Work Study 2022 Application

Job Title:

Research Assistant – Programming Cell Adhesion Junctions

Summer Session (May-Aug) hours requested:

680

Winter Session (Sept-Apr) hours requested:

810

Choose Position Classification:

Research

Job Description

Two research assistants will become integral members of the Single-Molecule Mechanobiology Lab (SMML) to develop and characterize DNA nanostructure-based molecular probes to study cell-cell interactions. The probes will enable a fluorescence readout of the adhesive communication between cells. By reprogramming the adhesive junctions between cells, the ultimate goal of the project is to develop strategies towards identifying drug targets that control the adhesive interactions in disease processes. This project aims to design and test new DNA structures using state-of-the-art single-molecule techniques, which allow the measurement of the structure and function of DNA nanostructures that ultimately control cell adhesion.

Students will use an interdisciplinary approach that combines cell biology, biochemistry, modelling, fluorescence microscopy, and single-molecule techniques to achieve the project goals. We plan to recruit two students with a background in molecular biology, biochemistry, chemistry, or bioengineering with strong experimental skills to work collaboratively on this project. Students will perform cell culturing and microscopy to replicate the cell-cell adhesion process. The students will then determine the nanomechanics of different families of DNA nanostructures. We anticipate that each student will be responsible for characterizing one class of DNA nanostructure in the project. The students will systematically create variants of the DNA nanostructure using established molecular biology methods combined with an established structural prediction tool. The final goal is to apply these structures to the cell adhesion models to study their adhesion dynamics. The students will work as a team alongside the research group and will be responsible for:

(1) Participating in all the necessary training required for safety and the job will be provided online and in-person mentorship from the lab members.

(2) Conducting hands-on research and development activities involving literature reviews, DNA structural design, gel electrophoresis, DNA purification, and single-molecule characterization. Specifically, the students will design the experiments with the supervisor, create a family of sequence and structural variants of DNA nanostructures, ensuring their corrected folded structure using computational structure prediction tools. The student will then synthesize the DNA and use the Acoustic Force Spectroscopy to perform the DNA nanostructure's structural characterization at the single-molecule level.

(3) Communicating and presenting research results to an audience, including students, faculties, and industrial partners, at workshops and conferences, including the undergraduate research conference, the Western Canada Biophysics Symposium, and Eminence Cluster Workshops. Students will also write formal reports and have the opportunities to draft first-author research papers depending on the project outcome.

(4) Participating in group meetings, discussion sessions, and workshops. Students are expected to provide constructive feedback on each other's work. The students will be actively involved in planning our 3rd annual biophysics symposium, an entirely student-run regional research conference in Aug. 2022 (possibly online, given the COVID situation).

(5) Initiating and leading collaboration within the research group and other research labs on campus through various networking opportunities. Participate in research collaboration meetings with collaborators in McGill and SFU.

(6) Learning essential skills, including project management, time management, leadership, and communications. It is also expected that students will develop professional knowledge and expertise in areas complementing their background, including cell biology, molecular biology, computer programming, image processing, big-data analytics, bioengineering.

The students will receive supervision and support directly from the supervisor during weekly individual meetings and group meetings. Dr. Li will also be available for discussions on-demand. Both students will also be well-supported by the research team members, including 3 PhD, 3 MSc, 4 undergraduate, and 1 postdoc with diverse backgrounds in cell biology, biochemistry, and biomedical engineering. Furthermore, the research team members will provide training, guidance, support, and potential further collaboration opportunities.

The complexity of the research project tasks is similar to those found in undergraduate Directed Studies or Honours Thesis projects. The students will be well-equipped to think independently to solve problems once they have finished training and obtained relevant background knowledge in the field. Half of the techniques used in the project (e.g. biochemistry and molecular biology) can be found in upper-year undergraduate chemistry and biochemistry labs. The complexity of the research project will be monitored and adjusted throughout the project to best support student learning objectives, match their career goals and experience levels.

Our lab is highly cohesive and offers a friendly and inclusive environment for students from any cultural and academic background. My group's past and current trainees represent over ten different cultural and ethnic backgrounds with gender equality. Past members are currently in positions from tenure-track professors to R&D positions in tech industries to continuing graduate studies and medical training at top institutes in Canada and US. My group enjoys a highly collaborative environment and encourages open communications, regardless of the career stage (undergraduates are valued just as much as postdocs). We also host lab-social events almost monthly, such as celebrating festivals around the world, game night, pot luck, etc. We strive to create a balanced work-life style where everyone feels included and connected.

Qualifications

The candidate must have a solid background in basic sciences, including first- and second-year mathematics, physics, and chemistry. A second-year course in thermodynamics will significantly enhance the understanding of critical concepts in the project. Lab experience in molecular biology and demonstrated computer programming skills are highly preferred but not required.

The position is most suitable for upper-year undergraduate or graduate students in sciences and engineering. However, exceptional second-year undergraduate students will also be considered.

A successful candidate should enjoy independent problem-solving and hands-on experimentation. An ideal candidate will thrive on the freedom to design experiments and test their ideas. The candidate should demonstrate strong observational, analytical, organizational skills and attention to detail as they are required to handle sophisticated and delicate scientific equipment (e.g. super-resolution microscopes and home-built optical systems). Scientific rigour and creativity are also critical to the success of the candidate. Good communication skills and comfort working in a fast-paced team environment are needed to be an excellent fit for this position in our highly interdisciplinary and collaborative research team.

1. Personal growth and professional development

I will draw on my experience as a work-study and research supervisor of >40 trainees to provide an enriched experience. Students will receive training and orientations that complement their academic programs in the first two weeks,

including safety, team building, project management, and technical training. Students will receive a lab tour to meet with my group and learn about their projects. I will review the lab expectation document with each student and understand his/her career expectations. Following onboarding, I will set up weekly meetings to help individuals develop project milestones, timelines, and plans to reach them. Students will learn both research and project management skills through these interactions. Two-way constructive feedback will be provided on an ongoing basis. I will further support each student's personal growth and professional development by: (1) Encouraging problem-solving where students will take ownership of their project and develop solutions independently. I will provide guidance and support on-demand. (2) Providing teamwork experience with collaborative project design and open-ended questions. (3) Improving communication skills through weekly group meetings where students present their work in-depth and reflect on feedback from the team. (4) Cultivating leadership skills by allowing students to take ownership of their projects and lead collaborative campus efforts. Students will also take turns to chair journal club and lead lab maintenance. Halfway evaluation and reflection on progress will be conducted to adjust plans for the second half of the project. Finally, a two-way review will be provided to wrap up their terms at the end.

2. Workplace Skills

Through this work-study project, I will help students develop transferable soft skills and work-specific skills: (1) Leadership, teamwork, and collaboration skills will be developed through ownership of independent projects that require collaboration with group members. I will provide mentorship to develop those skills in weekly meetings and online workshops. The students will apply and transfer these skills in their ongoing research. Students are also encouraged to take the initiative (leadership) to develop new collaboration (teamwork). Constructive feedback will be provided bi-weekly to help students improve. (2) Communication skills will be developed and practiced through weekly meetings and an end-term report. Students will learn from senior members how to prepare scientific presentations and receive feedback on their presentations. (3) Project and time management skills will be developed through ongoing meetings and online workshops to set realistic milestones, progress evaluations, and schedules, which is key to maintaining students' well-being and work-life balance. Students will reflect and apply these skills back to their projects through two-way feedback and mid-term reviews. (4) Critical thinking and problem-solving skills will be developed through an independent working environment with sufficient team guidance. (5) Interdisciplinary job-specific molecular biology skills, bioengineering, modelling, and microscopy will be developed through this project. These skills will complement the regular university curriculum and provide a competitive edge in their future career. I will oversee the proper development of the above skills, which will be applied immediately to the project and transferable in future employment.

3. Career Exploration

Students in this role will develop new biotechnology from concept to application. This allows students to gain first-hand collaborative experience in interdisciplinary work involving molecular biology, biophysics, microscopy and modelling, similar to many R&D environments in academia and industry. This experience has enabled my previous students to pursue opportunities in academia (graduate studies and professorship) and industry (biotech, pharmaceutical, and medical diagnostic). The transferable skills developed in my lab will also help students transition from technical positions to project management, coordination and leadership roles. Each year, I invite 5-6 external professors, industry collaborators (e.g. Precision Nanosystems) and community partners (e.g. BC Cancer) to research seminars and visit my lab. All students will have an opportunity to meet individually with the invited speaker. This is critical for students to build their network and learn about work outside of the University. Additionally, I invite all my students to join LinkedIn, where I will share my network and introduce them to contacts should they need it. This has helped three previous students secure jobs in R&D and engineering firms. Furthermore, I will provide students with opportunities to organize local workshops and attend national and international conferences to further explore career paths and opportunities. Lastly, our interdisciplinary research is highly collaborative, where we work with international research groups, companies, and local health agencies. Therefore, my student has plenty of opportunities to work with people in different fields and explore career opportunities in different disciplines and institutions.

4. Hands on Learning

Students will engage in hands-on learning, including: (1) training on state-of-the-art equipment and techniques, (2) project design and experimentation, (3) data analysis, (4) scientific- and community-oriented communication, (5) project management and collaboration. The comprehensive hands-on learning components are based directly on real-world problems students encounter in the research and development (R&D) environment. Students will gain first-hand experience solving R&D problems through independently designing and conducting experiments, which happens regularly in R&D. Given that such experience is limited in a regular university curriculum, I will provide training through iterative discussions and feedbacks over the project. Students will develop working knowledge and skills at the interfaces of biology, chemistry and computer science that are increasingly required in biotech industries. Students will receive training in each discipline and practice over the project. Students will also have ample opportunities to practice public communication of their work and receive feedback through weekly group meetings. Lastly, most students will face challenges in project and time management, critical skills in the real world. Online seminars and weekly in-person guidance will be provided to support the development of these skills. My training environment will give the student first-hand experience in a real-world teamwork environment where every member's contribution is crucial to the team's success. Students working in our collaborative environment will learn to take responsibility as their work impacts the team's progress. Whenever students encounter challenges, they will be encouraged to troubleshoot independently or seek peer-mentoring before coming to me for a solution.

5. Mentorship and Support

Students will attend initial training and workshop on safety, lab procedures, programming, team building, and project/time management. I will meet with individual students to understand their backgrounds and work together to develop clear project milestones and expectations. During weekly meetings, I will provide feedback and support to help each student stay on track. This two-way communication will help address the student's personal and professional challenges, ensuring their physical and mental well-being. Additional peer support and interactions with my group will help the student feel like part of the team. The level of guidance and mentorship will be tuned according to individual students' styles to be challenging enough to stimulate independent thinking yet not too challenging to feel hopelessly stuck. The student will be guided and gain independence throughout the project. Students will work with me to develop, refine, and update project milestones and achievements throughout the term. Progress review meetings will occur at the start, mid-term, and end-term to provide opportunities for two-way constructive feedback and a clear way for students to self-evaluate success. Developing clear goals and time management (section 4) are critical aspects of achieving work-life-academic balance through the project. In addition, work-life-academic balance will be enhanced through monthly lab-social events (virtual during COVID) such as monthly group lunch/dinner, movie/game nights, lab hiking trips, etc. Students will also enjoy strong peer support from a cohesive team. Last but not least, my lab has an established inclusive environment with members from diverse cultural backgrounds and gender equality.

6. Contribution to the University as a whole

Students will be part of the UBCO Centres of Research Excellence initiatives, founded to support clusters aligning with the strategic plans of departments, faculties and the campus. Students will participate in highly interdisciplinary and collaborative activities involving multi-institutional researchers from UBCO, UBCV, SFU, CU Boulder, BC Cancer Agency, Interior Health, and industry partners from Pfizer and LUMICKS. The goal is to understand health and disease better and create technologies that ultimately transform healthcare. This goal is in perfect alignment with UBCO's research strength in "Healthy Living, Wellness and Aging" and "Emerging Technologies". Furthermore, the research positions will address the key "research excellence" themes in both UBCO's ASPIRE vision and "Shaping UBC's Next Century". This includes conducting research that is "interdisciplinary", "collaborative (internal and external)", creating and enhancing "undergraduate and graduate research opportunities", and "research in practice". An essential aim of this position is to train the next generation of problem solvers by integrating teaching and research. The specific outcome of the position will help us develop new and improved methods to study diseases at the cellular and molecular levels. The outcome of the research will be shared with the campus through conference presentations in the Undergraduate Research Conference (April), Canadian Biophysics Meeting (May) and Eminence Cluster Workshops (August). Additionally, students will have the opportunity to share the research outcome through peer-reviewed journal publications.

Moreover, the students' work will be highlighted beyond the UBCO campus through collaboration networks, highlighting the quality of integrated research and teaching.