It is with humility and gratitude that I accept this award; and while the 3MT is an individual competition, this project would be inconceivable without the hard work done by our research team: my supervisors Dr. Jesse Zhu and Dr. George Nakhla, my teammates Kai Li and Zhenqi Wang and all the grad student predecessors from Western University that brought our team to the stage we're at now. We truly stand on the shoulders of giants.

Warhol once said that, in the future, everyone will be famous for 15 minutes. While I don't intend to use all of my remaining 12 minutes now, I would like to attempt to share some of my research and thoughts in a timeframe befitting this award, in 3 minutes.

Most of us, including myself, take for granted that the water that comes out of our tap is safe to drink. This is a privilege of the western world. Sadly, around 1 in 9 people, nearly 780 million individuals, don't have access to safe drinking water sources. The root of this problem is most closely related to untreated, dirty water mixing with drinking water. Some studies estimate that nearly 2 million people, most of whom are children, die each year from consuming dirty water.

For over a century, a complex network of pipes buried underground, transports our dirty water to a facility to be cleaned before reintroducing it back to the environment. The bits of debris in this water stream – hair, toilet paper and virtually any other thing you could possible conceive of – are removed in relatively simple operations. What's significantly more difficult to do is to remove the harmful components of the water you can't see. This is typically done by employing microorganisms, bacteria, which use these contaminants as a food source so that they can grow. The first time I heard this, like maybe some of you, it seemed a little strange to be using bacteria to get rid of waste because I thought bacteria were what we were trying to remove. But this is actually the simplest and most cost effective method of treating water and is used almost exclusively around the world. By providing these bacteria with a home, a large tank resembling an unkempt swimming pool, some oxygen and a food source, our waste, the bacteria are retained within the treatment facility and operate effectively to remove the contaminants.

These systems have been in place for nearly a hundred years and haven't dramatically changed since they were first designed. They rely on a vast infrastructure network to transport the wastewater and large areas of land to treat it. But as cities expand and become more densely populated, it becomes increasing difficult to accommodate this method of treatment. Or, when a community is small and remote, they lack the necessary infrastructure required to deliver their dirty water to a treatment facility. The picture that most often comes to our mind when thinking about such places typically are African villages. While this is a very appropriate image, what we often don't consider is our northern communities here in Canada, largely inhabited by First Nations people, who also share this plight of such African villagers, with nearly 40% of their water systems categorized as "high risk", meaning they have major deficiencies that pose a high risk to water quality and could lead to potential health and safety or environmental concerns.

So, our team at Western set out to create a treatment process that addresses the flaws of conventional systems and developed a treatment unit with a small building footprint and reduced infrastructure requirements. We were able to achieve this by exploiting the fundamental feature of the conventional system that makes them so effective, the bacteria. By creating a system in which we could grow larger bacteria, we could reduce the building footprint required for treatment. To do this, we employ a technology called a fluidized-bed because they offer high surface area in a reactor volume. Small particles – like sand, rocks or small bits of plastic – provide a surface for the bacteria to grow on and are suspended in the water using pumps. Because the bacteria are grown on these particles, they can get nearly 100 times large than in conventional systems, reducing the size of the reactor needed to treat the water.

After several iterations of this technology we are now at what we are calling the mobile-scale, in which we've built these reactors inside a semi-truck trailer. This means we are able to transport our biological treatment system to site-specific locations, reducing the need for infrastructure.

Now, this is all easier said than done. Our team has constantly struggled to improve the systems based on an ethos of using recycled resources. A recent case in point is our purchase of a trailer on kijiji that we negotiated down to $5000. We have also begun to develop our own electronic sensors. This significantly reduces the cost of automation and provides us with real time data that can be accessed over the internet thereby providing critical operational information of the system.

The theme of this year's conference, rethinking the PhD, brings me to my final point. We are all familiar with the cliché that academics observe the world from an ivory tower. The metaphor suggests that intellectuals engage in pursuits that are disconnected from the practical concerns of everyday life. As someone who has spent the last year and a half wading through the sewers, I can confidently add my voice to those graduate students who insist that the problems that we tackle are very real. So let’s drop the tiresome image of the ivory tower and find a new metaphor that does us justice. This is one area where my own research is not helpful because all I can think of at the moment is a picture of a porcelain bowl and I know that we can do better than that.