

Letting Curiosity be your Guide

Drexel MEM's Joel Krakower at NASA

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Drexel University's [Co-op program](#) is known for launching students into the workplace, presenting an opportunity for undergraduates to witness their education in action. Mechanical Engineering BS/MS senior Joel Krakower exemplifies the potential of this real-world participation, from his initial spark of interest in the field of nuclear science and engineering through his master's thesis and senior design project. With over two years of experience working on High Performance Nuclear Thermal Propulsion (HP-NTP) at NASA, including a long volunteer effort, a Summer 2022 Co-op, and an ongoing internship, Krakower has taken advantage of the freedom to experiment, problem-solve, and lead in a position that will inform his future at Drexel and beyond.

Krakower's experience at NASA didn't begin as a Co-op, instead, his first year at NASA was spent volunteering under Dr. Michael Houts, a principal investigator in NASA's Space Technology Directorate. Krakower came to Drexel with an enduring interest in nuclear technology and, with the encouragement of his Co-op advisor, reached out to Dr. Houts, whose research in HP-NTP excited him. According to Krakower, nuclear research at NASA a great deal of "research acreage," meaning there is an abundance of work needed to be done in the early phases of investigation, work that a capable volunteer researcher like Krakower could begin to chip away at. In August of 2021, Krakower got to work as a volunteer at NASA.

During this period, Krakower applied and expanded on the skills he acquired in Drexel's Complex Fluid and Multiphase Transport lab and his previous Co-op at Constellation's Nuclear Monitoring and Diagnostics center, where he explored thermal fluid analysis. Just as a spark of interest in nuclear technology drove Krakower to reach out to Dr. Houts, his work as part of Houts' team seeded new areas of inquiry that Krakower was now eager to explore. That Spring, Houts recommended Krakower apply for a summer internship where he would have the chance to deepen his research experience at the NASA Marshall Space Flight Center, as well as get paid for his efforts.



In Summer of 2022, Krakower went down to Alabama to begin a formal internship with NASA, continuing work on the HP-NTP project with the Propulsion Research and Development Laboratory (PRDL). Part of a team of interns working on liquid-core nuclear thermal propulsion engines, Krakower was charged with navigating early research and development – the work was open-ended and challenged the intern team to map their own course. Krakower was quick to take

the helm of this experimental phase, channeling his earlier work with NASA, his Co-op with Constellation, and academic experience to shape this opportunity into a highly productive and inventive deep dive into work with nuclear thermal propulsion engines.

With the freedom of exploration that this position afforded him, Krakower spent the early part of his summer experience with NASA working on an experimental model a joint team of NASA Interns and University partners were using to investigate a liquid-core nuclear reactor. Reviewing and recreating this earlier model, Krakower demonstrated a key inconsistency – that the model didn't follow a fundamental physical law, the conservation of momentum.

In identifying this inconsistency, Krakower opened a line of inquiry that set the stage for his master's thesis. As a part of this NASA team, Krakower confronted engineering challenges that continue to inform his academic exploration at Drexel. Conversely, aspects of his education, even the most basic physical laws that are taught in introductory physics courses, continually informed his work in NASA's Propulsion Research and Development Lab.

Throughout the summer, Krakower relied on innovative problem solving to navigate the experimental roadblocks that came along. He tackled challenges in experimental design as they emerged. To address difficulties in measuring liquid metals, for instance, Krakower drew from his experience in Drexel's Complex fluid and Multiphase Transport lab to devise a multiphase experiment. Realizing his experimental designs also required Krakower to grow and adapt, as he improved his own manufacturing skills to keep the project going when a professional machinist was unavailable.

As the other interns returned to classes at the end of August, Krakower's schedule afforded him additional time in Alabama to continue his experimental work. Now, as he navigates his master's thesis, Krakower continues to engage with his research within the HT-NTP project at PRDL, returning to the modeling problem with which he began his internship. This spirit of exploration and the interaction between a Drexel engineering education and real-world experience lies at the heart of a deeply enriching Co-op. Not only has Krakower's curricular and independent studies at Drexel prepared him for work at NASA, but the hands-on experience in at PRDL has deepened his ambitions as a student and researcher.



Beginning the moment he reached out to Dr. Houts, Krakower let his curiosity be his guide. Drexel's flexibility in accommodating independent studies and atypical Co-op's streamlined Krakower's experience, providing a strong foundation for charting his own course. Reflecting on this flexibility, Krakower emphasizes that the opportunities to embrace whatever excites you will always be available, so long as you "take initiative and seek it, as there are always avenues that can be explored to get you what you need and where you can learn what you want to learn."

According to Krakower, following your curiosity can be as simple as an online search to offer new insight on a topic covered in class or as complex as seeking out advanced papers and graduate level textbooks. For Krakower, it is important to remind yourself as you explore higher levels of complexity as an engineering student that “it's okay if it takes you a long time to learn something. What we do is not easy by any measure, so it's important to have patience with yourself as you struggle through the more complicated things.”