FACULTY COMMITTEE ON GRADUATE EDUCATION, CONTINUING EDUCATION AND SPECIAL PROGRAMS

GRADUATE COURSE PROPOSAL FORM

Contact Name: ANDREW M SHEDLOCK    Email: SHEDLOCKAM@COFC.EDU   Phone: 843-762-8811

Department Name: BIOLOGY    Graduate Program name: MARINE BIOLOGY

Course Prefix, Number, and Title: BIOL 649 COMPARATIVE GENOMICS

I. CATEGORY OF REVIEW (Check all that apply)

<table>
<thead>
<tr>
<th>NEW COURSE</th>
<th>CHANGE COURSE</th>
<th>DELETE COURSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Course (attach syllabus*)</td>
<td>Change Number (IV, VII, VIII, IX)</td>
<td>Delete Course (IV, VII, IX)</td>
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<td>Change Title (IV, VII, VIII, IX)</td>
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<td>Change Credits/Contact hours (II, IV, VII, IX)</td>
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<td>Prerequisite Change (IV, VII, VIII, IX)</td>
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<tr>
<td></td>
<td>Edit Description (III, IV, VII, VIII, IX)</td>
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</tbody>
</table>

☐ Approve for Cross-listing (attach Graduate Permission to Cross-list Form)

Date (Semester/Year) the course will first be offered, course changes or deletion will go into effect: SPRING 2015

NEW COURSE:

*ATTACH THE SYLLABUS FOR A NEW GRADUATE COURSE to include:

- Course description and objectives
- Method of teaching (e.g., lecture, seminar, on-line, hybrid)
- Required and optional texts and materials
- Graduate School Grading Scale
- Assignments, student learning outcomes and assessment components
- Policies to include attendance, Honor Code, American Disabilities Act statement
- Tentative course schedule with specific topics
List prerequisites and / or other restrictions below

None

Will this course be added to the Degree Requirements?

a) ☐ Yes  ☒ No

b) If yes, explain

II. NUMBER OF CREDITS and CONTACT HOURS per week

<table>
<thead>
<tr>
<th></th>
<th>Lecture</th>
<th>Lab</th>
<th>Seminar</th>
<th>Ind. Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Contact Hours</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Credit Hours</td>
<td>4</td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

Is this course repeatable? ☐ yes  ☒ no  If so, how many credit hours may the student earn in this course?

III. CATALOG DESCRIPTION Limit to 50 words EXACTLY as you want it to appear in the catalog; include prerequisites, co-requisites, and other restrictions. If changing course description, please include both old and new course descriptions.

An in-depth consideration of genome structure, evolutionary dynamics, and computational analysis driving multidisciplinary “-omics” approaches to medicine, organismal biology, and environmental science. Students discuss landmark primary literature emphasizing a comparative phylogenetic framework for new advances in genomics and analyze genome-scale data in the computer lab to develop a research proposal. A background in cellular or molecular biology is recommended.

IV. RATIONALE / JUSTIFICATION: If course change – please indicate the course change details. If course change or deletion—please provide reasons for change(s) to or deletion of a course. If a new course—briefly address the goals/objectives for the course and the relationship to the strategic plan.

This course has been taught three times as Special Topics (BIOL 502/502L). Primary goals of the lecture are to give students an in-depth comparative understanding of the structure, dynamics and diversity of published genomes within a phylogenetic and population genetic framework and to evaluate emerging high-throughput biotechnologies and associated “-omics” strategies driving how genomes are assembled and interrogated at various levels of organization. Primary goals of the “hands-on” computer laboratory are to teach students analytical strategies essential for thinking critically and creatively about genomic research. Students are mentored to complete a hypothesis-driven “proof-of-principle” in silico pilot study incorporated into a genomics-enabled grant proposal modeled after NSF guidelines and review standards. Student projects employ database informatics, distributed computing tasks, open source software tools and work flow pipelines, and large-scale data manipulation and analysis.

Lectures and labs draw heavily upon recent publications in a fast-growing field and are enriched by proprietary access to

September 2011
assembly and transcriptomic data from ongoing NIH-funded national genome assembly projects. Labs utilize newly installed SC-EPSCoR and NSF-funded genomics-dedicated cyberinfrastructure at CofC, and benefit from collaborative research and technical support from CofC Computer Science, MUSC, Clemson, and Harvard Medical School. Students are encouraged to engage guest scientists hosted by the class who are doing cutting-edge research in genomics, both locally and globally. All written work is also communicated orally in a student-run professional project symposium at the end of the course. Collectively these goals and activities aim to transform graduate students intellectually as emerging investigators empowered by new technologies and high impact experiential learning so they can enter the workforce ready to contribute integrative solutions to complex modern problems in the life sciences. As such, the class directly articulates with multiple goals and strategies outlined in the College of Charleston Strategic Plan (http://www.cofc.edu/strategicplan/), namely:

"Goal 1: Provide students a highly personalized education based on a liberal arts and sciences core and enhanced by opportunities for experiential learning.

Goal 3: Provide students the global and interdisciplinary perspectives necessary to address the social, economic, environmental, ethical, scientific and political issues of the 21st century.

Strategy 2: Develop nationally recognized graduate programs.

Strategy 7: Provide up-to-date facilities and infrastructure to enhance academic, co-curricular and extra-curricular programs.

Strategy 8: Collaborate with local, national and international institutions to leverage higher education for a stronger South Carolina."

V. STUDENT LEARNING OUTCOMES and ASSESSMENT

<table>
<thead>
<tr>
<th>Student Learning Outcomes</th>
<th>Assessment Method and Performance Expected</th>
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<tbody>
<tr>
<td>What will students know and be able to do when they complete the course?</td>
<td>How will each outcome be measured? Who will be assessed, when, and how often? How well should students be able to do on the assessment?</td>
</tr>
</tbody>
</table>

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 lecture 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 exam.
| 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 outcomes 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.

How does this course align with the student learning outcomes articulated for the major, program, or general education? What
This course strengthens and broadens the curriculum available to College of Charleston graduate students in the related areas of molecular biology, genomics and bioinformatics. It also advances research and training opportunities for students seeking to utilize shared resources and expertise at CoC and MUSC. BIOL 649 introduces a rapidly expanding new area of technology-driven discovery and is accessible to a broad cross section of graduate students pursuing research in organismal biology, ecology, evolution and environmental science. It also elaborates and distinguishes the curriculum in The Graduate School with a comparative, evolutionary perspective on genome biology presently not available at MUSC or many peer institutions even though scientific literacy and critical thinking in this area are becoming important competitive factors for students pursuing professional opportunities in the life sciences. Importantly, BIOL 649 reinforces student investigative skills through hands-on experiential learning by doing genome science not just studying concepts in genomics. This active peer-driven learning model is critical to the completion of the synthetic assignments and demonstrates student research capacity through synergistic implementation of investigative skill sets integrated across the fields of genomics and computational biology. The class is unique at the College of Charleston in having the expertise and cyberinfrastructure in place to allow students to work directly with distributed computing of original next-generation, high throughput sequence data. This investigative approach is rapidly becoming a new standard for integrating molecular genetics with organismal biology, ecology, behavior and evolution. Empowering students to design and conduct investigations utilizing high-throughput DNA sequencing strategies is a potentially transformative high impact learning experience inspiring young investigators to seek advanced training programs and make important contributions at the forefront of the "omics" revolution in the life sciences.

VII. IMPACT ON EXISTING PROGRAMS AND COURSES: Please briefly document the impact and expected changes of this new/changed/deleted course on other departments, programs and courses: if deleting a course—list all departments and programs that include the course; if adding/changing a course—explain any overlap with existing courses in the same or different departments; if adding or deleting a course that will be part of a joint program identify the partner institution.

BIOL 649 has a close relationship with BIOL 623/L Genomics taught by Dr. Christine Byrum and also Special Topics courses in the area of bioinformatics taught by Dr. Gavin Naylor. However BIOL 649 Comparative Genomics complements these other courses with minimal redundancy in a manner that is congruent to major distinct areas of specialization within the field. BIOL 649 Comparative Genomics focuses primarily on the comparative biology of eukaryotic genomic structure and its integration with organismal complexity and diversity within a phylogenetic and population framework. The laboratory is entirely computational, not experimental as in BIOL 623/L, and the emphasis is on comparative genome evolution, high-throughput whole-genome data structures, and designing a research proposal based on an in silico investigation of large-scale genomic information. BIOL 649 does not include wet lab experiments common to functional genomics and research in developmental biology, such as the locus-specific quantitative PCR methods emphasized in BIOL623/L. Moreover, BIOL 649 targets advanced graduate student specialists already engaged in molecular research who are encouraged to make productive use of their MS or PhD thesis and dissertation projects to complete a pilot investigation of genome-scale data as part of a research proposal. This is distinct from and complementary to a more topical introduction to the field of genomics (BIOL 623/L) and also is largely an implementation of bioinformatics methods, not a detailed treatment of underlying mathematical theory, models and statistics emphasized in more purely bioinformatics or computer science programming courses, such as those taught by Dr. Naylor (Biology) and also Dr. Paul Anderson (College of Charleston Computer Science Dept). Overall BIOL 649 covers an important area of advanced training at CoC in a manner that complements existing wet-lab and bioinformatics course offerings, thereby broadening and strengthening the curriculum available to graduate students who would like to pursue genomics-enabled research in the life sciences.
VIII. COSTS ASSOCIATED WITH THE ACTION REQUESTED: List all of the new costs or cost savings, (including new faculty/staff requests, library or equipment, etc.) associated with the action requested. New courses requiring additional resources will need special justification.

The course requires no new costs and it has never required a course-specific teaching budget since it was first offered in 2011. However it benefits from a number of cost-saving developments, including two external grants dedicated to providing leadership on local and national levels at the CoFC in the area of student investigative mentoring and experiential learning in the genome sciences: (1) A FY13 $100K SC EPSCoR/IDeA GEAR Cyberinfrastructure grant awarded to Co-Investigators A. M. Shedlock (CoFC Biology / MUSC Center for Marine Biomedicine), P. Anderson (CoFC Computer Science) and D. Watson (MUSC Bioengineering and Hollings Cancer Genomics Center); and (2) A FY14-17 $335K NSF “Omics” REU Site Proposal Award to Co-Investigators A. M. Shedlock (CoFC Biology / MUSC Center for Marine Biomedicine) and P. Anderson (CoFC Computer Science). Teaching the proposed class previously as a Special Topics BIOL 502/L course in 2011-13 under the title Vertebrate Genome Biology set the critical collaborative and instructional foundation for establishing 4 previous and 30 new “next-generation” genomics-enabled student training internships that will engage graduate student mentors, 3 shared MUSC-CoFC predoctoral Teaching Assistantships in Molecular Biology, an MUSC GAANN Predoctoral Teaching Internship in Genome Biology, and the new high-throughput CoFC computing cluster of the Charleston Computational Genomics Group (C2G2, co-founded by Co-I’s Shedlock and Anderson) specifically reserved for genomics-enabled student research projects demanding high-throughput distributed computing capabilities. The proposed class is already thoroughly engaged with active training and cost-saving initiatives at CoFC and MUSC but also benefits from shared networked user access to state-of-the-art facilities in the Santee-Cooper GIS Computing Laboratory hosted through collaborative agreements with Dr. Norm Levine (CoFC Geology Dept.) and Instructor user accounts at Clemson University Palmetto and Harvard Medical School Orchestra supercomputing facilities, that include licensed software access, IT tech support, large-scale sequence data management support and data security all of which can be brought to bear on facilitating CoFC graduate student project development and implementation in BIOL 649 Comparative Genomics.
IX. APPROVAL AND SIGNATURES

Signature of Program Director:  

Date: 10-30-14

Signature of Department Chair:  

Date: 11-3-14

Signature of Additional Chair*:  

Date: 

Signature of Schools' Dean:  

Date: 11-3-14

Signature of Additional Schools' Dean*:  

Date: 

Signature of the Provost:  

Date: 12-30-14

Signature of Budget Director/Business Affairs Office:  

Date: 

*For interdisciplinary courses

Return form to the Graduate School Office for Further Processing

Signature of Chair of the Faculty Committee on Graduate Education, Continuing Education & Special Programs:  

Date: 1/17/2015

Signature of Chair of the Graduate Council:  

Date: 2/13/15

Signature of Faculty Senate Secretary:  

Date: 

Date Approved by Faculty Senate: 

September 2011
PROPOSED NEW COURSE: BIOL 649 COMPARATIVE GENOMICS

4.0 CREDITS, TWO WEEKLY LECTURES PLUS ONE LABORATORY

INSTRUCTOR: Andrew M. Shedlock
Technical Support: Paul Anderson (Computer Science) and Norm Levine (Geology)

LECTURES: 12:15-1:30 PM TUESDAYS & THURSDAYS
COMPUTER LABORATORY: 530-830 PM THURSDAYS

OFFICE HOURS: AFTER THURSDAY LAB AND BY APPOINTMENT

LOCATION: ROOM 100 School of Science and Mathematics Building (SSMB); Labs in 225 SSMB

COURSE DESCRIPTION

BIOL 649 is an advanced integrative lecture and laboratory course that provides an in-depth comparative consideration of genome structure, diversity, evolutionary dynamics, and new methods of computational analysis driving multi-disciplinary “-omics” approaches to medicine, organismal biology, and environmental science. Part 1 provides the conceptual and theoretical and technical knowledge necessary to understand and critically evaluate the results and biological relevance of landmark genome projects covered in Part 2 through peer-driven interactive discussion of recent literature and weekly presentations. Material from lecture informs the hands-on active learning laboratory dedicated to hypothesis formation, data structures, analytical methods, and computational work flow required to complete an individual pilot study and produce a fundable proposal for genomics-enabled original research, the main assignment of the course.

LEARNING OBJECTIVES FOR BIOL 649

1. To understand fundamental and advanced concepts and the theoretical, molecular, organismal and evolutionary framework of eukaryotic genome biology.

2. To understand the hierarchical scales of biological organization inherent to the investigation of eukaryotic genome content, structure, variation and dynamics.

3. To understand the primary structure of genomic data and the standard tools and strategies used to interrogate genomes.

4. To gain hands on computational experience in gathering genomic data, analyzing large-scale genomic data, and interpreting results of genomic investigations.
5. To gain hands on experience designing a genome scale investigation, completing an hypothesis driven pilot study, and communicating a proposal for original genome research based on pilot results both in writing and orally.

6. To become familiar with the historical developments, new advances, and future directions of genome science based on active review and discussion of the primary literature in genome biology.

COURSE POLICIES

Attendance, Behavior, Special Needs and Academic Integrity

Attendance is essential and required for all lectures and laboratories and will be recorded and incorporated into the class participation grade. It is imperative that any need to miss class for professional reasons be communicated well in advance and approved by the Instructor. Medical emergencies, bereavement, and other health-related reasons for missing class should be accompanied by appropriate documentation from a health care professional. Matters of inconvenience or forgetfulness or oversleeping are not legitimate excuses for missing class. Lateness will result in a deduction of participation points and should be explained to the Instructor in a private conference.

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 the Instructor as soon as possible and for notifying one week before accommodation is needed.

BIOL 649 is taught with the assumption you will come to class prepared and will behave in a professional, mature manner by showing respect for your teachers and fellow classmates, by paying attention and engaging conscientiously in peer-driven interactive learning activities, and by not creating distractions. Disruptive behaviors will not be tolerated.

Academic integrity is major priority for the College of Charleston and for BIOL 649. This is especially true given the need to work interactively, share ideas, and rely on a large body of online resources and published references to develop student projects. However, these resources cannot be used without proper citation and are easily copied inappropriately as a form of plagiarism. To avoid any confusion about this serious matter, we will strictly adhere to the following policy as quoted from the Honor Council’s recommended guidelines:

“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.

In cases where it is determined that a student’s actions were due to a misunderstanding, the situation 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 by both 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 XF 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 X to be expunged. 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 stored on a cell phone), 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.”

Assessment and Grading based on 2000 points

Midterm and Final Exams (600)  
Annotated bibliography (300)  
Proposal outline and justification (200)  
Full proposal with pilot study (400)  
Oral presentation (300)  
Participation (200)  

Grading Scale

93 and above: A  
90-92.9: A-  
87-89.9: B+  
83-86.9: B  
80-82.9: B-  
77-79.9: C+  
73-76.9: C  
60-72.9: C-  
below 60: F

Assignments

Annotated Bibliography Assignment (Due Tuesday April 15 in class)

In the laboratory section of Genome Biology you will be developing a research 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 it 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.

**Proposal Outline and Justification (200 points)**

**Written Grant Proposal (400 points)**

The primary assignment of BIOL 649 is a written research proposal of testable questions and how to address them with genomics-enabled investigation. The focus of this assignment is not on presenting comprehensive or conclusive data but rather on thinking critically about the integration of genome-scale data analysis with your emerging or continuing research interests in eukaryotic biology. The assignment is rooted in the practical professional reality of needing to construct convincing arguments for funding your research as a pre- or post-doctoral investigator. As such it follows closely the format and guidelines provided to Principal Investigators by the National Science Foundation for preparing competitive research grants for basic research in the life sciences.
Proposal structure (10 page limit; 12pt Times; layout ssp w/1 inch margins):

1) Literature and background (frame the foundation and context for your work based on previous published investigations in the primary literature)
2) Summary of testable hypotheses for target taxa; includes rationale and justification of proposed activities and data you need to build and analyze
3) Methods (computational work flow; experimental work should not be primary focus)
4) Preliminary data (results of your preliminary incomplete study = proof-of-concept)
5) Budget request and time-line for your project
   -Variable, but aim for a 1-year pilot project capped at $50K to be completed by yourself with appropriate outsourcing (assume your salary will be covered by other sources).
   -The goal of this part of the assignment is for you to think critically about designing and scaling your research priorities within the realistic constraints of time, money and access to facilities.
6) Bibliography of references cited in the format of the journal Genome Research.

The proposal outline and justification will be used to evaluate the rationale, referencing, hypothesis formation, sampling design, methods and efficacy of the research. Its main purpose is to provide constructive feedback in a timely manner prior to completion of the final written proposal that incorporates all elements 1-6 above.

Oral Presentation of Research (300 points)

On the final day of the course students will present a 15-minute research talk, using Powerpoint slides in the format of a professional research symposium. Questions and discussion will follow each presentation and will be graded for conscientious participation.

COURSE MATERIALS AND REFERENCES

Comparative Genomics Dropbox:
There is no required text for this class, but we will read and review a large body of primary literature. Lecture slides with audio capture of in-class narration, course handouts, reference material and all primary literature for both lecture and laboratory discussion will be distributed through a shared Dropbox folder dedicated to the course.

Online References:

Original articles for published genome assemblies available via the Entrez-NCBI searchable database for Genome Project Resources:
Texts Placed on Reserve at Addlestone and Marine Resources Libraries:


PROVISIONAL COURSE SYLLABUS BASED ON THREE YEARS OFFERING THE COURSE AS BIOL 502 SPECIAL TOPICS

LECTURE:

PART I.

Jan 9 - Introductions, policies, goals, course overview

Week 1 – Jan 14 & 16
The emergence of the era of genomics
Building genome assemblies
High throughput genome analysis platforms

Week 2 – Jan 21 & 23
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 28 & 30
Jan 28: Robyn Grayson-Lottes (MUSC Pediatrics) Guest Lect on her class project in Genome Biology and how it relates to her PhD dissertation research
Jan 30: Paul Anderson (Comp Sci) Guest Lect on Computational Approaches 1
Week 4 – Feb 4 & Feb 6
The Transcriptome
Protein coding genes
Single copy DNA vs. multigene families
MicroRNAs: trash or treasure?
Feb 6: Ben Parrot (MUSC Ob/Gyn and Marine Biomedicine) Epigenomic mechanisms and the frontier of gene regulatory networks

Week 5 – Feb 11 & 13
Mobile DNA and genomic repeats
The genomic molecular “fossil” record
Genome evolutionary dynamics
Repeats as genetic markers

PART II.

Week 6 – Feb 18 & 20
Comparative Vertebrate Biology and Phylogenetics
Reconstructing ancestral states
Testing hypotheses with genome scale information
Paleogenomics and the importance of fossils

Week 7 – Feb 25 & 27
Genome assemblies in the vertebrate tree of life
Living in water
Jawless fishes
Lamprey and hagfish genomes
Cartilaginous fishes
The Elephant Shark assembly
Bony fishes
Teleost assemblies and genomic diversity
The coelacanth assembly and lungfish genomes

DISCUSSIONS
Jaillon et al et al Nature 2004
Kasahara et al et al Nature 2007
Amemiya et al Nature 2013

Feb 27: EXAM 1 (300 POINTS) COVERING MATERIAL WEEKS 1-7

Week 8 – Mar 4 & 6  SPRING BREAK NO CLASS

Week 9 – Mar 11 & 13
Mar 11: Paul Anderson (CofC Comp Sci) Guest Lect on Computational Approaches II
Mar 13: Gavin Naylor (HML-MUSC) Guest Lect on Genome Bioinformatics
Week 10 & 11 – March 18, 20, 25, 27
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
DISCUSSIONS
   Hellsten et al *Science* 2010
   Voss et al *Genome Research* 2011
   Alfoldi et al *Nature* 2011
   Shaffer et al *Genome Biology* 2013

Week 12 – April 1 & 3
Endothermy and taking flight
   Dinosaur genomes
   The chicken and turkey assemblies
April 3: Chris Balakrishnan (East Carolina U) Guest Lec on The zebrafinch assembly and the neuro-genomics of song learning
DISCUSSIONS
   Hillier et al *Nature* 2004
   Warren et al *Nature* 2010

Week 13 – April 8 & 10
Mammalian adaptation and diversification
   The platypus assembly
   The opossum assembly
   The diversity of Eutherian assemblies
DISCUSSIONS
   Lindblad-Toh et al *Nature* 2010

April 15: ANNOTATED BIBLIOGRAPHY ASSIGNEMENT DUE

Week 14 – April 15 & 17
April 15: Chris Botka (Harvard Med School) Guest Lecture on Medical Genomics and Research Computing for Big Data
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?

DISCUSSIONS
   Lander et al Nature 2001

Week 15 – April 22

EXAM 2 (300 POINTS) COVERING MATERIAL AFTER SPRING BREAK

LABORATORY:

Weeks 1-3
Module 1: Individual Project Formation
   Identify testable hypotheses
   Develop rationale and justification for proposed research
   Select taxonomic scope
   Design genomic sampling

DEMOS: NCBI Toolbox; UCSC Browser; Hapmap; NHGRI; Pubmed; OMIM

Weeks 4-8
Module 2: Project Implementation
   Compile data from online or proprietary resources
   Select and test relevant computational tools
   Construct primary data set
   Analyze primary data set

DEMOS: Galaxy Pipeline; RepeatMasker & Modeler; RMpipe; DAVID; Kegg Pathways

Weeks 9-11
Module 3: Project Synthesis
   Prioritization of pilot results
   Interpretation of statistical significance and trends
   Graphical summary of most relevant comparisons
   Interpretation and discussion of evidence
   Synthesis of arguments for proposed funding

   Submit proposal outline and justification (Due March 11th; 200 points)

DEMOS: C2G2 tutorials; R Studio; Lasergene tutorials.
Weeks 12-14
Module 4: Written and Oral Communication
   Selection of final bibliographic resources
   Written construction of graded pilot proposal
   Preparation of oral presentation of research
Oral presentation at student-run symposium (Tuesday April 17; 300 points)
Submit full written proposal (Due by 5 p.m. Wednesday May 1st; 400 points)