

Molecular Techniques for Field Biology – BIOL 4353/5353

Summer 2016 Schedule

Instructors:

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Instructional Assistant:

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This is an outline of the lecture, discussion, and laboratory activities planned for this intensive two-week course. Details on general classroom policies, what to turn in at the end of the course, and additional requirements for graduate credit, if applicable, are provided at the end of this syllabus. The class environment will be active, but informal. Please never hesitate to interrupt to ask questions or offer recommendations. Since many of the planned activities are complex or have multi-day components, we will almost certainly need to modify this schedule as we go along. That is part of the research process. If you have never had a lab class in which you had some noticeable degree of control or independence, this will be a pleasant new experience for you. But be prepared to be confused a little (or a lot!) from time to time. We sometimes let you wander about on your own for a while so you can learn what is needed to keep yourself organized. We believe you can learn by mistakes as well as by successes. We may even thank you publicly in class for making a mistake that can help others learn what to do (or not to do). It won't hurt your grade, but it helps others. If you only feel comfortable in lab when you have specific minute-to-minute guidance, then be prepared to be uncomfortable. This will be an important experience in learning self-direction and laboratory independence. One guaranty is that it will be a learning partnership. If you take it half-heartedly, your performance assessment will disappoint all of us. The only way you can fail is by failing to take this learning partnership seriously.

General Background Reading: Articles from Scientific American: *Evolution*

For a literary experience: Wambaugh, Joseph. 1989. *The Blooding* (The dramatic true story of the first murder case solved by genetic "fingerprinting"). Bantam Books, New York. [Note: This book is now out-of-print, and these paperback copies are the property of Jim Thompson. It is on loan to you for the duration of this summer session. You are not graded on your reading of this book. Reading it is voluntary. But it is relevant to our topic and is a good literary experience. Thank you.]

Any student in this course who has a disability that may prevent him or her from demonstrating his or her abilities should contact James Thompson, Donna Cobb (405) 325-7430, and the Disability Resource Center, Goddard Health Center, Rm. 166, (405) 325-3852, as soon as possible so that accommodations necessary to ensure full participation and facilitate your educational opportunities can be discussed.

Some Special Events will be scheduled during the session. They typically involve invited speakers for a presentation or some group UOBS activity like a Biological Station photoimage competition. These will be shown on the final syllabus distributed during our first class session.

Week 1:

Tuesday, 17 May

Morning

- Overview of the Course and Organization of Lab Manual
- Introduction to Molecular Biology (L) Primer, Chap. 1
- Introductory Laboratory Biotech. Explorer, Appdx A
 - a. Introduction to major equipment
 - b. Safety
 - c. Use of pipettors
 - d. Practice loading of agarose gels
- Overview of Molecular Techniques (L)

Afternoon

- Protein Electrophoresis Avisé, pp. 55-63
 - a. Introduction to techniques (L) Manual, A12 – A44
 - b. Cellulose acetate: *Drosophila* ADH Manual, A1 – A4
- Protein Polymorphism in Natural Populations (L)

Wednesday, 18 May

Morning

- Morning Meeting (D)
- Introduction to Population Genetics (L)
- Cellulose Acetate: Rat and Mouse Hemoglobin Manual, A5 – A11
- DNA Electrophoresis Protocol Discussion (L) Manual, C15 – C16
- Make an Agarose Gel for DNA Electrophoresis

Afternoon

- Local “Field Trip”: Seining for Minnows
- Set up DNA Gels:
 - a. lambda DNA
 - b. lambda/*Hind*III ladder
 - c. 1 kb DNA ladder
- Cellulose Acetate for Protein Polymorphism with Minnow Tissues
- Staining and Examination of DNA Gel

Thursday, 19 May

Morning

- Morning Meeting – Protein Polymorphism and Genetic Distance (L) Avisé, ref. pp. 107-110
- DNA Electrophoresis and Restriction Digestion Protocol Discussion (L) Avisé, pp. 67-78; Manual, B1-27
- Set Up Restriction Digests of Unknowns Manual, C12 – C14
- DNA Isolation Protocol Discussion (L) Manual, C1 – C8
- Begin DNA Isolation of *Drosophila* Genomic DNA
(complete up to 30+ min incubation-on-ice point)
- Set Up DNA Gels to Run Digests

Afternoon

DNA Isolation (continued)

Stain and Photograph DNA Unknown Electrophoresis Gels

Plan Individual Projects (*All organism materials must be approved before collection begins.*)

Friday, 20 May

Morning

Morning Meeting: Data Interpretation (e.g., estimating DNA fragment sizes) (L)

Turn in Title of Paper to be Discussed in Class

Introduction to Evolution (L)

Run Gel on *Drosophila* Genomic DNA

Afternoon

Individual Projects

-- Including Isolation of Genomic DNA from Organisms of Choice

Discuss Assigned Journal Article (Group Reading #1) (D)

Saturday, 21 May

Morning

Morning Meeting (D)

Contrast Nuclear and mtDNA Isolation Protocols (L)

Manual, C24 – C28

Discuss DNA Isolation Using Commercial Kits (L)

Manual, C6 – C7

Collect Tissue from Individual Project Organisms and Discuss

Qiagen Kit DNA Isolation Protocol

Afternoon

ADH Allele Survey from UOBS Population

Hardy-Weinberg (continued): Effects of Deviations from H-W Assumptions (L)

Finish Qiagen Kit Isolation of DNA and Prepare DNA Samples for Transfer to DNA

Sequencing Lab

Individual Projects

Week 2:

Monday, 23 May

Morning

Morning Meeting: Review Earlier Techniques (D)

Discuss PCR Protocol and Supporting Articles (D)

Awise, pp. 87-92

Manual, C21 – C23, C29

Introduce Engles/Gloor Isolation Protocol

Morning (continued)

Set Up PCR for microsatellites from *Drosophila*

Run Gel on DNA Isolated by Kit

Set up Electrophoresis of DNA Markers for Southern Blots

Individual Projects

Afternoon

Discuss Southern Blot Protocol (L)
Set Up Group Southern Blots
Generating Restriction Maps (L)
Run gel for microsatellite PCR products
Individual Projects

Manual, C17 – C20

Tuesday, 24 May

Morning

Morning Meeting: How to Make a Phylogenetic Tree (D)
Change Paper on Group Southern Blots
Set Up Gels for *microsatellite* PCR Product
Introduction to Behavior Genetics (L)
Discussion of Applying Molecular Techniques to Population Problems (L/D)
Individual Projects

Afternoon

Set Up PCR for BarCoding locus: COI
Individual Projects
Discussion of Assigned Journal Article (Group Paper #2) (D)

Wednesday, 24 May

Morning

Morning Meeting (D)
Discussion of Results from First Set of Assigned Problems
Discussion of DNA Sequencing and Other Techniques (L)
Stain and View Southern Blot Gels
Run Gel on DNA BarCoding Samples

Avise, pp. 84-87, 92-104

Afternoon

DNA Fingerprinting (D)
Introduction to Computer Databases and Search Programs
Analysis of *Adh* Sequencing Results and Other Search Problems
Individual Projects

Computer Lab

Computer Lab

Thursday, 25 May

Morning

Morning Meeting (D)
Complete Discussion of Results from Remaining Assigned Problems
Discuss: Optional Background Reading
Continue Computer Search Program Applications and BarCoding Results
Complete Individual Projects

Computer Lab

Afternoon

Begin Individual Presentations of Research Article (T)

(Note: All PowerPoint Presentations Must Be Provided to Jim Thompson **Before** 1:30 so they can be loaded onto the classroom computer for presentations that begin at 1:30.)

Clean Lab Area and Begin Packing Lab Equipment

Friday, 26 May

Morning

Complete Individual Presentations (T)

Final Discussion and Overview of the Course (D)

Turn in Package of Materials To Be Evaluated; ***Experiment Evaluations Must Be Completed by Jim Thompson or Ron Woodruff Before You Leave***

The program will be concluded by 12:00.

Key:

L = lecture

D = discussion

T = student talks

Other periods are primarily laboratory time.

Protocols in this guidebook have been derived from many sources, which should be clear from the copied material. *Molecular Cloning: A Laboratory Manual* by J. Sambrook and D.W. Russell (3rd edition, 2001. CSHL Press, Cold Spring Harbor, NY) is an excellent general source. Others will be available for your use in class.

Other Important Course Information

All students are responsible for knowing and following proper laboratory safety practices and safety rules at all times. This includes following guidelines prohibiting eating or drinking during lab or wearing contact lenses during class periods in which volatile chemicals and preservatives are in use. The safety rules and fire exit procedures are posted in the classroom.

Any student in this course who has a disability that may prevent him/her from fully demonstrating his/her abilities should contact us personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate your educational opportunity.

The OU Academic Misconduct Code is available as a link from the Provost's student academic integrity page, <http://www.ou.edu/provost/integrity>. In 2004, UOSA adopted an Honor Pledge, "On my honor, I affirm that I have neither given nor received inappropriate aid in the completion of this exercise." Each student should be aware of the University regulations in regard to cheating on class examinations or other work. It is also important to understand the various kinds of plagiarism, all of which will be considered forms of cheating. Additional information about such things as what constitutes plagiarism and the advantages and limitations of using internet sources will be discussed in class where appropriate. Any instance of cheating will be dealt with seriously, under the guidelines set out by the University. I sincerely trust that this will not be necessary.

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What To Turn In at the End of the Course

1. Summary of Individual Projects

- A. "Diary" style summary of protein and DNA results and your interpretations
- B. Drawings and/or original plates to illustrate your results
(Include a cross-reference to your samples on another person's plates [we expect you to share lanes on plates]; this can be done easily by having each person number the plates sequentially and using these numbers to reference data in the notes)

2. Problems and Unknowns, Including:

- A. Restriction Digest Unknowns: your interpretation and explanation, including your estimates of each fragment size
- B. Protein Polymorphism Data Set: calculation of levels of polymorphism and average heterozygosity for examples provided
- C. Restriction Mapping Problem and Other Problems as Assigned During the Session

3. Journal Article Presentation

- A. Prepare a 1-3 page handout that includes:
 1. Authors, date, title, source (journal name, volume, and inclusive page numbers)
 2. Brief summary (or photocopy the article abstract)
 3. Key figures and tables that can be used by each person to follow your presentation
 4. Note: These handouts will yield a set of 12 useful journal article summaries on which you can take notes during a presentation and then refer to in the future when you need examples of research in this field. Copies for all members of the class will be made for you from an original that you provide to Jim Thompson or Ron Woodruff.
- B. Prepare a written outline of your presentation, using any style you choose. This will be the set of lecture notes from which you will give your talk. But during your presentation, you should know the material well enough that you can use your notes for quick reference but still talk through the study rather than read your notes. For students enrolled for graduate credit, a formal paper summarizing and critiquing the research article will also be required. Guidelines for its format will be provided individually.
- C. PowerPoint Talk: Your presentation of the journal article to the class is important. You should plan to spend 15-20 minutes providing an introduction to the question studied by the authors, an outline of their methods (although we do not expect tedious detail -- we can help guide your planning of this if you want to ask us), and most importantly a detailed discussion of their results and conclusions. The results should refer to specific data in tables and figures and their interpretation. Any ideas you personally have for improving or expanding upon the study will also be welcome. The PowerPoint presentations should be transferred to a memory stick so all talks can be loaded onto an instructor's computer to be used during the presentation sessions.

4. Finally, in all appropriate sections, critique your own performance and results. What did you learn from the experience and what, if anything, would you do differently next time to improve?

Massive length is neither expected nor needed, but it is important that you think about what you did and what it means. You will not be graded to any significant extent on whether your data look great or your gels are beautiful. You will, however, be evaluated on your involvement and attempts to learn and improve. There is no good reason to put off the preparation of experiment summaries until the last minute. Good students (and we know all of you are good students) will want to develop this written critique/diary as you go along. In addition to making the learning experience richer, this will keep you from having a heavy project to complete at the end of the course. We have no doubt you are motivated to excel, and we look forward to helping you do so. **The full collection of written work must be reviewed by either Jim Thompson or Ron Woodruff on the last morning of the class before you leave after the last public talks. It will not be done before that time.**