**RESEARCH PROPOSAL:** (Maximum size: 350 words/2800 characters.) Write a research proposal in your own words, intended for a non-expert audience. Your faculty mentor should review your responses before submission. Your proposal should include:

* Research Problem & Significance
  1. Clearly state the research question or problem your project addresses
  2. Explain why this question matters: What potential impact could your research have on the field? For example, you can describe how your work might influence concepts, methods, technologies, treatments, services, or interventions—either in theory or practice
* Your role in the project and research group
  1. Describe your specific objectives within the project
  2. Briefly outline the methods you will use and the tasks you will carry out
  3. Explain how you will collaborate with others (e.g., faculty mentor, research team, external partners), including mentoring or training you expect to receive
* If you have been previously funded through this program (on any research project), please describe your progress to date. Explain how funding will support your continued development and the advancement of the current project

The Herring River Estuary at Cape Cod National Seashore historically contained extensive salt marshes. After the Chequessett Neck Road dike was constructed in 1909 for flood control, tidal flow into and out of the estuary was severely restricted – there is only one small culvert that allows tidal saltwater to travel upstream of the dike. The ecology of the estuary suffered as invasive freshwater grasses overtook the salt marshes and water quality declined.

The National Park Service is leading a $50 million restoration project that will install a larger and adjustable tide control structure. Our project supports this work by developing an understanding of the tidal flow conditions through the existing culvert, providing critical data for the safe and controlled reintroduction of tides to the estuary.

The graduate student working on this project has performed field measurements of the water velocity as it enters the culverts. He found that these measurements did not agree with previously developed models of the culverts. To help explain the discrepancies between the measurements and models, I will construct scale models of the culvert in the lab and perform controlled experiments to observe the flow dynamics inside the culvert. This project will require me to learn new lab techniques in experimental fluid mechanics, such as methods for measuring water velocities and flow pattern tracking. Throughout the project, I will work closely with and receive guidance from both my faculty mentor and the graduate student.

The success of this project will not only increase the resilience of this critical estuary ecosystem to sea level rise but serve as a model for future coastal restoration projects. Additionally, salt marshes act as carbon sinks, while freshwater wetlands are a source of atmospheric methane – restoring the Herring River Estuary to its original salt marshes could sequester hundreds of thousands of tons of carbon dioxide. The coastal restoration model we are contributing to, if scaled, can become a viable method of reducing greenhouse gas emissions and can thus contribute to the mitigation of climate change.

**PERSONAL STATEMENT:**(Maximum length: 300 words/2400 characters): Please submit a brief statement addressing the following:

* What existing skills (technical, professional, interpersonal, or other) and experiences (academic, professional, personal) do you bring to this research experience that will support your success?
* What new skills or knowledge do you hope to gain from this experience?
* How does this research experience align with your academic and professional goals?

During my sophomore year, I worked on a related research project in the DeFrees hydraulics lab. This experience was one of my first research experiences, and I was able to work closely with and receive mentorship from the graduate student that led the project. Throughout the project, I learned about the research process and experimental design, literature review and writing, and data analysis and organization. Additionally, the sensors and data acquisition techniques I helped set up and operate for the previous project will also be used for this research experience, and the familiarity I have will serve as a springboard for the new project.

Although some of the lab work I’ll be doing for this project will be familiar, there are many new research techniques in environmental fluid mechanics that I hope to learn about with this experience – for example, simulating conditions of environmental systems in the wave flumes, and measuring water velocities with infrared cameras. The context of this project is also new to me, and I hope to gain knowledge about coastal resilience and restoration, which I have been curious about throughout my undergraduate career.

I will be working closely with Professor Todd Cowen and his graduate student Evan Heberlein, and hope that their mentorship and feedback will help me continue to grow as an engineer and researcher. They have already provided me with opportunities to present my work during the environmental fluid mechanics lab seminar and pursue publication, both experiences that will challenge me and develop new skills.

In my future career, I hope to apply my engineering skillsets to water-related climate resilience projects, especially those grounded in ecological solutions. This project is the perfect opportunity to dive into these interests and discover future opportunities and connections within the field.