

Physics plays a central and foundational role in physical sciences, including environmental chemistry. As an important character in the history of physics, Maxwell's demon was proposed by the physicist James Maxwell in 1867 in a thought experiment. In the experiment, the demon is able to decrease the entropy of the system by sorting the gas molecules, which seems to violate the second law. While Maxwell's demon has provoked substantial debate in philosophy and in physics, it provides a valuable guidance on my research in environmental chemistry and on how we as a society aim towards achieving the United Nation Sustainable Development Goals should deal with the large number of chemicals we produced and used that may cause various environmental issues.

In this seminar, I will first give a brief review on the life history of Maxwell's demon, from which the Landauer's Principle was derived to connect the second law of thermodynamics with information theory, both of which are relevant to environmental chemistry as my research area. Using some of my research as examples, I will discuss what information we need to get for the large number of chemicals we have produced in order to achieve what Maxwell's demon has achieved, i.e. preventing the system from going towards disorder. I will then demonstrate how I gain the essential information for environmental processes and risk assessment of chemicals and how I answered different research questions in environmental chemistry by thoughts and methodologies widely used in physics, including model development, conservation laws, symmetry, reversibility, and analogy. Finally, I will share my insight on how Maxwell's demon can help guide policy making related to chemicals' uses and emissions to achieve Canada's 2030 Emissions Reduction Plan and the targets set by the Kunming-Montreal Global Biodiversity Framework.