BIOL/EVSS 649/659 COMPARATIVE GENOMICS SPRING 2018
INSTRUCTOR: Andy Shedlock
LECTURE TIME: 2:00PM – 3:15PM, TUESDAYS & THURSDAYS
LOCATION: 100 School of Science & Math Bldg (SSMB)
OFFICE HOURS: After class time and by appointment
PREREQUISITES: None required, but undergraduate level courses such as genetics and molecular biology as well as ecology, evolution, and conservation are recommended

COURSE OUTLINE & SYLLABUS:

PART I.

Jan 9 - Introductions, policies, goals, course overview

Week 1 – Jan 9 & 11
- The emergence of the era of genomics
- Building genome assemblies
- High throughput genome analysis platforms

Week 2 – Jan 16 & 18
- Anatomy and origins of genome architecture
- The construction of genome theory
- Neutralist versus selectionist arguments
- Major components of genomes
- Coding vs. non-coding compartments

Week 3 – Jan 23 & 25
- The Transcriptome
- Protein coding genes
- Single copy DNA vs. multigene families
- Jan 25: Paul Anderson (Comp Sci) Guest Lec on Computational Approaches I

Week 4 – Jan 30 & Feb 1
- Feb 1: Chris Botka (Harvard Med School) Guest Lec on HPC Bioinformatics
- MicroRNAs: trash or treasure?
- Functionality and Clustering
- The frontier of gene regulatory networks
- Translational genome biology

Week 5 – Feb 6 & 8
- Mobile DNA and genomic repeats
- The genomic molecular “fossil” record
- Genome evolutionary dynamics
- Repeats as genetic markers

PART II.

Week 6 – Feb 13 & 15

Comparative Vertebrate Biology and Phylogenetics
Reconstructing ancestral states
Testing hypotheses with genome scale information
Paleogenomics and the importance of fossils

Week 7 – Feb 20 & 22

Genome assemblies in the vertebrate tree of life
Living in water
Jawless fishes
    Lamprey and hagfish genomes
Cartilaginous fishes
    The chimera assembly
Bony fishes
    Teleost assemblies and genomic diversity
    The coelacanth and lungfish genomes

Week 8 – Feb 27 & Mar 1

Feb 27: Paul Anderson (Comp Sci) Guest Lec on Computational Approaches II
Mar 1: EXAM 1 (300 POINTS) COVERING MATERIAL WEEKS 1-7

Week 9 & 10 – Mar 6, 8, 13, 15

Living on land
Amphibian genomes
    The Xenopus assembly
    Salamander genomes
Amniote origins and reptilian genomic diversity
    The Anolis assembly
    The painted and softshell turtle assemblies
    The alligator assembly
    The python assembly and garter snake genome
    The tuatara genome

Mar 20 & 22 SPRING BREAK NO CLASS

Week 12 – Mar 27 & 29

Endothermy and taking flight
    Dinosaur genomes
    The chicken and turkey assemblies
    The zebrafinch assembly and cryptic neoavian genomic diversity
    The emu genome

Week 13 – Apr 3 & 5

Mammalian adaptation and diversification
The platypus assembly
The opossum assembly
The diversity of Eutherian assemblies

Week 14 – April 10 & 12
Primate comparative genomics
Placing the human genome in perspective
Human population genomics and public health
Personalized genomics and individual health
Forensics and the law
Who sees the data and why?

Week 15 – April 17 & 19

April 17: STUDENT SYMPOSIUM PORJECT PRESENTATIONS
ANNOTATED BIBLIOGRAPHY ASSIGNEMENT DUE (300 POINTS)
April 19: EXAM 2 (300 POINTS); MATERIAL AFTER EXAM 1

Grading based on 1000 points:

Midterm Exams (600)
Bibliography Assignment (300)
Participation (100)

Overview of Annotated Bibliography Assignment (Due Tuesday April 17 in class)

In the laboratory section of Vertebrate Genome Biology you will be developing a fundable proposal based on a pilot study that analyzes genome-scale information. In order to accomplish this in a rigorous and properly researched manner you will need to explore the genome biology primary literature in detail and appropriately cite studies that introduce your ideas and explain your proposed research activities and expected results.

Your proposal will thus need to consider (more on this assignment separately in lab):

- An introduction including why the genomics of this group is important (such as evolutionarily or medically or ecologically or economically, etc.).
- A review of the current state of the genetic and genomic knowledge surrounding this taxon using correct reference citations from printed or electronic sources of the peer-reviewed scientific literature.
- What important questions remain about the taxon and what data would you need to generate to answer these questions.
- A hypothesis and the nature of results that would either confirm or reject that hypothesis, including what results would support the hypothesis and what results would force you to reject your hypothesis.

- A summary of your argument and concluding statement.
- A proper, accurate and consistently formatted bibliography in the style of the scientific journal *Genome Research*.

ASSIGNMENT (300 Points): Provide an annotated bibliography that comprehensively addresses all aspects of the development and presentation of your research proposal. For each citation in this document, you will need to provide a one-page or less written summary of the reference and explicitly describe how it does relate or does not directly relate to your proposal synthesis. Do not just copy the abstract and major bullets but rather summarize what you are/are not taking away from carefully reading and comprehending and thinking critically about the entire reference as is relates to your project ideas. YOUR ANNOTATED BIBLIOGRAPHY SHOULD INCLUDE AT LEAST 30 REFERENCES. Most (at least around 70%) but not necessarily all of these should also be included in your final written proposal (lab section assignment) but regardless, you must summarize all the papers you explored as part of your proposal literature background, development and synthesis.

Online References:

Original articles for published genome assemblies available via the Entrez-NCBI searchable database for Genome Project Resources: http://www.ncbi.nlm.nih.gov/genomes/leuks.cgi

Texts Placed on Reserve at Addlestone and Marine Resources Libraries:

Brown, T. A. 2006. *Genomes 3*. Garland Science, New York, NY.

Caetano-Anollés, G. (Ed.) 2010. *Evolutionary Genomics and Systems Biology*. Wiley-Blackwell, Hoboken, NJ.

Dittmar, L. and D. Liberlies (Eds.) 2010. *Evolution After Gene Duplication*. Wiley-Blackwell, Hoboken, NJ.

Gibson G. and S. Muse 2009. A Primer of Genome Science, 3rd ed., Sinauer Associates, Inc., Sunderland, MA.

Murphy, W. (Ed.) 2007. *Phylogenomics*. Methods in Molecular Biology Series, Humana Press, Totowa, NJ.

Lynch, M. 2007. *The Origins of Genome Architecture*. Sinauer Associates, Inc., Sunderland, MA.

Pough, F.H., Janis C.M., and J.B. Heiser. 2008. *Vertebrate Life*, 9th ed., Prentice Hall, NJ.

Van Straalen, N. M. and D. Roelofs. 2012. Ecological Genomics, 2nd ed., Oxford University Press, New York, NY.

Additional Formal Considerations:

Learning Outcomes, Assessment and Grading Scale:

1. Understand fundamental and advanced concepts and the hierarchical scales of biological organization inherent to the investigation of eukaryotic genome content, structure, variation and dynamics.

The instructor will assess learning outcome 1 based on student performance on tests covering materials presented in the co-requisite lectures over the course of the semester. Two exams (one mid-term and one final) will be given that require in-depth review of genome structure and creating graphical representations of data and relating experimental results to the genome science concepts discussed in lecture.

Grade A = Student correctly represents concepts and data provided by lecture material and case studies and relates the experimental results to genomic concepts for at least 90% of each exam.
Grade B = As above for 80-90% of each exam.
Grade C = As above for 60-80% of each exam.
Grade F = As above for less than 60% of each

2. Understand in-depth the primary structure of genomic data and the standard tools and newly emerging technologies and strategies used to interrogate genomes.

The instructor will assess learning outcome 2 by evaluating students based on oral in-class summaries and written outlines of their project development strategies and aims for testing hypotheses established for individual class projects. In-depth understanding will also be evaluated based on performance on tests covering materials presented in lecture and laboratory over the course of the semester. Two exams (one mid-term and one final) will be given that require review of fundamental aspects of genome structure and creating graphical representations of data and relating experimental results to the genome science concepts discussed in lecture and investigated in lab.

Grade A = Student correctly represents concepts and data provided by lecture material, case studies and lab assignments and relates the experimental results to genomic concepts for at least 90% of each assignment or exam.
Grade B = As above for 80-90% of each assignment or exam.
Grade C = As above for 60-80% of each assignment or exam.
Grade F = As above for less than 60% of each assignment or exam.

3. Become familiar with the historical developments, new advances, and future directions of genome science based on review and discussion of the primary literature in genome biology.

The instructor will assess learning outcome 3 through written and oral presentation assignments and active participation in student discussion relating pilot study results to the genome biology concepts discussed in lecture and investigated in lab.

Grade A = Student correctly relates genome data analysis results collected from investigations in lab to genome biology concepts for at least 90% of each assignment.
Grade B = As above for 80-90% of each assignment.
Grade C = As above for 60-80% of each assignment.
Grade F = As above for less than 60% of each assignment.

4. Gain hands-on experience designing an hypothesis-driven genomic investigation, analyzing large-scale genomic data, interpreting results of genomic investigations, and communicating a proposal for funding future work based on pilot results both in writing and orally.

The instructor will assess learning outcome 4 through written and oral presentation assignments and active participation in student discussion relating pilot study results to the genome biology concepts discussed in lecture and investigated in lab.

Grade A = Student correctly relates genome data analysis
results collected from investigations in lab to genome
biology concepts for at least 90% of each assignment.
Grade B = As above for 80-90% of each assignment.
Grade C = As above for 60-80% of each assignment.
Grade F = As above for less than 60% of each assignment.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

1. **Center for Student Learning:** I encourage you to utilize the Center for Student Learning's (CSL) academic support services for assistance in study strategies, speaking & writing strategies, and course content. They offer tutoring, Supplemental Instruction, study strategy appointments, and workshops. Students of all abilities have become more successful using these programs throughout their academic career and the services are available to you at no additional cost. For more information regarding these services please visit the CSL website at http://csl.cofc.edu or call (843)953-5635.
2. **Center for Disability Services (http://disabilityservices.cofc.edu/for-faculty/faqs.php)**

   The College will make reasonable accommodations for persons with documented disabilities. Students should apply for services at the Center for Disability Services/SNAP located on the first floor of the Lightsey Center, Suite 104. Students approved for accommodations are responsible for notifying me as soon as possible and for contacting me one week before accommodation is needed

ACADEMIC INTEGRITY STATEMENT

Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified, are investigated. Each incident will be examined to determine the degree of deception involved.
Incidents where the instructor determines the student's actions are related more to a misunderstanding will be handled by the instructor. A written intervention designed to help prevent the student from repeating the error will be given to the student. The

intervention, submitted by form and signed both by the instructor and the student, will be forwarded to the Dean of Students and placed in the student's file.
Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Dean of Students. A student found responsible by the Honor Board for academic dishonesty will receive a XXF in the course, indicating failure of the course due to academic dishonesty. This grade will appear on the student's transcript for two years after which the student may petition for the XX to be expunged. The F is permanent. The student may also be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from the College by the Honor Board.
Students should be aware that unauthorized collaboration--working together without permission-- is a form of cheating. Unless the instructor specifies that students can work together on an assignment, quiz and/or test, no collaboration during the completion of the assignment is permitted. Other forms of cheating include possessing or using an unauthorized study aid (which could include accessing information via a cell phone or computer), copying from others' exams, fabricating data, and giving unauthorized assistance. Research conducted and/or papers written for other classes cannot be used in whole or in part for any assignment in this class without obtaining prior permission from the instructor. Students can find the complete Honor Code and all related processes in the Student Handbook at http://studentaffairs.cofc.edu/honor-system/studenthandbook/index.php