2021 Work Study Application

Job Title

Research Assistant – Cancer biomarkers screening

Summer Session (May-Aug) hours requested

680

Winter Session (Sept-Apr) hours requested

816

Choose Position Classification

Research

Job Description

The Single-Molecule Mechanobiology Lab (SMML) is recruiting students at the senior undergraduate or graduate levels to develop methods that characterizes extracellular vesicles (EVs) as biomarkers for early detection of cancer. EVs are ubiquitous in all body fluids and is only recently shown to be key mediators and biomarker in diseases including diabetes, cancer and neurodegenerative diseases. Understanding and characterizing heterogeneity and molecular biomarker profiles of EVs is critical towards early detection of disease and treatment monitoring. However, no current techniques are sensitive enough to simultaneously detect multiple properties of individual EVs. Using high-sensitivity and high-resolution microscopy techniques in our lab, the students will develop a single-particle tracking and imaging assay to characterize EVs from clinical samples in a high-throughput fashion. The students will eventually turn this development into a proof-of-concept device that will help identify unique biomarker for diseases such as diabetes and cancer. The work will be performed primarily in SMML with interdisciplinary collaboration with BC Cancer Agency, School of Engineering, and the School of Health and Exercise Sciences.

Students will work with a team of researcher and use an interdisciplinary approach that combines molecular cell biology, biophysics, fluorescence microscopy, and quantitative image processing to achieve the project goals. Two students with background in molecular biology / (bio)chemistry / physics / biomedical engineering and strong hands-on skills will be recruited to work on this project. There are two major components that require two open positions to work collaboratively. The first position will be responsible for developing single-particle analysis and tracking method to determine the size distributions of individual EVs; the second position will be responsible for quantifying surface biomarkers from clinical samples. The two major components will be integrated together one assay where a prototype lab-on-a-chip diagnostic device will be developed. The two students will work as a team, help and support each other's work and learn from each other's expertise to further enhance their personal growth and professional development. Students will be responsible for:

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

(2) Conducting hands-on research and development activities, which involves literature review, molecular biology, surface chemistry, image analysis, and state-of-the-art fluorescence imaging. Specifically, the students will participate in both designing and performing the experiment in a timely manner. The student will optimize procedures in isolating EVs from cell culturing media and labelling the EVs either by lipophilic dyes or specific fluorescent antibodies for imaging purposes. The student will learn state-of-the-art techniques including single-molecule fluorescence microscopy and super-resolution microscopy and apply it to characterize fluorescence kinetics at the single-molecule level. The students will also be responsible for quantitatively analyzing the images to produce publication quality results.

(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 to take place in Aug. 2021 (online, given COVID situation).

(5) Initiating and leading collaboration within the research group and with 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. Supervisor 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, and 2 postdocs with diverse backgrounds. 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 finished training and obtained relevant background knowledge in the field. Half of the techniques used in the studies (e.g. biochemistry and molecular biology) can be found in upper-year undergraduate chemistry and biochemistry labs.

Qualifications

The candidate must have a solid background in basic sciences and engineering, including first- and second-year mathematics, physics, and chemistry. A course in cell biology and/or biomedical engineering is required. Previous lab experience is preferred but not required.

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

The candidate must enjoy independent problem-solving and hands-on experimentation. Lab experience in molecular biology, biomedical engineering, computer programming, or microfabrication are significant assets. The candidate should demonstrate strong observation, analytical, and organizational skills and the ability to handle technical equipment and pay attention to details. Good communication skills and a strong will to work in a team environment are needed to be an excellent fit for this position in our highly interdisciplinary research team.

Student Learning Outcomes

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 leading collaborative efforts across campus. 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 at the end of their terms.

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. Through two-way feedback and mid-term reviews, students will reflect and apply these skills back to their projects. (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 participate in developing 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 4-5 external professors, industry collaborators (e.g. biotech) 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 my student to build their network and learn about work outside of the university. Furthermore, 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 two previous students secure jobs in R&D and engineering firms. Furthermore, I will provide students with opportunities to organize local workshops and attend conferences to explore career paths further. Lastly, our interdisciplinary research is highly collaborative in nature 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 multiple disciplines and institutions.

4. Hands on Learning

Students are responsible for 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 set of hands-on learning components is based directly on real-world problems students will encounter in research and development (R&D). Students will gain first-hand experience solving R&D problems through independently designing and conducting experiments, which happens on a regular-basis in R&D. Given such experience is limited through regular university curriculum; I will provide training through iterative discussions and feedbacks over the term of the project. Students will develop interdisciplinary knowledge and skills combining biology, chemistry and computer science, which is increasingly required for biotech jobs. To support this, students will receive training in each discipline and practice over the project. Students will also encounter challenges in communicating their results publicly, which they will have ample opportunities to practice and receive feedback through weekly group meetings. Lastly, most students will face challenges in project and time management, critical skills in the real world. To support students in developing these skills, online seminars and weekly in-person guidance will be provided. Students will also be placed in a collaborative environment where they will learn to take responsibility for their impact on the team. This 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. 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 student's style so that students will be challenged enough to think independently but not too much to be 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 lab-social events (virtual during COVID) such as monthly group lunch/dinner and movie/game nights. Students will enjoy strong peer-support from a cohesive team. My lab provides an 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 better understand health and disease and create technologies that ultimately transform healthcare. This goal is perfectly aligned 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 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.