

Methods in Evolutionary Biology
BIOS 716-DL1

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Description:

The course is geared to students who plan on doing research in Molecular Ecology, Molecular Evolution, Conservation Genetics, Genomics, and Biocomplexity. This course is based on the introduction provided by BIOS 515. The lecture reviews the basic concepts of Molecular Biology, Genetics, Molecular Evolution, covered in BIOS 515. The detailed protocols for DNA extractions, Polymerase Chain Reactions (PCR), Fluorescent sequencing, Microsatellite fingerprinting, and NextGen sequencing will be covered. These protocols will then be implemented in the lab section. Bioinformatics analysis will be expanded to cover the algorithmic basis for the most common methodologies. An introduction will be given to computer science and the basic hardware and operation system of computers. Finally, we cover basic PERL scripting, commercial analytical packages, and WEB based analysis tools.

The course is integrated to combine, theory, protocols, and analysis in a pragmatic applied paradigm. The lecture section will be a combination of theoretical reviews and Bioinformatics exercises. The lab section will utilize cutting edge technologies and instrumentation in the field.

Prerequisites: Molecular Ecology BIOS 515 or consent of the instructor.

Course Textbooks and Materials:

An Introduction to Molecular Ecology, Trevor Beebee & Graham Rowe 2008
Bioinformatics for Beginners, Supratim Choudhuri 2014

Other reading will be assigned from the literature and from the Web.
Blackboard will be used to distribute lectures and assignments.

Other reference Books:

Bioinformatics: Sequence and Genome Analysis, David Mount 2004
Molecular Cell Biology, Lodish et al, W.H. Freeman and Company, Fifth Edition 2004
Molecular Ecology J.R Freeland
Molecular Methods in Ecology A.J. Baker et al

Credits: This course carries 3 lecture credits and 1 lab credit.

Grading:

Grades will be based on class interaction (10%) and a combination of lab reports, Standard Working Protocols, and Analysis reports each week. Assignments are due the following week they are posted.

Class interaction will be measured by participation in class meetings and by participation in on-line discussions.

Computer resources:

You will need to have access to email and the web to access assignments.
Blackboard will be used to distribute lectures and assignments
All of these resources are available to GMU students at PWI and elsewhere.
You may also need to read WWW documents in *.pdf (Adobe Acrobat).
Readers are available for free for Windows, Macintosh and many unix platforms at the Adobe website.

Class Schedule Spring Semester

| SECTIONS | COURSE SCHEDULE | ASSIGNMENTS |
|-------------------|------------------------------------------------------------|-------------------------------------|
| Lecture | Introduction and Course Plan | |
| Lab 0 | Literature Search | |
| | Medline & GMU Library | Unix exercise |
| | Endnotes & Mendeley & Zotera | Due next week |
| Computer Lab I | Unix review I & Intro to Galaxy | |
| Lecture | Review of Restriction Digestion | |
| Lab 1 | Restriction Digestion Reactions | Standard Working Protocol |
| | Electrophoresis_making Agarose gels | Restriction Digestion Analysis |
| | Visualizing Restriction Digestions on Agarose Gel | Due next week |
| Computer Lab II | Kodak 1D analysis and Restriction mapping | |
| Lecture | Review of DNA Extraction: Bio101 Soil & Tissue | |
| Lab 2 | DNA extraction (Soil & Sediment samples) | |
| | Make a 1% Agarose Gel | Report on Agarose gel |
| | Quantitation of DNA on Agarose gel | Due next week |
| Computer Lab III | Introduction to PERL Programing | |
| Lecture | Overview of PCR & LH PCR Fingerprinting | |
| Lab 3 | PCR on 16S rRNA for soil community for Fingerprinting | PERL exercise |
| Computer Lab IV | PERL Programing | Due next week |
| Lecture | ABI3130 & Overview of LH PCR & Fingerprint Analysis | |
| Lab 4 | Quantitation of PCR products from last week on Agarose gel | |
| | Prepare dilutions of PCRs for Fingerprinting | LH-PCR assignment |
| | Run fingerprints on ABI 3130xl capillary | Due next week |
| | LH-PCR Analysis: Genemapper | |
| | Run PCRs for Cloning experiment next week. | |
| Computer Lab V | Galaxy/Portal Tools/Create tools | |
| Lecture | Over view of Cloning | Standard Working Protocol |
| Lab 5 | Cloning of PCR products using TOPO-TA cloning kit | DNA Extraction & PCR |
| | | Due next week |
| Computer Lab VI | Galaxy Tools for Microbial community analysis | |
| Lecture | Transformation efficiency & Overview of plasmid prep | |
| Lab 6 | Pick colonies & Grow plasmids | |
| | Pick colonies, lyse colonies, and run PCR | Report on Transformation Efficiency |
| Computer Lab VII | Unix and Programming Review | Due next week |
| Lecture | Overview of Sequencing | |
| Lab 7 | Run PCRs from clones on agarose gel | |
| | Purify PCR products with Ampure solution | Compare Blast and Bayesian Analysis |
| | Run cleaned PCRs on 1% agarose gel | Due next week |
| Computer Lab VIII | Compare Blast analysis and RDP11 Bayesian Analysis | |
| Lecture | Review Gel Filtration purification method | |
| Lab 8 | Run sequencing Reactions on purified PCR products | |
| | Cleanup sequencing reactions (done before) with Sephedex | |
| | Dry sequencing reaction in speed vac | Qiime Example |
| | Run Sequencing Reactions on Capillary machine (ABI 3130XL) | Due next week |
| Computer Lab IX | Qiime Analysis-UNIX platform | |
| Lecture | Review Sequence Analysis & Assembly | |
| Lab 9 | Analyze sequence data on ABI 3130XL | Galaxy assignment |
| | Prepare sequence data for Sequencher | Due next week |
| Computer Lab X | Sequencher | |

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| Lecture | PGM Sequencing & Microbiome | Literature Review |
| Lab 10 | PGM data analysis (de-multiplexing data) | NextGen technology |
| Computer Lab XI | Geneious | Due next week |
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| Lecture | Microbiome Project & Ecological Oscillations | Standard Working Protocol |
| Lab 11 | Nextgen sequencing (demos for PGM) | Nextgen sequencing & Microbiome |
| Computer Lab XII | Correlation Network Analysis | |
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| Lecture | Microbial Ecology Examples | Clone Analysis |
| Lab 12 | Nextgen sequencing (demos for PGM) | Literature Review : Clone analysis |
| Computer Lab XIII | PICRUST, USEARCH, Mothur | |
| | | |
| Lecture | Microbial Ecology Examples | Literature Review |
| | Microsat Commander | Students Choice |
| Computer Lab I XIV | Metagenome Analysis | |
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Grading Scale

| Letter Grade | Percentage | Registrar's Equivalent on a Scale of 0-4.0 |
|--------------|------------|--------------------------------------------|
| A+ | > 96 | 4.0 |
| A | 92.0-96.0 | 4.0 |
| A- | 90.0-91.99 | 3.67 |
| B+ | 88.0-89.99 | 3.33 |
| B | 82.0-87.99 | 3.00 |
| B- | 80.0-82.0 | 2.67 |
| C | 70.0-77.99 | 2.00 |
| F | < 70 | 0.00 |

Academic Integrity

GMU is an Honor Code university; please see the University Catalog for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit to those people in the proper, accepted form. When doing homework, the work must be yours. It is totally unacceptable to copy the work of another student in this course in any form.

GMU Email Accounts

Students must use their Mason email account to receive important University information, including messages related to this class. See <http://masonlive.gmu.edu> for more information. Students will need to have access Blackboard for class lectures and assignments,

Other Useful Campus Resources:

Writing Center: A114 Robinson Hall; (703) 993-1200; <http://writingcenter.gmu.edu>

UNIVERSITY LIBRARIES "Ask a Librarian" <http://library.gmu.edu/mudge/IM/IMRef.html>

Counseling and Psychological Services (CAPS): (703) 993-2380; <http://caps.gmu.edu>

University Policies

The University Catalog, <http://catalog.gmu.edu>, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. Other policies are available at <http://universitypolicy.gmu.edu/>. All members of the university community are responsible for knowing and following established policies.