Western Faculty Profile: Dr. Murray Junop

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No conflicts of interest declared.

Background

Dr. Murray Junop is an Associate Professor and the Associate Undergraduate Chair in the Biochemistry Department at Western University. His primary research focuses on using x-ray crystallography to determine macromolecular structures crucial for the repair of various types of DNA damage. Ultimately, understanding the structures of these DNA repair proteins not only sheds insight into their function and molecular mechanism, but also provides necessary information for developing new anticancer therapies. Dr. Junop teaches undergraduate and graduate level courses offered in the department of Biochemistry. Violet Liu, a Reviewer on the Editorial Review Board at WURJ-HNS, had the pleasure of interviewing Dr. Junop to learn more about his career in research and his advice to students.

Tell us about you and your career path

Dr. Junop received his Bachelor of Science degree in Applied Chemistry and Biology at Ryerson

University. As an undergraduate student, he pursued a chemical engineering project for his fourth-year research thesis with Environment Canada, which involved designing an instrument used for automated analysis of greenhouse gases and chlorofluorocarbons in the atmosphere. However, it was a third-year course in recombinant DNA technology that peaked his interest in biochemistry and motivated him to pursue a Master's degree focusing on mobile genetic elements at Western University with Dr. David Haniford. During completion of his Ph.D. he became increasingly interested in the fate of chromosomal DNA double strand breaks that arise as a consequence of composite transposon mobilization.

When asked about his post-doc experience, Dr. Junop commented that it all began when he sat down beside a crystallographer during the lunch break of a research conference. "She (Dr. Wei Yang) had seen our research presented during the conference, and asked if I was interested in continuing as a post-doc in her lab using x-ray crystallography to understand the molecular mechanisms of DNA repair. It wasn't in my blueprint since x-ray crystallography was so different from all the previous research

I had done before. But the prospect of learning such a powerful technique and applying it to my area of interest captured my attention. I remember thinking, if I don't do it, I'll always regret not taking this wonderful opportunity to explore and grow." As it turned out, Dr. Junop accepted the offer and went to the NIH in Washington, D.C. for four years to continue his post-doc study. During these four years, he determined structures of several key proteins from different essential DNA repair protein pathways, specifically DNA mis-match repair and non-homologous end-joining.

Dr. Junop received several faculty offers, but chose to return to Canada and began his independent research career at McMaster University. In addition to his productive research in DNA repair and collaborations involving bacterial virulence and development of antibiotics, Dr. Junop was awarded McMaster's top teaching award (McMaster Student Union Teaching Award) in both 2006 and 2011. He moved his lab to Western in 2014, where he and his wife's immediate live, and has continued to pursue similar research interests and teaching in undergraduate and graduate biochemistry courses. "The idea of pursuing education has always interested me," Dr. Junop commented, "I enjoy interaction with students very much, and consider one of the most rewarding parts of my career".

What are your current research projects?

The Junop lab primarily focuses on understanding protein structure and function using biochemical/biophysical techniques such as x-ray crystallography. This type of analysis is pivotal for understanding molecular mechanisms and developing new drugs for diseases such as cancer. Over the years, the Junop Lab has made outstanding contributions in many projects regarding the understanding of bacterial virulence, antibiotic resistance, DNA transposition and various DNA repair mechanisms. Currently, the Junop Lab is focused on mammalian DNA interstrand crosslink repair and both single and double-stranded DNA break repair

mechanisms. An interesting additional area looks at DNA repair in *Deinococcus radiodurans*, a strain of bacteria that can repair its genome with fantastic speed and accuracy following levels of DNA damage that would kill other organisms 1000s of times over. Understanding mechanisms responsible for this genome repair and reassembly has potential to contribute to the field of synthetic biology, as the experimental results could prove to be very useful for technical advancement in genome engineering of large chromosomes in designer organisms.

Dr. Junop's lab collaborates widely with research groups at Western as well as others labs from both inside and outside Canada. Of note, his group has been collaborating with a biopharmaceutical company in Paris, as the experimental data have the potential for clinical applications. Indeed, Dr. Junop's research involving protein structure determination has the potential to contribute significantly to almost any area of biological and biomedical research. "When I got into x-ray crystallography, it was my dream to identify and develop compounds of medicinal value."

In general, what do you believe will be the future of biochemistry research? What future changes do you expect to see in this discipline?

"There are many technical advances that are and will continue to change research. One example I find particularly interesting resides in designed organisms." Using recent improvements in DNA synthesis, sequence acquisition, analysis and genome editing, the area of synthetic biology is bound to take off in leaps and bounds. Scientists will increasingly be able to engineer genomes (mostly bacterial and plant) with new functional capabilities that are useful for a variety of purposes. Dr. Junop foresees the fields of synthetic biology, cell biology and biochemistry becoming even more intertwined in the future. Although particular techniques will continue to be replaced

by more powerful variations, structural understanding of proteins will continue to play a vital role, since the understanding of protein structure/function relates to every aspect of biology.

Techniques used for biochemical research will inevitably continue to advance in the future with increasing efficiency and accuracy in obtaining experimental data, opening new vistas for advanced understanding of complex biological processes. In terms of crystallography, technical advancement might be the key to overcoming difficulties in understanding protein-protein interactions that are currently lacking, as many large protein complexes cannot be analyzed with crystallography since they are too large to be crystallized. However, Dr. Junop believes that training as a scientist (approach, creativity and critical thinking) is more important than a particular technology. “Techniques will come and go, but the ability to ask critical questions and think clearly about how to answer those questions will always be the most important aspect of science training and research success.”

In your opinion, what are the most rewarding and most challenging part of research?

According to Dr. Junop, the challenging aspect is also one of the rewarding aspects of working in a research lab. “Managing the group dynamic within a lab can be challenging at times. Making sure that everyone’s project is moving forward and spending time to ensure that everyone is on the right track. However, this is also the most rewarding part of running a lab: engaging with the students. When the students are really interested in their projects, we can sit down and talk about various sorts of issues during their research. To me, this process is very rewarding.”

Dr. Junop also expressed the potential of discovery as one of the most delightful aspects of research. “When it comes to research, nothing beats discovery. The most rewarding aspect to me by far is discovering something that is truly new. One of the reasons that I like solving protein structures, is

that there is a potential to see something that no one has ever known or seen before. Of course, to be truly the first person to see or understand a new discovery of doesn’t happen every day, but the potential is exciting. It’s like being Christopher Columbus in the molecular world, when he first set foot on a foreign shore. It’s the same thing for science, and the potential is the most rewarding aspect to me.”

As a professor, what are the most rewarding and most challenging part of teaching?

Dr. Junop commented that the most challenging part of lecturing is preparing and structuring the materials to be presented in a course, as the lecturer needs to have clear goals of what the students need to learn. “When preparing for a course, I also need to keep in mind of how the course would fit into the development of students. It is necessary to beware of what other courses that the students have usually taken, and make sure that this course’s contribution is unique. This aspect is often challenging, but enjoyable at the same time.”

“However, the challenging aspect is also the fun part of lecturing. The part that I enjoy the most is giving lectures and engaging with students. It is magical to see students become inspired, when they actually engage with the materials and begin to put everything into a bigger and broader picture. It doesn’t happen all the time – but when it happens – it’s just amazing.”

What qualities do you look for in a potential research assistant?

“I think curiosity is the essential drive for research, because we often run into unexpected problems in the lab, it could be technical problems or unexpected results, and you need a burning desire to know the reasons behind the results. It is essentially the curiosity that pushes people

forward in research.” Dr. Junop has also commented that it is important for students to be a team-player and have the ability to collaborate with others in a laboratory environment, as there are many different personalities in a lab. “It is very interesting to have a variety of different people working in the same environment. I have seen some incredible scientists, some are extroverts and some are introverts, all working and mentoring people differently and successfully. In terms of personality, science is very open in terms of what it takes to achieve success.”

To read more about Dr. Junop’s research, please visit his website at:

<https://junoplab.wordpress.com>