

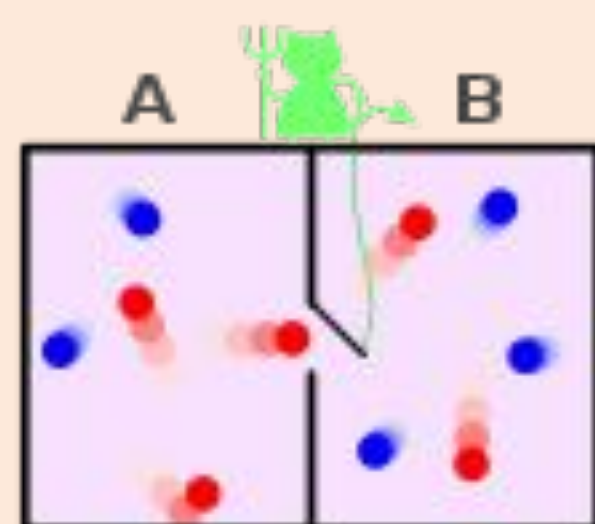
### ABSTRACT

The lower bounds of energy used in communications and computing are not well understood. The objective of this project is to use the principles of James Maxwell's thought experiment, Maxwell's Demon, and of Claude Shannon's research document titled "A Mathematical Theory of Communication", to measure the Demon's effectiveness by modeling the relationship between the Demon and the physical system as a discrete channel with noise, and measuring the energy extracted as a function of the conditional entropy. The overall goal is to **plot the bit-error rate versus energy transfer** of a digital model of the Demon.

### INTRODUCTION and BACKGROUND

#### Maxwell's Demon:

- ❑ The demon can only open and close the sliding door between the sides to sort the particles as they move towards the hole.



- ❑ The Demon's goal is to move all the particles from the left side to the right.

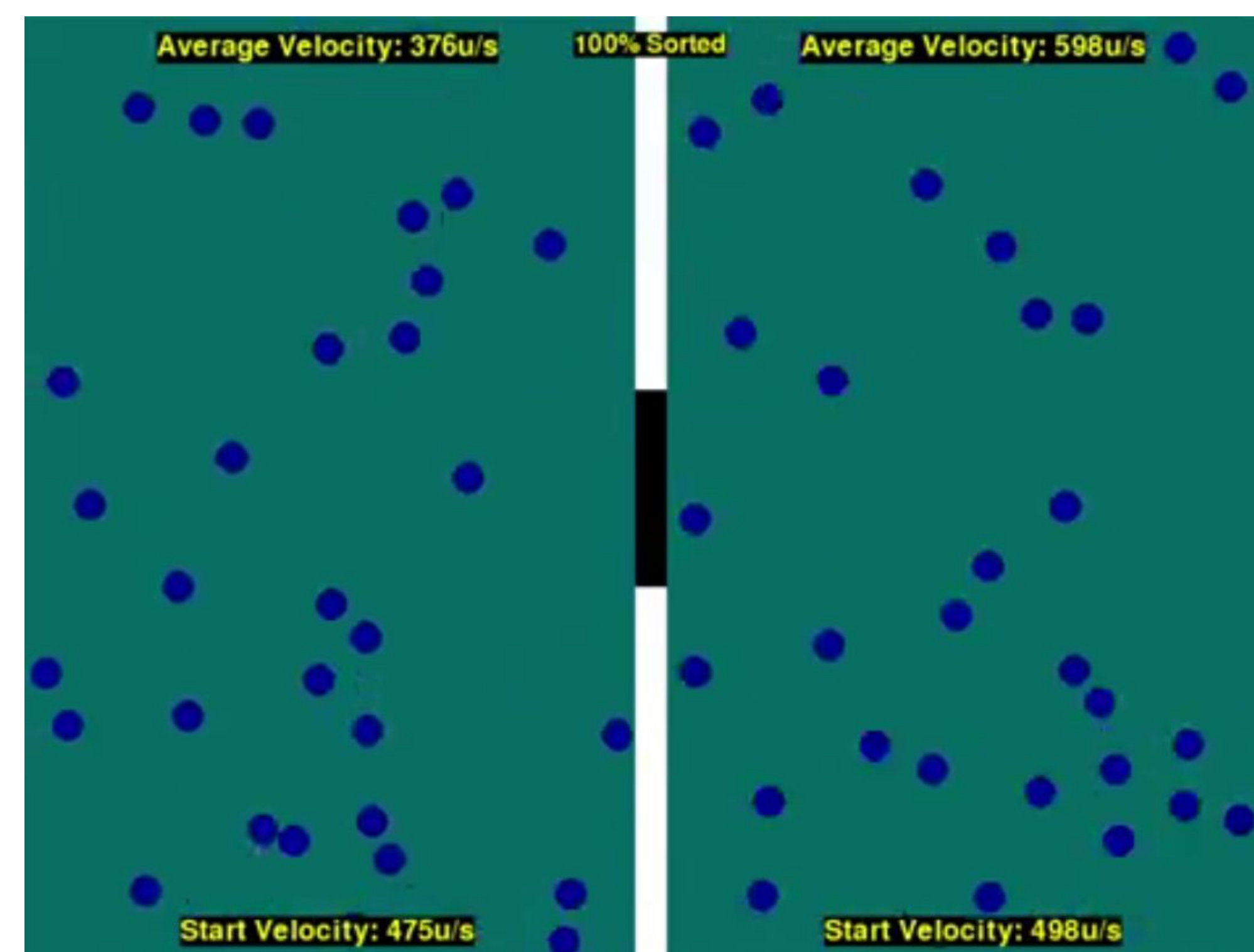
#### Information Theory:

- ❑ The scientific study of the quantification, storage, and communication of digital information.
- ❑ A key measure in information theory is entropy. Entropy quantifies the amount of uncertainty involved in the value of a random variable or the outcome of a random process.

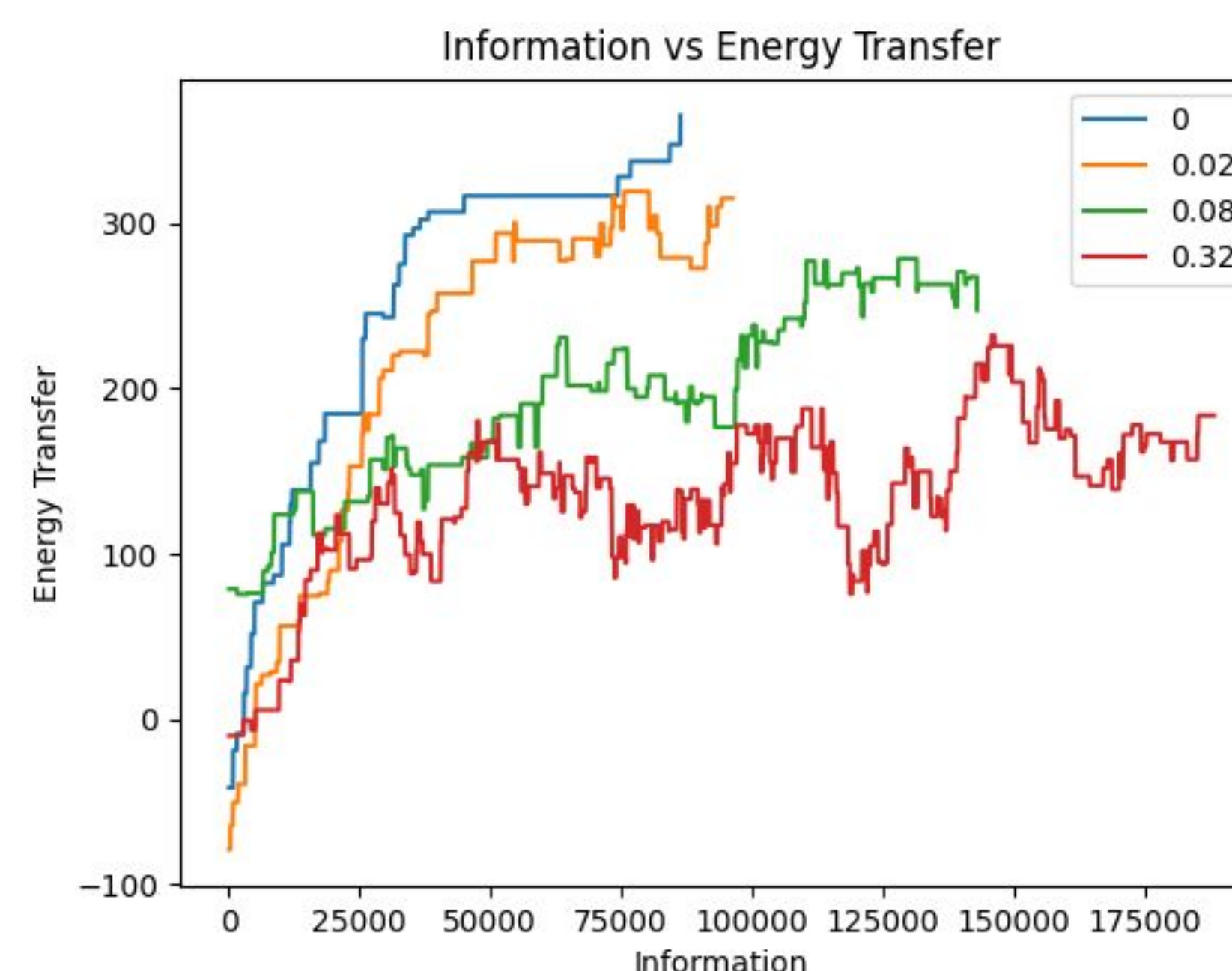
### METHODS

This project utilizes the Python as well as **Pygame** - a cross-platform set of Python modules. Using **object-oriented programming**, the code for a Maxwell's Demon simulator was created and used to experiment hypotheses.

### RESULTS



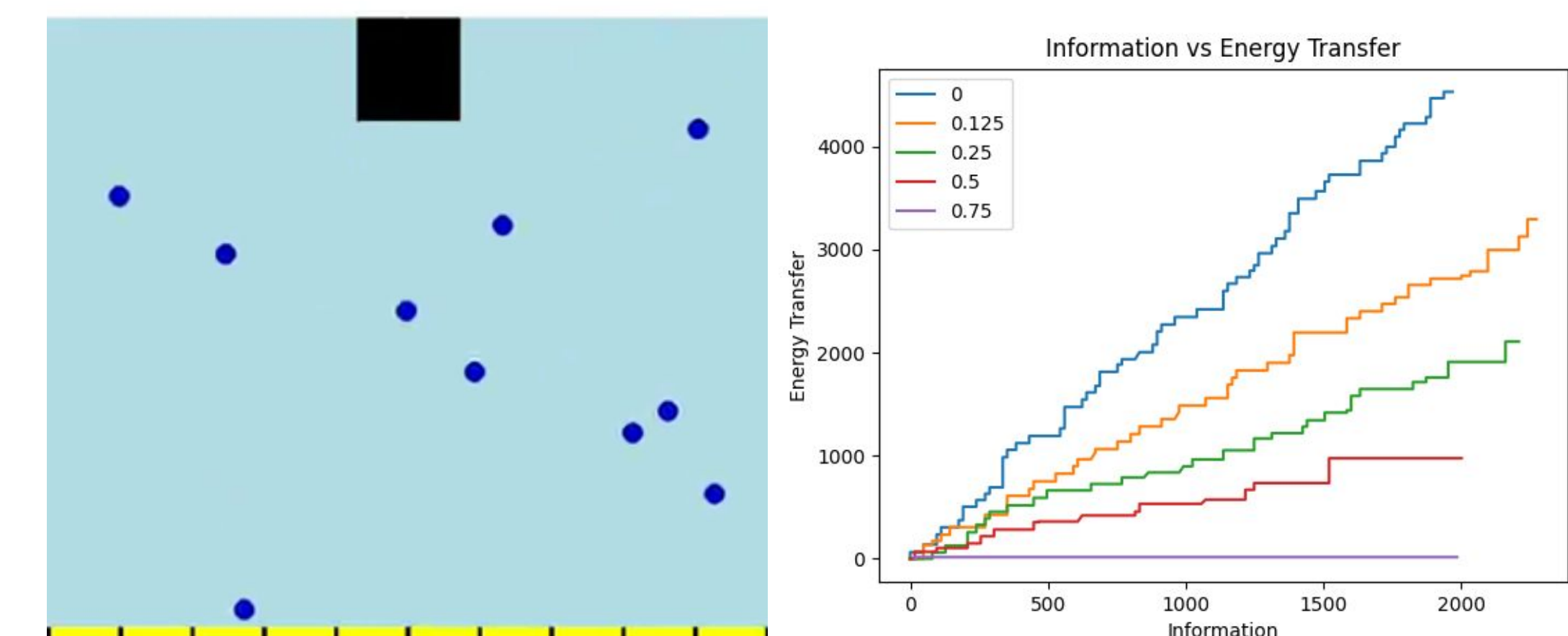
Coded Maxwell's Demon Simulation



Graph of Information vs Energy Transfer

### DISCUSSION

The project also developed a **High Pressure Demon**. The plug hangs from the top of a container and floats when the container is light due to the water molecules colliding with its bottom. When the container becomes heavy, the deflectors controlled by the Demon are used to redirect water molecules to the plug again to allow the plug to stay suspended for heavier weights.



### FUTURE DIRECTIONS

The next step for this project will be to write a **technical report** to document the data and results from both the Maxwell's Demon simulation and the High-Pressure Demon. The next steps will also include testing concepts for **more Demon simulations**.

### ACKNOWLEDGEMENTS

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