draft; 15 final</td>
<td>25</td>
</tr>
<tr>
<td>Lab notebook</td>
<td>5 early + 10 final</td>
<td>15</td>
</tr>
<tr>
<td>Lab presentation</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Grand total:</td>
<td></td>
<td>100</td>
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</tbody>
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90-100 pts = A  
80 – 89 pts = B  
70-79 pts = C  
60 – 69 pts = D  
< 60 pts = F

I reserve the right to calculate a curve if the distribution is unreasonable (e.g. all A’s or all F’s).

##Passing this course will result in 0.5 writing intensive credits, and 0.5 oral intensive credits##

Grading Criteria:
Assignments must be turned in at the beginning of class or you will receive a zero. The only exceptions are the draft and final versions of the term paper, which will loose 1/2 letter grade each day past the due date.

discussion participation – I expect each student to contribute questions, answers or comments during discussions which help the class to progress toward a deeper understanding of the topic at hand. There is no simple formula, such as “each student must say something during each discussion.” Instead, I expect students to read the assigned material BEFORE Thursday discussions, think about it, and then make meaningful contributions.

thought pieces- The thought pieces will usually address a topic that bridges a Thursday discussion and the upcoming Tuesday lecture. I do not have right or wrong answers in mind for these assignments. Your work will be graded on the basis of the novelty and creativity of the ideas, the clarity and precision of the writing, and the soundness of the scientific logic. These short writings will help acquaint students with my expectations for the term paper.

problem sets – In a few cases, I will substitute a problem set for a thought piece. These will usually involve DNA/bioinformatic skills, sometimes utilizing free web-based software. These will be more like traditional problem sets in that answers could be wrong. However, many right answers will be possible. Students are encouraged to help each other, but must turn in individual answers which differ from other students’ answers. If you “copy” answers from other students, you will receive a zero for the assignment, and may be dropped from the course.
class and lab presentations – Public speaking can be intimidating and difficult, at first. I will not penalize students for nervousness. I will provide one-on-one suggestions for improving the presentation style following each presentation. Grades will be based on the following: familiarity with the assigned reading, depth and breadth of additional library research on the topic, organization of the presentation, improvement in presentation style during the semester. Presentations in lecture will be 30-40 minutes, probably in teams of 2 students (depending on enrollment). Presentations in lab of about 30 minutes will be done by each group on the last day of lab.

term paper – A rough draft is due on Nov. 12. I will meet with you individually to discuss your rough draft. The assignment is to chose a microbial group of interest, then search the scientific literature in order to address the following questions: 1) What is our current understanding of the diversity and phylogenetic relationships of this group based on molecular phylogenetic data? 2) What do we know about the geographic and habitat distribution of members of this group? 3) What do we know about the ecological role of members of this group? 4) What area is most in need of additional research, and how would you go about it? For questions 1-3, be sure to make arguments concerning the strengths and weaknesses of existing data and analyses. Your paper should read like a review in a scientific journal. Your paper will receive scores in each of these areas: 1) novelty and creativity of the ideas, 2) clarity and precision of the writing, and 3) soundness of the scientific logic, 4) depth and breadth of library research, and 5) organization. I will provide a handout with more detailed instructions.

lab notebook – Your lab notebook should provide legible detail concerning everything that you do in the lab. It will also include tabulations of results and analyses of the data. Grades will be based on 1) completeness, 2) clarity (e.g. please print if your cursive is illegible), 3) organization, and 4) effort (how much work you put into analyzing your samples). I will provide a handout with guidelines for lab notebooks. Your notebook will be graded early in the semester for 5 points, and again, at the end, for 10 points.

LABORATORY
The laboratory will provide hands-on experience with a few of the molecular techniques presented in the lecture. We will analyze Bacterial and Fungal diversity in a set of soil samples collected early in the semester. The samples will be divided by substrate (live roots, dead roots, needles, wood, mineral soil). Students will work together in teams, divided by substrate. We will then isolate bacteria and fungi from each substrate using selective media. In tandem, community DNA will be extracted directly from each substrate. We will then perform PCR and ribosomal RFLP analyses of the isolates and the original substrates. Depending on the speed of our progress, we may then clone PCR fragments from some samples, and sequence the clones. Such analyses have never been carried out in boreal forest, to my knowledge!! Questions we may begin to address include: Do fungal and bacterial communities differ according to soil substrate? Are ectomycorrhizal fungi important components of the community away from tree roots? Are there associations between particular bacteria (e.g. nitrogen fixers) and particular fungi? Each group will present its results orally at the end of the semester in lab.

A note on plagiarism:
This warning is probably unnecessary, but I have to cover all the bases. Plagiarism will be rewarded with an F in the course. When in doubt, cite it! “Plagiarism is defined as appropriating passages or ideas from another person’s work and using them as one’s own.” (Dr. Joy Morrison, Syllabus, JB 486/ED 486 Media Literacy, Spring 2001). Note that using text from the internet without citation is just as inappropriate as copying from a book. Also see the Student Code of Conduct at http://www.uaf.edu/reg/schedule/policies.html#student_conduct.
Provisional Lecture Schedule:

Tues Sept 10 – LT: What is microbial diversity?
Thur Sept 12 – LT: Review - Mendelian inheritance, glossary of genetics
Tues Sept 17 - LT: Review – DNA structure, replication, transcription, translation
Thurs Sept 19 – LT: DNA extraction, PCR, restriction enzymes and sequencing
Tues Sept 24 – LT: Anonymous methods: RAPD, AFLP, REP, BOX + ERIC
Thurs Sept 26 – Students: PCR and DNA extraction biases; LAB NOTEBOOK TURNED IN
Tues Oct 1 – LT: Analysis of anonymous data – association testing, diversity indices, ordination
Thurs Oct 3 – Students: Example uses of anonymous methods
Tues Oct 8 – LT: Taxon/locus specific methods – Hybridization, 16S cloning, RFLP, ARDA, DGGE, SSCP
Thurs Oct 10 – Students: evolution of 16S-based methods
Tues Oct 15 – LT: T-RFLP, RISA, Gene-chips, coming soon
Thurs Oct 17 – Students: Example uses of taxon/locus specific methods
Tues Oct 22 – LT: Analysis of sequence data 1 – alignment, distance analysis and BLAST searches
Tues Oct 29 – LT: Analysis of sequence data 2 – parsimony and maximum likelihood
Thurs Oct 31 – Students: Detecting horizontal gene transfer
Tues Nov 5 – LT: Comparative analyses with phylogenetic trees 1 – molecular dating, character mapping
Thurs Nov 7 – Students: Problems with tree-building – alignment and rate heterogeneity
Tues Nov 12 – TERM PAPER ROUGH DRAFT DUE.
Thurs Nov 14 – LT: Comparative analyses using phylogenetic trees 2 – cospeciation, population genetics
Tues Nov 19 – LT: The Tree of Life
Thurs Nov 21 – Students: Coevolution of legumes and rhizobia
Tues Nov 26 – LT: Diversity and ecology of Archaea + Bacteria
Thurs Nov 28 – THANKSGIVING HOLIDAY.
Tues Dec 3 – LT: Diversity and ecology of the Fungi
Thurs Dec 5 – Students: Are they really extremophiles?
Tues Dec 10 – LT: Molecular microbial ecology of the soil
Thurs Dec 12 – Students: Microbial diversity and ecosystem function. Course Evaluation; LAST CLASS.
Tues Dec 17 – TERM PAPER DUE.