Methods in Evolutionary Biology
BIOS 716/EVPP 615

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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 715/EVPP515. The lecture reviews the basic concepts of Molecular Biology, Genetics, Molecular Evolution, covered in the above. 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 715 / EVPP 515 or consent or 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 eficiency & 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	
Lecture	PGM Sequencing & Microbiome	Literature Review
Lab 10	PGM data analysis (de-multiplexing data)	NextGen technology
Computer Lab XI	Geneious	Due next week
Lecture	Microbiome Project & Ecological Oscillations	Standard Working Protocol
Lab 11	Nextgen sequencing (demos for PGM)	Nextgen sequencing & Microbiome
Computer Lab XII	Correlation Network Analysis	
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	

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.