11:126:383: Nucleotide Sequence Analysis

Section 01: Tuesday – 10:20 am - 3:10 pm
Section 02: Thursday – 10:20 am - 3:10 pm

Instructor: Dr. Sonia Arora
sonia.arora@rutgers.edu
Office Hours: By Appointment

Teaching Assistant: Nicholas Jansma
nicholas.jansma@rutgers.edu
Office Hours: By Appointment

Location: Foran Hall Rm. 124. In case of university announced or weather-related closures, Zoom classes may be announced ahead of time: these will be synchronous, meaning the class will meet in real-time online.

Class Structure: This class consists of three components each week (except when noted on tentative schedule).

1. Lecture: Short background/review of tools and techniques covered in the dry lab exercises.

2. Demonstrations: Every week we learn a new tool. Your TA will demonstrate how to navigate this tool and database.

3. Dry Laboratory Exercises: Demonstrations will be followed by hands-on dry laboratory exercises. You may work in small groups. You are expected to stay and finish all the lab activities during the class and upload them on CANVAS before leaving. Late submissions will be penalized.

Course Policies:

Attendance: Attendance is a crucial component of this course as it is a hands-on lab-based course and is therefore MANDATORY.

Absence must be notified ahead of time when possible or as soon as possible. All absences must accompany a valid reason and documentation e.g. doctor's note, conference letter, interview invitation letter, etc. In the event of absence, it is the student's responsibility to learn the tool taught and submit the assignment by the deadline.

There will be NO MAKE UP exams or quizzes without documentation should you be absent on the day of exam.

If you have unexcused and/or un-notified absence, your work for that week will not be accepted. In addition, more than one unexcused absence 5 points will be deducted from your overall grade for every unexcused absence.

Tardiness: Students should arrive in the classroom on time. If too many students arrive late it is disruptive to rest of the class. Tardiness will be monitored and penalized. You will be marked tardy if I have already started the lecture (usually within five minutes of class start time). More than one tardy, 5 points will be deducted from your overall grade for every tardiness.

Late Work: Deadlines are firm. Late work will be penalized by deduction of 5 points from that week's score and no work will be accepted after two weeks.

Cell Phones and Social Media: The use of cell phones, mp3 players, social media etc. in the classroom is not acceptable. Please make sure your cell phones are turned off or silent during the class.

You are expected to stay for the entire length of the class time- you will be doing a hands-on dry laboratory exercise each week and you can leave only at the end of the lab period or when you have finished and uploaded the lab.

Any misconduct will be dealt as per Rutgers University's code of student conduct found at http://judicialaffairs.rutgers.edu/university-code-of-student-conduct. Students are expected to abide by all Rutgers University regulations with regards to academic misconduct.

Course Description and Learning Objectives:

This is a mixture of lecture & dry laboratory-based course. It is aimed at examining the basic tools that form the foundation of bioinformatics. The course introduces students to DNA, RNA & amino acid sequence analysis using publicly available and web-based tools such as Blast, Clustal, etc. The course also covers biological databases and the identification of genes & proteins in these databases. The students obtain mastery of analyzing information on NCBI, Genbank, and OMIM databases. In addition, the course familiarizes students with techniques of genetic manipulation, recombinant DNA technology & restriction mapping. The students learn how to use programs like NEBcutter, Net Primer, and Primer 3Plus. The course also covers the analysis of primary data obtained from DNA sequencers, finding open reading frames, translating nucleotide sequences into amino acid sequences, and determining protein and DNA characteristics using several programs.

Upon completion of the course, students should be able to

1. Critically analyze nucleotide and amino acid sequences; and find homologous sequences.
2. Examine and extract gene, protein & disease information available at various biological databases.
3. Utilize computational methods to design genetic manipulation experiments in wet laboratory.
4. Understand & analyze primary sequence data obtained from DNA sequencing projects.
5. Employ current fundamental bioinformatics (computational) methods to access information regarding a gene or protein, conduct research, and communicate findings.

Course Textbook: The following are **recommended** books for the course; additional material will be provided in the class:

1. Understanding Bioinformatics. Marketa Zvelebil and Jeremy O. Baum (Authors); Garland Science; 1st edition (2008) ISBN: 0815340249.

2. Bioinformatics and Functional Genomics, Jonathan Pevsner (Author), Wiley-Blackwell; 3rd edition (2015) ISBN: 978-1-118-58178-0

3. Practical Bioinformatics, Michael Agostino (Author); Garland Science; 1st edition (2012). ISBN: 0815344562

Course Site:

Each section has its respective course canvas site. All the relevant materials including weekly lectures, labs, quizzes, projects, etc. will be posted on it. All submissions and grading are done online as well. It is your responsibility to make sure that you are enrolled in my CANVAS class and to check it regularly for updates. Any emergency announcements regarding class including but not limited to any class cancelation will also be posted via CANVAS.

Assessment: You will be evaluated as follows:

(A) Weekly Lab Assignments (**25% of grade**): Each week you will be assigned Computational Lab Exercises. The dry labs are in-class assignments: you can work in small groups. You are expected to complete these exercises during class time and upload the finished assignments on the CANVAS site.

Late submissions will be penalized by a deduction of 5 points/per week delay from the total score. No submission will be accepted after two weeks.

(B) Bi-weekly Quizzes - (**25% of grade**): There will be bi-weekly take-home quizzes. Each quiz will be online, open book but **TIMED** - meaning you can do the quiz anytime during that week (before the start of the next class) but once you start the quiz you will have a certain assigned time to complete it. So, my advice is to read up before starting the quiz and be familiar with the topic- if you depend on opening the slides and attempting it synchronously- it may not work.

The content of the quiz will be based on the topics covered in weeks before that week: see schedule for more information. There will be no make-up quiz.

(C) Unit Practical Examinations (**25% of grade**)

There will be two closed book, closed notes, in-class practical examinations - see schedule for dates. The exams will involve mini dry lab exercises like the ones done during the classes. There will be no make-up exam except under extreme emergency with prior notice and adequate documentation of a valid emergency. The format of the make-up exam may be different from the original exam.

(C) Comprehensive Final Case Study Practicum- (**25% of grade**)

You will be assigned a case study to investigate a gene/protein. You will use dry lab techniques taught in the class to collect literature information, run simulations, and collect and analyze the data. You will answer the questions that follow your case. This is an in-class, closed-book final assessment. Peer work will not be allowed and TA help will be limited.

Academic Integrity: Students are responsible for reading and complying with Rutgers University's academic integrity policy. To view Rutgers University's Academic Integrity Policy, please use the following link http://academicintegrity.rutgers.edu/academic-integrity-policy. The academic integrity/honesty policies hold good for all in-class work, exams, and take-home assignments. Plagiarism, cheating, or other violations of Rutgers University's Academic Integrity Policy will be subject to appropriate penalty based on the infarction.

Accommodations for Students with Disabilities: For all accommodations, please follow the procedures outlined at https://ods.rutgers.edu/students/registration-form. Full policies and procedures are at https://ods.rutgers.edu/.

Tentative Class Schedule
(Section 1 – Tuesday | Section 2 - Thursday)

Week	Date	Topic	Lab/Assignment
I	Section 1: 1/16 Section 2: 1/18	Introduction Structure of DNA (Self Review)	Assignment 1: Watch the movie: Secret of Photo 51 & write the critique.
II	Section 1: 1/23 Section 2: 1/25	Biological & Genomic Databases	Assignment 2: Tour of NCBI Quiz 1-based on weeks I & II
III	Section 1: 1/30 Section 2: 2/1	Protein Sequence & Structure Databases	Assignment 3: PDB, Uni-Prot Database
IV	Section 1: 2/6 Section 2: 2/8	Sequence Alignment I	Assignment 4: BLAST Quiz 2-based on weeks III & IV
V	Section 1: 2/13 Section 2: 2/15	Sequence Alignment II	Assignment 5: Clustal Omega, BioEDIT
VI	Section 1: 2/20 Section 2: 2/22	**PRACTICUM I (Weeks I to IV material)**	
VII	Section 1: 2/27 Section 2: 2/29	Gene Structure	Assignment 6: NCBI ORF-Finder, Genscan Quiz 3- Based on Week VII
VIII	Section 1: 3/5 Section 2: 3/7	Molecular Cloning	Assignment 7: DNA technology virtual lab @ HHMI; NEB Cutter
IX	Section 1: 3/12 Section 2: 3/14	**NO CLASSES- SPRING BREAK**	
X	Section 1: 3/19 Section 2: 3/21	PCR and Primer Design	Assignment 8: NET Primer and Primer Blast Quiz 4- Based on Weeks VIII- IX
XI	Section 1: 3/26 Section 2: 3/28	Specialized Tools: CLC Main Workbench and SMS2	
XII	Section 1: 4/2 Section 2: 4/4	**PRACTICUM II (Based on Weeks V, VII, VIII, IX)**	
XIII	Section 1: 4/9 Section 2: 4/11	Case Studies	
XIV	Section 1: 4/16 Section 2: 4/18	FINAL Comprehensive Practicum	
XV	Section 1: 4/23 Section 2: 4/25	Review/Catch Up	