

SENIOR SEMINAR: MITOCHONDRIAL GENOMICS

BIOL 4930 001- 004 – Spring 2023

Class meeting times

Lecture: Wednesday 10:10 am - 12:00 pm, Poole E257

[this course is also taught face-to-face to Clemson students and online (via Zoom) only to IVE (international virtual exchange) students]

Instructor Information

Instructor: Dr. J. Antonio Baeza

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Web page: http://www.clemson.edu/cafls/departments/biosci/faculty_staff/baeza_a.html

Office hours: TH 9:30 - 10:30 AM, 226 Long Hall (only with previous appointment)

Planned modality of the course: Traditional (for Clemson students) + Blended/Hybrid (for IVE students)

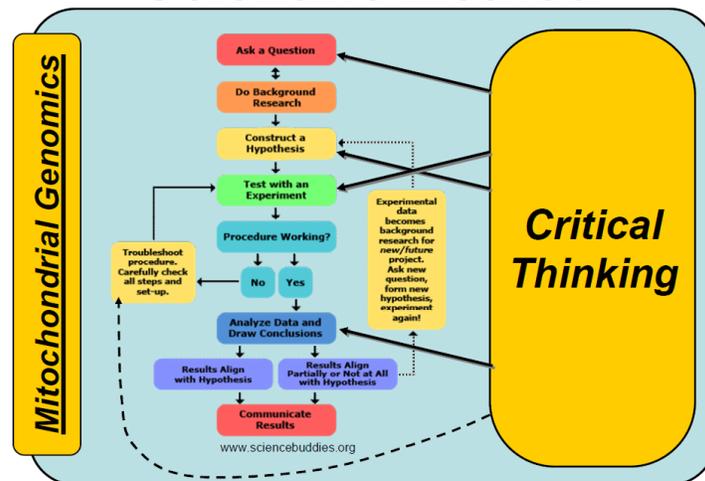
This course will be traditional (for Clemson students) + blended/hybrid (for IVE students). We will meet face-to-face and via Zoom (with IVE and VE students) on the day/time designated for the class meeting. Using a variety of multimedia elements, I have designed an engaging and high-quality environment. This course contain a blend of synchronous online and face-to-face instruction. Hybrid courses use a variety of multimedia elements, as well as live, face-to-face opportunities. Blending these offerings will provide an engaging and supportive environment for you to the learn the material. Be assured that no matter what medium is used, I have taken a deliberate approach to ensure you a high-quality experience.

Mask/Face Covering Policy

Science supports that the wearing of masks reduces SARS-COVID-2 transmission- out of respect for your classmates and the instructor/guests and their families- I would appreciate everyone wearing a face covering while in class. Note that Mask's or face coverings are not required.

Course description in Short: in this course, we will learn about mitochondrial genomes. Mitochondria are organelles of utmost importance in 99.999% of uni-cellular and multi-cellular organisms. Perhaps more importantly, I will expose you to the scientific method and you will learn to think critically. We will be using various mitochondrial genomes as examples to improve your critical thinking skills. You will also improve your information literacy skills.

Scientific Method



Course Description - Topical Outline

Mitochondria are the energy-transducing organelles of eukaryotic cells in which fuels to drive cellular metabolism are converted into ATP through the process of oxidative phosphorylation. Mitochondria have a double membrane. The outer membrane separates the mitochondrion from the cytosol while the inner membrane is invaginated to form cristae which protrude into and define the matrix of the organelle. The enzyme complexes of the oxidative phosphorylation system are embedded in the mitochondrial inner membrane. In addition to their central role in ATP synthesis mitochondria accommodate central metabolic pathways, like the Krebs cycle and the β -oxidation of fatty acids. They provide cells with a large number of metabolites, such as amino acids and steroids, and are involved in the formation of heme and iron-sulfur clusters.

The question of the origin and subsequent evolution of the mitochondrion has long captivated and challenged biologists. So far, we know that the mitochondrion originated only once, that is, mitochondria in all eukaryotic lineages descend from a common ancestor, the LMCA (last mitochondrial common ancestor). From comparative mitochondrial genomics — through the analysis of genes contained in mtDNA and the protein sequences they specify — we also know that the mitochondrial genome is of (eu)bacterial origin. These sequences point us to members of a particular bacterial phylum, α -proteobacteria (also termed Alphaproteobacteria), as the closest extant free-living relatives of mitochondria, and therefore the bacterial group from within which the mitochondrial genome emerged.

Mitochondria contain their own genome, the mitochondrial DNA (mtDNA), which is located in the mitochondrial matrix. 'Mitochondrial Genomics' is an introductory course to the structure, function, and evolution of animal mitochondrial genomes.

This course has three general topics: (1) *structure*. What is the length and main structural characteristics of animal mitochondria?, How many genes and other elements the mitochondrion genomes code for? What genes are there? (2) *Function*. What is the identity and function of all genes encoded by the mitogenome? (3) *Evolution*, including the exploration of selective pressures in protein coding genes present in animal mitochondrial genomes. In this course, we will explore the structure, function, and evolution of the mitochondrial genome using a set of 'friendly' bioinformatics tools.

This course will also provide opportunities to participants to improve their critical thinking abilities and information (including digital) literacy.

Important:

All students will be completing the GenBio-MAPS (General Biology–Measuring Achievement and Progression in Science) assessment test late during the semester and an Exit Interview Survey.

During **Aug 31 (Wed)**, you will be asked to take an assessment. This assessment is part of normal course requirements and will provide feedback on how well you understand fundamental biology concepts. The survey will contain 15 questions, and the answers will not be graded, but you will receive bonus points (20 points) for completing the assessment. This assessment will take roughly 20-40 minutes to complete.

Clemson Thinks²

This course is part of the Clemson Thinks² (CT²) critical thinking experiment, a program aimed at improving student critical thinking skills. Simple memorization of facts and repetition of definitions is not a sufficient skill set to address the complex problems our world faces today! **As a Clemson undergraduate, we expect you to develop the ability to think critically and to evaluate how knowledge is constructed and the assumptions underlying such knowledge.**

Critical thinking is reasoned and reflective judgment applied to solving problems or making decisions about what to believe or what to do. Critical thinking gives reasoned consideration to defining and analyzing problems, identifying and evaluating options, inferring likely outcomes and probable consequences, and explaining the reasons, evidence, methods and standards used in making those analyses, inferences and evaluations. Critical thinking is "*skeptical without being cynical, evaluative without being judgmental, and purposefully focused on following reasons and evidence wherever they may lead*". Please, visit <https://www.insightassessment.com/FAQ/FAQs-General-Critical-Thinking/What-is-Critical-Thinking> for additional information. Also, you can find more information on the CT² program at <http://www.clemson.edu/assessment/thinks2/>.

Student Learning Outcomes

- Understand and analyze the structure of animal mitochondrial genomes
- Understand structural and functional annotation of mitochondrial features
- Visualization of protein coding genes, tRNAs, and rDNA.
- Explore and learn online genomic tools
- Understand and estimate selective pressures in protein coding genes
- Infer systematic relationships using protein coding genes present in mt genomes.
- Interpret quantitative relationships in manuscript graphs and tables.
- Explain the limitations of correlational data published in scientific papers.
- Analyze data to identify and summarize problems as part of the scientific method.
- Integrate information/data to solve a problem as part of the scientific method.
- Develop and justify one or more than one hypotheses.
- Identify the limitations of one or more than one hypotheses.

BIOSC 4910 001-004 Senior Seminar | MitoGenomics Syllabus Spring 2023

- Identify alternative interpretations of the data or observations.
- Evaluate competing interpretations, explanations, evidence, and conclusions.
- Effectively communicate complex ideas.

Critical Thinking Assessment and In-Class Activities

First, you **might** be assessed by the CT² program through the application of a 'pre-course' test (California Critical Thinking Test) which will assess your initial critical thinking status and a second 'post-course' follow-up test to measure the difference. Dates for taking the pre- or post-course tests will be announced by the instructor during the semester.

Then, throughout the semester, there will be announced home-work as well as in-class activities, artifacts, and reports (see below) during the lecture period worth 1000 points towards your final grade (see below). At least one of these in-class activities include the discussion of a scientific paper. The different activities will be focusing on specific attributes of mitochondrial genomes. **During the activities, you will be exposed to the scientific method and critical thinking.** I will lead the discussion so that you can: i. identify, develop, and/or justify one or more than one hypothesis covered in the activities, ii.. identify the limitations of one or more than one hypothesis proposed in the activities, iii. understand experimental design and its different components to test one or more than one hypothesis, iv. evaluate competing interpretations, explanations, evidence, and conclusions related to the in-silico experiment described in the different activities, and v. identify alternative interpretations of the data or experimental observations. The activity will also allow you to vi. integrate information/data to understand and solve a problem, and vi. effectively communicate complex ideas. Those students absent for the *ICPA* will receive zero points. **You need to participate and respect deadlines to perform well in the course.**

Course prerequisites: At minimum, students are expected to have a basic knowledge of how to use a computer, web browser, and a word processing program to be successful in this online class. Students must be comfortable with their computer system and willing to deal with any problems that may arise. Lack of technical knowledge can greatly interfere with your learning. If you do not have these skills, consider taking a short computer course prior to enrolling in any online course.

Skills you are expected to know:

- Get your password and login into the class Canvas site
- Attach files to email messages or upload them to Canvas
- Compose written documents in a word processor such as Microsoft Word or Pages
- Word processing tasks (type, cut, paste, copy, name, save, rename, etc.)
- Use a web browser
- Download information from the Internet
- Respond to online discussion forms
- Backup your files
- Use a webcam and/or cell phone to take videos and pictures

BIOSC 4910 001-004 Senior Seminar | MitoGenomics Syllabus Spring 2023

Participants are expected to be comfortable logging into the online course site and accessing/downloading files such as Microsoft Office documents, YouTube videos, and PDFs. In addition, participants should be able to use Microsoft Office (or an equivalent program suite) to compose written documents, spreadsheets, and PowerPoint presentations. For technical assistance with the online course site, participants should contact CCIT's email (ithelp@clermson.edu) or visit CCIT's website: (http://www.clemson.edu/ccit/help_support/).

Required Knowledge: be a Biology Major. Students are expected to have access to a computer with an internet connection and have some means by which they can stream and record themselves (video and audio). If your laptop or cellphone lacks these capabilities, make sure you purchase an appropriate device. Course material will be posted directly to our Canvas page unless otherwise communicated by the instructor.

If the instructor is more than 15 minutes late for lecture without notice, students may leave without penalty.

Should I need to miss class due to illness or travel there will either be a substitute or an e-Learning activity. This would be communicated to you via Canvas.

Lecture Text: NON Required

Lecture Grading

Final Lecture Grade: total n^o of points earned out of a maximum of 1000 points.
Scale: 900-1000 = A, 800-899.9 = B, 700-799.9 = C, 600-699.9 = D, <600 = Failed

Important Note: Grades will not be rounded up. Thus, the above are hard cutoffs.

Important Note: You need to bring a white paper to every lecture or be ready to submit a short report online at any point in time during the semester (*word file*)

Lecture grades will be based on a total of 13 home-works, reports, and artifacts + class participation activities.

The breakdown of points is described below. You will be expected to understand all material presented in lecture, recommended manuscripts, bioinformatics tools, assigned outside readings, and develop artifacts.

Important: It is mandatory that complete all reports, activities and artifacts if you want to pass the course.

BIOSC 4910 001-004 Senior Seminar | MitoGenomics Syllabus Spring 2023

Grading specifics:

[please, check deadlines below]

R: Literature Review Preliminary: 25
R: Literature Review Final: 50
R: Preliminary Annotation I: 50
R: Preliminary Annotation II: 50
R: Final Annotation: 100
A: Circular Depiction: 75
R: Codon & Nucleotide Usage: 25
A: tRNA exploration & depiction: 100
R: D-loop/CR exploration: 25
R: PCG selection analysis I: 100
A: Video I: 100
R & A: PCG selective pressure analysis II: 100
A: Video 2: 200

[Class participation: 50 pts]

[Evaluation: 50 extra points]

Total points for lecture **1000 pts**

R = report, A = artifact (figures or videos)

Activities: Lecture Reports + Artifacts (including videos)

Throughout the semester, there will be in-class activities worth 1000 points towards your final grade. These activities may include discussing a paper, providing a written report about a specific analysis, designing a figure focusing on a specific mitochondrial feature, and developing videos explaining your results. Those students failing to provide reports or artifacts during the deadline date will receive zero points.

There will be no opportunity to make up missed reports or artifacts. In the case that a student misses a deadline and has a University- and instructor- approved excuse **in advance**, the student will be excused from that specific activity and scores will be prorated.

Important: Honor students will develop extra activities during the semester. These activities will be discussed with the instructor at the beginning of the semester. Activities include the production of two artifacts: one video and one poster.

BIOSC 4910 001-004 Senior Seminar | MitoGenomics Syllabus Spring 2023

LECTURE SCHEDULE

IMPORTANT NOTICE: *topics and order are subject to minor / moderate change*

Date	Topics	REPORT / ARTIFACT
Week1	Introduction	Selecting mitochondrial genomes
Week2 (Wed)	Literature Review & Genome Annotation	GenBio-MAPS
Week3 (Wed)	Literature Review & Genome Annotation	R: Literature Review Preliminary
Week4 (Wed)	Mitogenome Annotation & Curation	R: Literature Review Final
Week5 (Wed)	Mitogenome Annotation & Curation	R: Preliminary Annotation I
Week6 (Wed)	Mitogenome Annotation & Curation	R: Preliminary Annotation II
Week7 (Wed)	Mitogenome Circular Depiction	R: Final Annotation
Week8 (Wed)	Mitogenome Circular Depiction	
Week9 (Wed)	Codon & Nucleotide Usage	A: Circular Depiction
Week10(Wed)	tRNA exploration & depiction	R: Codon & Nucleotide Usage
Week11(Wed)	D-loop/CR exploration & depiction	A: tRNA exploration & depiction
Week12(Wed)	Instructions: Video in Express or Rush	R: D-loop/CR exploration
Week13(Wed)	PCG selective pressure analysis	Exit Interview Survey
Week14		
Week15(Wed)	PCG selective pressure analysis + VIDEO	R: PCG selection analysis I A: Video I
Week16(Wed)	Video script & tools	R & A: PCG selective pressure analysis II VIDEOS
Finals Week		

Instructor Statement on Attendance Policy

Attendance: You must participate during the first week of class. If you have not participated or you accumulate excessive absences (more than one absence constitutes excessive absences), you may be dropped from the course.

You should speak with me as soon as possible regarding any absence and develop a plan for any make-up work. It is your responsibility to let me know if you need to make any changes due to the pandemic. In the event of an emergency, you should make direct contact with me, preferably before a class or an exam takes place. You may find it helpful to use the Notification of Absence module in Canvas. If you have difficulty or are unable to electronically report the absence, you may call the Office of Advocacy and Success at 864-656-0935 for assistance and guidance.

BIOSC 4910 001-004 Senior Seminar | MitoGenomics Syllabus Spring 2023

Clemson University undergraduate student attendance policies are available in the undergraduate catalog. This includes sections on attendance policy, enrollment, anticipated absences, unanticipated absences, excused absences, appeals, and auditing. Some of the most pertinent information is copied below.

Important: Any exam that was scheduled at the time of a class cancellation due to inclement weather, University power outage, etc., will be given at the next class meeting unless contacted by the instructor. Any assignments due at the time of a class cancellation due to inclement weather will be due at the next class meeting unless the instructor contacts students. Any extension or postponement of assignments or exams must be granted by the instructor via email or Canvas within 24 hours of the weather-related cancellation.

You must participate during the first week of class. If you have not participated or you accumulate excessive absences (1 or more classes), you may be dropped from the course.

You should speak with me as soon as possible regarding any absence and develop a plan for any make-up work. It is your responsibility to let me know if you need to make any changes due to the pandemic. In the event of an emergency, you should make direct contact with me, preferably before a class or an exam takes place. You may find it helpful to use the Notification of Absence module in Canvas. If you have difficulty or are unable to electronically report the absence, you may call the Office of Advocacy and Success at 864-656-0935 for assistance and guidance.

UPDATED: 08 15 2022

If the instructor is more than 15 minutes late for lecture without notice, students may leave without penalty.

Should I need to miss class due to illness or travel there will either be a substitute or an e-Learning activity. This would be communicated to you via Canvas.

Inclement Weather

Any exam that was scheduled at the time of a class cancellation due to inclement weather, University power outage, etc. will be given at the next class meeting unless contacted by the instructor. Any assignments due at the time of a class cancellation due to inclement weather will be due at the next class meeting unless the instructor contacts students. Any extension or postponement of assignments or exams must be granted by the instructor via email or Canvas within 24 hours of the weather-related cancellation.

Academic Continuity

Clemson has developed an Academic Continuity Plan for academic operations. Should university administration officially determine that the physical classroom facility is not available to conduct classes, class will be conducted in a virtual (online) form. The university issues official disruption notifications through email, website, text notification and Social Media. When notified, use one of the following links to navigate to Clemson Canvas where you will find important information about how we will conduct class:

- o Primary access link: <http://www.clemson.edu/canvas>
- o Secondary access link, if needed: <https://clemson.instructure.com/>
- o You can also use the Canvas Student App. Visit the downloads page for this app.

Course activities will occur through the Canvas course and GoogleDrive.

Expectations

Expectations (in terms of your performance) are high for this course!!!

UNIVERSITY POLICIES

Accessibility Services:

Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to this class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848, by emailing studentaccess@lists.clemson.edu, or by visiting Suite 239 in the Academic Success Center building. Appointments are strongly encouraged – drop-ins will be seen if at all possible, but there could be a significant wait due to scheduled appointments. Students who have accommodations are strongly encouraged to request, obtain and send these to their instructors through the AIM portal as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester.

You can access further information at the Student Accessibility website. Other information is at the university's Accessibility Portal.

Non-Discrimination:

The Clemson University Title IX statement: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. This Title IX policy is located on the Campus Life website. Ms. Alesia Smith is the Clemson University Title IX Coordinator, and the Executive Director of Equity Compliance. Her office is located at 223 Brackett Hall, 864.656.0620. Remember, email is not a fully secured method of communication and should not be used to discuss Title IX issues.

Clemson University aspires to create a diverse community that welcomes people of different races, cultures, ages, genders, sexual orientation, religions, socioeconomic levels, political perspectives, abilities, opinions, values and experiences.

Academic Integrity:

As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a "high seminary of learning." Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.

BIOSC 4910 001-004 Senior Seminar | MitoGenomics Syllabus Spring 2023

All infractions of academic dishonesty by undergraduates must be reported to Undergraduate Studies for resolution through that office. In cases of plagiarism instructors may use the Plagiarism Resolution Form.

See the Undergraduate Academic Integrity Policy website for additional information and the current catalogue for the policy. For graduate students, see the current Graduate School Handbook for all policies.

Emergency Preparedness:

Emergency procedures have been posted in all buildings and on all elevators. Students should be reminded to review these procedures for their own safety. All students and employees should be familiar with guidelines from the Clemson University Police Department. Visit [here](#) for information about safety.

Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

1. Ensure you are signed up for emergency alerts
2. Download the Rave Guardian app to your phone
(<https://www.clemson.edu/cusafety/cupd/rave-guardian/>)
3. Learn what you can do to prepare yourself in the event of an active threat
(<http://www.clemson.edu/cusafety/EmergencyManagement/>)

Copyright Statement:

Materials in some of the courses are copyrighted. They are intended for use only by students registered and enrolled in a particular course and only for instructional activities associated with and for the duration of the course.

Student Resources:

The Department of Biological Sciences is committed to providing a supportive learning environment for all students. If you are facing tough times, please utilize these resources. You may also reach out to me directly.

- a. Financial Assistance: Clemson Student Financial Aid
(<http://www.clemson.edu/financial-aid/index.html>), and Anderson Interfaith Ministries
(<https://www.aimcharity.org/>)
- b. Food Insecurity: Clemson Paw Pantry (<http://facebook.com/CUpawpantry>)
- c. Textbook Assistance: Clemson Library FAQs
(<https://clemson.libanswers.com/faq/100017>) and Clemson Bookstore Open Education Resources copies (<https://clemson.bncollege.com/shop/clemson/page/find-oer>)
- d. General Resources:
(<https://www.clemson.edu/studentaffairs/advocacysuccess/resources/index.html>)
- e. Multicultural Resources and Support: Gantt Multicultural Center
(<https://www.clemson.edu/centers-institutes/gantt/multicultural-programs>)
- f. LGBTQ Support: Gantt Multicultural Center –LGBTQ Programs
(<https://www.clemson.edu/centers-institutes/gantt/lgbtq-programs/resources.html>)

BIOSC 4910 001-004 Senior Seminar | MitoGenomics Syllabus Spring 2023

- g. Adjustment and Transition: Counseling and Psychological Services (<https://www.clemson.edu/campus-life/student-health/caps>) and Student Transitions and Family Programs (<http://www.clemson.edu/studentaffairs/stfp/index.html>)
- h. Interpersonal Violence: Healthy Campus (<https://www.clemson.edu/campuslife/healthy-campus/interpersonal-violence/index.html>)
- i. Addiction and Recovery: SC: (<https://www.daodas.sc.gov/>), Web: (<https://addictionresource.com/>) and Vaping (<https://vapingdaily.com/health/>)