LIFS4884: Application of RNA Technology to Human Diseases

Fall Semester, 2024
Class time: 6:00–7:20 pm, Mon and Wed for lectures; 1:00–5:50 pm Fri for lab experiments
Venue: For lectures: Rm 5560, Lift 27-28, for lab experiments: Rm 4160, Lift 33

Instructor:
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Course overview

The philosophy of the course is to transition students from a purely academic mindset to a professional one, fostering skills and competencies that will be directly applicable in the workplace after graduation. This course adopts a project-based approach, designed to equip students with hands-on experience in RNA-related experimental techniques. Assessment is centered on student engagement with the experimental process, including lab participation, experiment design, execution, and the ability to coherently communicate findings through written reports and presentations.

The core of this course lies in experiential learning, with a strong emphasis on the practical application of RNA technologies in the diagnosis and treatment of human diseases. By integrating fundamental RNA knowledge and the principles of critical RNA-based technologies, the course ensures a comprehensive understanding of the field.

Throughout the course, students work collaboratively to grasp RNA basics and explore key RNA technologies. Teams are tasked with conceptualizing a project, designing experiments, and ultimately producing an RNA-related product. The culmination of the course sees these teams executing their experiments, analyzing data, and engaging in a comprehensive discussion of their results.

Eliminating traditional written exams, the course prioritizes the cultivation of practical project management skills. Students are continuously evaluated based on their experimental design acumen, oral scientific communication, and scientific writing abilities. The ultimate goal is to prepare students not just as learners but as professionals ready to tackle real-world challenges upon graduation.

Rationale for course selection

The choice of this course is driven by the following factors:

- RNA-related technologies are at the forefront of scientific innovation, addressing current global challenges through breakthroughs like CRISPR gene-editing and mRNA vaccines against SARS-CoV-2.
- Integration of RNA technology is already evident across multiple disciplines in our institution, enriching data science, biochemistry, and recombinant DNA technology courses.
- The course enhances practical skills, aligning with the hands-on experience sought in academic curricula.

- Skills acquired in this course are invaluable for students aiming for further studies or technical careers in research institutes or healthcare settings post-BSc.
- By laying groundwork for capstone projects, the course boosts employability prospects for graduates.

Course Objectives

Upon course completion, students will:

- Understand and critically evaluate the biochemistry, cell biology, and functional roles of RNAs.
- Master the principles of, and distinguish between, key RNA-related technologies.
- Design and execute a research project that employs RNA technology.
- Effectively communicate project findings through both oral presentations and written reports.

Teaching Approach

The educational format includes:

- Lectures (10%): Introducing RNA technology fundamentals.
- Active Learning (20%): Student groups engage in hands-on exploration and experimental planning.
- Seminars (10%): Groups share their experimental approaches and findings.
- Lab Work (60%): Practical execution of research experiments derived from student designs.

Evaluation Criteria

Students will be assessed through a trifecta of methods:

- Group presentation (20%): Quality and defense of experimental designs during presentations.
- Practical lab assessment (50%): Performance in executing research, including attendance, technical skills, report writing, and results.
- Individual final report (30%): Independently written reports detailing obtained results.

Tentative Schedule

Week 1: Introduction to RNA - Definitions, classifications, and unique RNA features.
Week 2: RNA Synthesis - Techniques and practical applications.
Week 3: Team formation and experimental design.
Week 4: Oral presentation and oligonucleotide ordering.
Week 5: Technical tutorials.
Week 6: Lab I - Synthesis of dsDNA variants.
Week 7: Lab II - Generation of in vitro transcribed (IVT) dsDNA.
Week 8: Lab III - dsDNA IVT reaction and purification.
Week 9: Lab IV - Purification of IVT RNAs and ribozyme processing for pre-miRNA Production.
Week 10: Lab V - Pre-miRNA purification and T4 PNK treatment.
Week 11: Lab VI - Pre-miRNA circularization.
Week 12: Finalization workshop - Drafting and refining the written report, preparing the oral presentation, and discussing future research directions.

Time	Location	Lectures	Seminar	Lab experiments
Jan 31, 6:00–7:30	Rm 5560, Lift 27-28,	Introduction to RNA		

Feb 5, 6:00–7:30	Rm 5560, Lift 27-28,	Introduction to RNA		
Feb 7, 6:00–7:30	Rm 5560, Lift 27-28,	RNA Synthesis - Techniques and practical applications		
Feb 9–Feb 18	New Year Break			
Feb 19, 6:00–7:30	Rm 5560, Lift 27-28,	RNA Synthesis - Techniques and practical applications		
Feb 21, 6:00–7:30	Rm 5560, Lift 27-28,	Team formation and experimental design (Initial design).		
Feb 26, 6:00–7:30	Rm 5560, Lift 27-28,	Team formation and experimental design (finalizing design) and ordering.		
Feb 28, 6:00–7:30	Rm 5560, Lift 27-28	RNA cloning and sequencing technology		
Mar 4, 6:00–7:30		No class, receiving oligo from company		
Mar 8, 1:00–5:50	Rm 4160, Lift 33			Lab I
Mar 15, 1:00–5:50	Rm 4160, Lift 33			Lab II
Mar 22, 1:00–5:50	Rm 4160, Lift 33			Lab III
Mar 24–Apr 11	Mid-term break (no mid-term for this course)			
Apr 12, 1:00–5:50	Rm 4160, Lift 33			Lab IV
Apr 19, 1:00–5:50	Rm 4160, Lift 33			Lab V
Apr 26, 1:00–5:50	Rm 4160, Lift 33			Lab VI
May 3, 1:00–5:50	Rm 4160, Lift 33		Workshop	
May 29, 1:00–5:50	Rm 4160, Lift 33		Final report submission	