Advanced Technologies in Biosciences

Course Number: 11:126:444
Credits: 3
Time: Mondays and Thursdays 9:15-10:35 Room 138A

Prerequisites:
General Biochemistry (11:115:403) or Molecular Biology and Biochemistry (01:694:407)
Molecular Genetics (11:126:481)

Instructors:
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Course Materials:
Primary reading material will be scientific journal articles or other scientific literature.

Catalog Description:
This course will provide an overview of technologies in molecular biosciences. It will consist of a lecture and demonstration format and cover the basic principles of each technology and their applications. The technologies covered include quantitative reverse transcription polymerase chain reaction (qRT-PCR), laser scanning confocal microscopy, genotyping, surface plasmon resonance label-free detection (Biacore), mass spectroscopy, TIM system and applications, flow cytometry and cell sorting (FACS), drug discovery and next generation sequencing.

Course Description:
This course will provide an overview of technologies in molecular biosciences. It will cover the basic principles of these technologies and discuss various applications to biotechnology. The course is designed for students with some understanding of molecular biology who wish to be familiar with the latest technologies. The course will consist of a lecture and demonstration format with two 80 minute lecture periods per week. The course is separated into six modules covering quantitative reverse transcription polymerase chain reaction (qRT-PCR), laser scanning confocal microscopy, genotyping, surface plasmon resonance label-free detection (Biacore), mass spectroscopy, TIM system and applications, flow cytometry and fluorescence-activated cell sorting (FACS), drug discovery and next generation sequencing. Each module provides general introduction and explanation of the technical theory behind the technique. Unique features and limitations of each modality along with advantages and disadvantages of each are explored. The lecture periods include demonstration of each instrument, detailed description of how the analysis is done, what the results look like and how they are interpreted. Application of these techniques to relevant research is highlighted using current primary literature that will be used for class presentation and discussion.

Syllabus:

Month	Date	Module	Topics	Instructor
January	21		General Introduction	Tumer
	25	qRT-PCR	Introduction, key terms, detection chemistries, absolute quantitation	Pierce
	28	qRT-PCR	Comparative quantitation by ΔΔCt, Primer design, RT reactions, controls and sample prep methods	Pierce
February	1	qRT-PCR	Presentations (Groups 1 and 2)	Pierce
	4	Flow cytometry	Introduction; principles, parameters and probes; measuring intrinsic versus extrinsic properties of cells	Bidle
	8	Flow cytometry	Application of functional probes and flow sorting; coupling with downstream molecular analyses	Bidle
	11	Flow cytometry	Presentations (Groups 3 and 4)	Bidle
	15	Quiz1		
	18	Genotyping	History and applications of molecular markers and genotyping	Honig
	22	Genotyping	Genotyping by Capillary Electrophoresis and Genotyping by Sequencing technologies	Honig
	25	Genotyping	Presentations (Groups 5 and 6)	Honig
	29	Biacore	Surface plasmon resonance technology and overview describing what Biacore instruments can measure	Li
March	3	Biacore	Surface preparation, regeneration and interaction measurement and instrument demonstration.	Li
	7	Biacore	Presentations (Groups 7 and 8) on academic and industrial applications of Biacore technology	Li
	10	Drug Discovery		Kimball
	14	Break		

	17	Break		
	21	Mass Spec.	Introduction to Proteomics and mass spectrometry	Lobel
	24	Mass Spec.	Protein identification and quantification	Lobel
	28	Mass Spec.	Presentations (Groups 9 and 10)	Lobel
	31	Quiz 2		
April	4	**T**NO **I**ntestinal **M**odel (TIM)	Introduction, Applications of TIM in Pharmacy Food and Safety	Ribnicky
	7	**T**NO **I**ntestinal **M**odel (TIM)	Presentations (Groups 11 and 12)	Ribnicky
	11	Confocal	Introduction, fluorescence, confocal imaging and resolution, optical sectioning/Z-stack, linear un-mixing	Pierce
	14	Confocal	Hands on Demonstration on Zeiss LSM 710; Groups of 10 each (Rm 206)	Pierce
	18	Confocal	Presentations (Groups 13 and 14)	Pierce
	21	Next Gen. Seq.	Evolution, description, and capacities of the main platforms used to generate NGS data; e.g., Illumina, Ion Torrent, PacBio.	Bhattacharya
	25	Next Gen. Seq.	Use of NGS data for genome assembly, gene prediction, functional genomics, metagenomics, and single cell genomics.	Bhattacharya
	28	Next Gen. Seq.	Presentations (Groups 15 and 16) on applications of NGS.	Bhattacharya
May	2	Quiz 3		

Learning Goals and Measures of Assessment:

1. After completing the course students will have a clear understanding of the underlying principles of each technology.

   Assessment: Student performance on quizzes and evaluation of performance in the classroom

2. After completing the course students will understand the unique role each technique has in basic and applied research and understand the limits of each.

   Assessment: Student performance on quizzes and performance on the group independent project and presentation

3. After completing the course students will have used current literature examples to understand how each technology is applied to address a biological question, why the particular technology is chosen and how the results are interpreted.

   Assessment: Student performance on the group independent project and group presentation

4. After completing the course students will understand the importance of attending events to which they have made a commitment.

   Assessment: Class attendance

Specific Measures of Assessment:

1. Three quizzes on lecture material and material covered in the group presentations. The two quizzes with the highest grades will be used for the final grade determination. The quizzes will consist of 60% of the grade.

2. One group presentation. Students will read an assigned paper covering the particular technology discussed in the lecture and present it in class. Group presentations will be made in groups of 2-3 students each and will focus on a current research paper assigned by the instructor covering that technology in class. The presentation will consist of 20% of the grade. The presentation will cover:

   a) Hypothesis, the objective of the research
   b) Why the particular technology is chosen to address this hypothesis
   c) How the particular technology addresses the hypothesis
   d) What are the results obtained with the particular technology
   e) How are these results interpreted

3. Class attendance and participation will consist of 20% of the grade.

ACCOMODATIONS FOR STUDENTS WITH DISABILITIES

Please follow the procedures outlined at https://ods.rutgers.edu/students/registration-form. Full policies and procedures are at https://ods.rutgers.edu/

ABSENCE POLICY

Students are expected to attend all classes; if you expect to miss one or two classes, please 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.

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.

STUDENT WELLNESS SERVICES

Just In Case Web App http://codu.co/cee05e

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.

Counseling, ADAP & Psychiatric Services (CAPS)

(848) 932-7884 / 17 Senior Street, New Brunswick, NJ 08901/ 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/

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.

Scarlet Listeners

(732) 247-5555 / http://www.scarletlisteners.com/

Free and confidential peer counseling and referral hotline, providing a comforting and supportive safe space.