Western Faculty Profile: Dr. Martin L. Duennwald

Soojie Hong¹

¹Schulich School of Medicine & Dentistry

Western University

No conflicts of interest declared.

Background

Dr. Martin L. Duennwald is a researcher and assistant professor at Western University. After conducting independent research at the Boston Biomedical Research Institute, he came to Western University in 2012 where he started the Duennwald Lab. His lab focuses on cellular protein quality control, protein misfolding and their pathological consequences in neurodegenerative diseases such as Huntington's disease, Parkinson's disease, and Amyotrophic Lateral Sclerosis (ALS).

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 as his fourth-year research thesis, aiming to design an instrument that would be used for automated analysis of greenhouse gasses, and soon gained his first research experience

with Environment Canada. However, it was a third-year course on recombination DNA technology that peaked his interest in biochemistry and motivated him to pursue a Master's degree at Western University. After receiving his Ph.D. in 1997, he began researching on DNA repair pathways and its related proteins, specifically double-stranded breaks in prokaryotic genomes.

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 had seen our research presented during the conference, and asked if I was interested in continuing as a post-doc in crystallography. It wasn't in my blueprint, and crystallography was so different from all the previous research projects that I had done before. But if I don't do it, I'll always regret not taking this wonderful opportunity to explore." As it turned out, Dr. Junop accepted the offer and went to Washington, D.C. for four years to continue his post-doc study. During

these four years, he became involved in genome repair mechanisms targeting double-stranded break, specifically non-homologous-end-joining.

Afterward, Dr. Junop began a career in teaching by starting at McMaster University, winning McMaster Student Union Teaching Award in 2010–2011. He came to Western University in 2014 after accepting a position as the Associate Undergraduate Chair in the Department of Biochemistry, and has been teaching undergraduate biochemistry courses since then. “The idea of pursuing education has always interested me,” Dr. Junop commented, “I still enjoy it, I think a very rewarding part of this career is to be able to engage the next generation”.

What are your current research projects?

The Junop lab primarily focuses on understanding protein structure and function using crystallography, a technique that allows scientists to visualize proteins at the atomic level. Over the years, the Junop Lab has been involved many projects regarding the understanding of antibacterial resistance and DNA transposition, as well as understanding the proteins and cellular mechanisms that govern both processes. Currently, the Junop Lab is focused on double-stranded break repair in relation to *Deinococcus radiodurans*, a strain of bacteria with a genome that can regenerate with the speed and accuracy that surpasses the human genome, thus allowing *D. radiodurans* to survive prolonged exposure to radiation. His research in this area has the potential to contribute considerably to the field of synthetic biology, as the experimental results could prove to be very useful for technical advancement in synthesizing large chromosomes in designer organisms.

Dr. Junop’s lab has also been collaborating with several other research labs to identify and design inhibitors targeting essential enzymes in the biosynthesis of gram-negative bacteria’s outer membrane from a structure-based approach. By disrupting the outer membrane, the inhibitors would

cause gram-negative bacteria to be more susceptible to drugs, thus increasing the efficiency of antibacterial medicine. “When I got into crystallography, it was my dream create and design a compound of medicinal values.” Dr. Junop’s research in this area has the potential to contribute significantly to antibacterial development. Currently, the Junop lab is collaborating with a biopharmaceutical company in Paris, as the experimental data have the potential for clinical applications.

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

“A large part of the future will reside in designed organisms.” Using synthetic biology, scientists can now design genomes and construct functional biological systems, such as organisms, for useful purposes. Dr. Junop believes that the field of synthetic biology and biochemical research will be closely intertwined in the future. A structure-based approach to understanding protein function will play also an active role in future research, since the understanding of protein functions relates to every aspect of biology.

The techniques used for biochemical research will also advance in the future, implying that there will be relatively simpler methods with increasing efficiency and accuracy in obtaining experimental data. In terms of crystallography, technical advancement might be the key to overcoming difficulties in understanding protein-protein interactions today, as certain proteins cannot be analyzed with crystallography since they are too large to be crystallized. However, Dr. Junop also believes that training as a scientist is more important than technology. “Techniques will come and go, but the abilities to ask critical questions and think clearly about how to answer questions will always be important in science.”

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>