**“Fundamentals of Microbial Genomics”**

Course Numbers 11:115:423; 16:682:534; 16:215:604

**This syllabus changes each year to reflect novel ideas and research advances.**

**COURSE SCHEDULE**

Monday and Wednesday, 5th Period (3:55pm – 5:15pm);

In-person in Foran Hall Room 124

**CONTACT INFORMATION:**

Instructors: Prof. Debashish Bhattacharya (Lead) and Dr. Timothy G. Stephens, with guest lecturers Dr. Julia Van Etten and Erin Chille

Bhattacharya office Location: Foran Hall 102

Stephens office Location: Foran Hall 135

Phone: 848-932-6218; Email: dbhattac@rutgers.edu, ts942@sebs.rutgers.edu

Office Hours: Monday and Wednesday, for 45 min after class

**COURSE WEBSITE, RESOURCES AND MATERIALS:**

* <https://rutgers.instructure.com/courses/337948>

**COURSE DESCRIPTION:**

This course will be taught in-person. The lecture notes will be uploaded to the Canvas course website. The course material will focus on the foundations of modern genomics: from experimental design to data acquisition, analysis, and interpretation. The course will be of an introductory nature and is intended to provide both undergraduate and graduate students the tools and understanding to take part in the on-going genomics (and -omics) revolution. Areas to be covered include de novo genome sequencing and assembly, gene prediction and annotation, functional genomics (RNA-seq), metagenomics, single cell genomics, proteomics, and metabolomics. Applications of these tools in the environmental, medical, and evolutionary microbiology fields will be covered with each of these broad areas being looked at in detail through lectures, paper-readings, and discussions. Students in this semester-long theory course are expected to enter with basic training in biology and an interest in bioinformatics and evolution. There is no course textbook.

**LEARNING GOALS:**

Goal 1: Explain basic genomic, multi-omics, bioinformatic, and evolutionary genomic concepts.

Goal 2: Describe the evolutionary origins, processes, and patterns of cells over geologic time.

Goal 3: Develop a comprehensive understanding of basic analytic tools in the genomics field such as DNA sequencing technologies, BLAST, phylogeny inference, gene prediction, and data interpretation.

Goal 4: Demonstrate the ability to explain and defend genomics and multi-omics principles in class debates.

Goal 5: Communicate effectively orally in class, and through written text and graphics.

**ASSIGNMENTS/RESPONSIBILITIES & ASSESSMENT:**

Evaluation and Grading of Undergraduate Students: Attendance: 10 pts (presence/absence recorded each class), Midterm: 20 pts, Debates: 10 pts, Pre-proposal: 10 pts, Final exam: 20 pts, Presentation: 20 pts, Final project report: 10 pts.

Evaluation and Grading of Graduate Students: Midterm: 20 pts, Debates: 10 pts, Pre-proposal: 10 pts, Final exam: 20 pts, Presentation: 20 pts, Final project report: 10 pts, Extra research proposal: 10 pts.

**ACCOMODATIONS for Students with disabilities**

Please follow the procedures outlined at <https://ods.rutgers.edu/students/getting-registered>. Full policies and procedures are at <https://ods.rutgers.edu/>

**ABSENCE POLICY**

Students must attend all classes to get the 10 pts for attendance; if you miss any classes, use the University absence reporting website <https://sims.rutgers.edu/ssra/> to indicate the date and reason for your absence. An email is automatically sent to me. Otherwise, you will forfeit the point(s).

**COURSE SCHEDULE:**

1. Wednesday, January 22, 2025: Course Introduction and a brief overview of current omics techniques **[DB]**
2. Monday, January 27, 2025: DNA sequencing methods **[DB]**
3. Wednesday, January 29, 2025: Analysis of RNA-seq data **[Tim]**
4. Monday, February 3, 2025: Analysis of metabolomic and proteomic data **[Tim]**
5. Wednesday, February 5, 2025: Prokaryote genomics and evolution **[DB]**
6. Monday, February 10, 2025: Databases and hands-on sequence analysis **[DB]**
7. Wednesday, February 12, 2025: Virus genomics and evolution **[Tim]**
8. Monday, February 17, 2025: Metagenomics (biomes, amplicons, biotic interactions) **[DB]**
9. Wednesday, February 19, 2025: Functional genomics (theory + applications) **[Tim]**
10. Monday, February 24, 2025: Genome reduction **[DB]**
11. Wednesday, February 26, 2025: Phylogenetics and Network analysis **[Tim]**
12. Monday, March 3, 2025: Big picture of evolution **[DB]**
13. Wednesday, March 5, 2025: Endosymbiosis and the chimeric origin of cells and their genomes **[DB]**
14. Monday, March 10, 2025: Practice exam review for 20min, then in-class writing of the pre-proposal: *Pre-proposals submitted to* *dbhattac@rutgers.edu* *by end of class* **[DB + Tim]**
15. Wednesday, March 12, 2025: *Midterm (in-class) written exam* **[DB and Tim]**

**March 15-23: Spring Recess**

1. Monday, March 24, 2025: Horizontal gene transfer **[Julia]**
2. Wednesday, March 26, 2025: *K*-mers in genomics **[DB and Julia]**
3. Monday, March 31, 2025: *Debate 1 – What can genetics and genomics do for conservation biology?*
4. Wednesday, April 2, 2025: Building multi-omics tools for coral conservation **[Erin]**
5. Monday, April 7*, 2025: Debate 2 – TBA*
6. Wednesday, April 9, 2025: Presentations 1-4
7. Monday, April 14, 2025: Presentations 5-8
8. Wednesday, April 16, 2025: Presentations 9-12
9. Monday, April 21, 2025: In-class review of lectures and sample take-home exam
10. Wednesday, *April 23: Final (in-class) written exam* **[DB and Tim**
11. Monday, April 28, 2025: Presentations 13-16­
12. Wednesday, April 30, 2025: Presentations 17-20

**Monday, May 5, 2025: Classes end**

**Final ESSAY/REPORT Date and Time**

Essay (all students): Thursday, May 7, 2025, 5pm

Graduate student report: Monday, May 9, 2025, 5pm

**ACADEMIC INTEGRITY**

The university's policy on Academic Integrity is available at <http://academicintegrity.rutgers.edu/academic-integrity-policy>. The principles of academic integrity require that a student:

* properly acknowledge and cite all use of the ideas, results, or words of others.
* properly acknowledge all contributors to a given piece of work.
* make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of impermissible materials or impermissible collaboration.
* obtain all data or results by ethical means and report them accurately without suppressing any results inconsistent with his or her interpretation or conclusions.
* treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress.
* uphold the canons of the ethical or professional code of the profession for which he or she is preparing.

Adherence to these principles is necessary in order to ensure that

* everyone is given proper credit for his or her ideas, words, results, and other scholarly accomplishments.
* all student work is fairly evaluated and no student has an inappropriate advantage over others.
* the academic and ethical development of all students is fostered.
* the reputation of the University for integrity in its teaching, research, and scholarship is maintained and enhanced.

Failure to uphold these principles of academic integrity threatens both the reputation of the University and the value of the degrees awarded to its students. Every member of the University community therefore bears a responsibility for ensuring that the highest standards of academic integrity are upheld.

In this course, we will take cheating very seriously. All suspected cases of cheating and plagiarism will be automatically referred to the student conduct office (<http://academicintegrity.rutgers.edu>), and we will recommend penalties appropriate to the gravity of the infraction.

**STUDENT WELLNESS SERVICES**

Access helpful mental health information and resources for yourself or a friend in a mental health crisis on your smartphone or tablet and easily contact CAPS or RUPD (<http://health.rutgers.edu>).

Counseling, ADAP & Psychiatric Services (CAPS)

(848) 932-7884 / 17 Senior Street, New Brunswick, NJ 08901/ [www.rhscaps.rutgers.edu/](http://www.rhscaps.rutgers.edu/)

CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professional within Rutgers Health services to support students’ efforts to succeed at Rutgers University. CAPS offers a variety of services that include individual therapy, group therapy and workshops, crisis intervention, referral to specialists in the community and consultation and collaboration with campus partners.

Violence Prevention & Victim Assistance (VPVA)

(848) 932-1181 / 3 Bartlett Street, New Brunswick, NJ 08901 / [www.vpva.rutgers.edu/](http://www.vpva.rutgers.edu/)

The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff and faculty. To reach staff during office hours when the university is open or to reach an advocate after hours, call 848-932-1181.

Disability Services

(848) 445-6800 / Lucy Stone Hall, Suite A145, Livingston Campus, 54 Joyce Kilmer Avenue, Piscataway, NJ 08854 / <https://ods.rutgers.edu/>

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: <https://ods.rutgers.edu/students/documentation-guidelines>. If the documentation supports your request for reasonable accommodations, your campus’s disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: <https://ods.rutgers.edu/students/registration-form>.