

CITIZEN SCIENCE AND HIGH TIDE FLOODING: ONGOING MONITORING EFFORTS BY UNH INNOVATION SCHOLARS

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BACKGROUND

THE INNOVATION SCHOLARS PROGRAM

- Established in 2018
- Year-long experience for first-year UNH CEPS students
- Hands-on, research-based opportunities with UNH faculty, staff, and graduate students, and within local communities
- Four Cohorts: Advanced Manufacturing, Biomaterials, Internet Engineering, and *Ocean and Environmental Sensing*

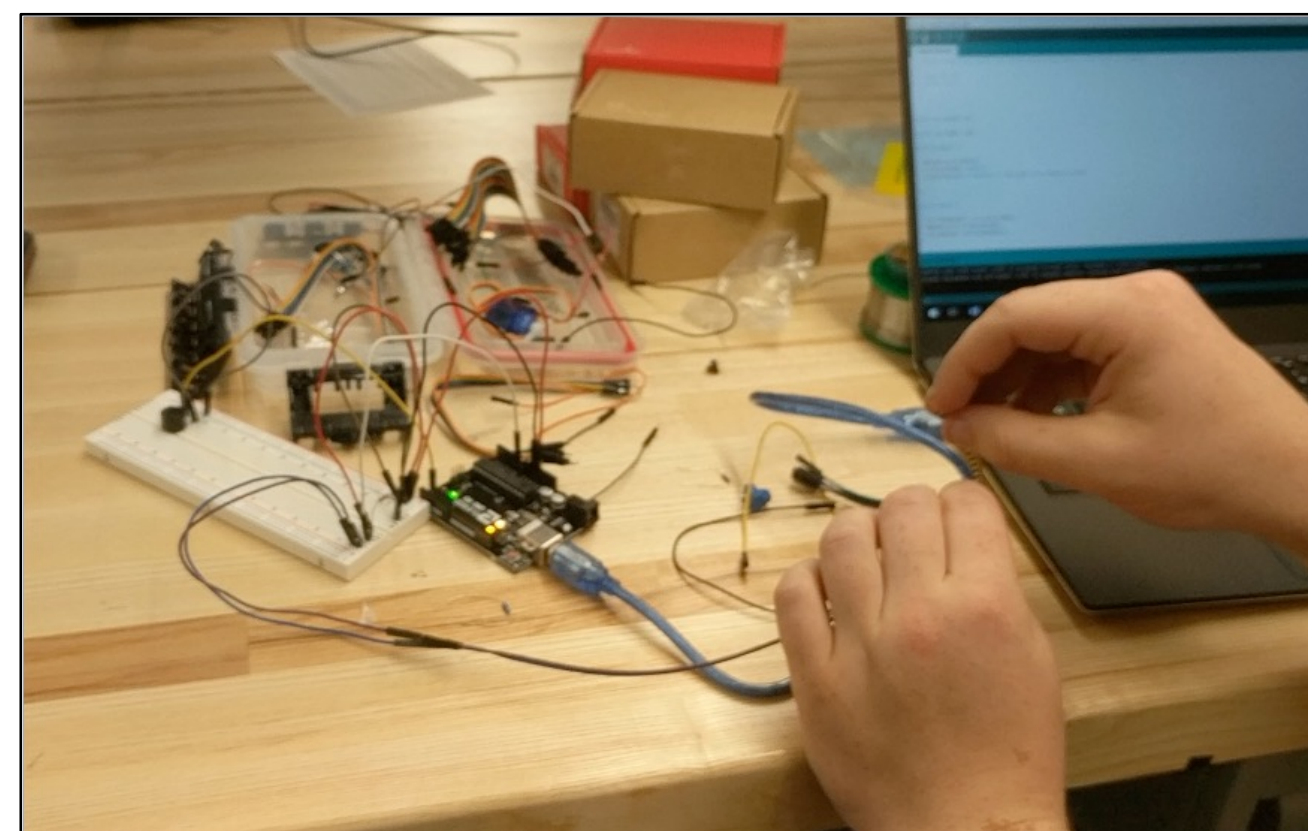


Figure 1: Students work with Arduino microcontrollers to operate simple sensors.

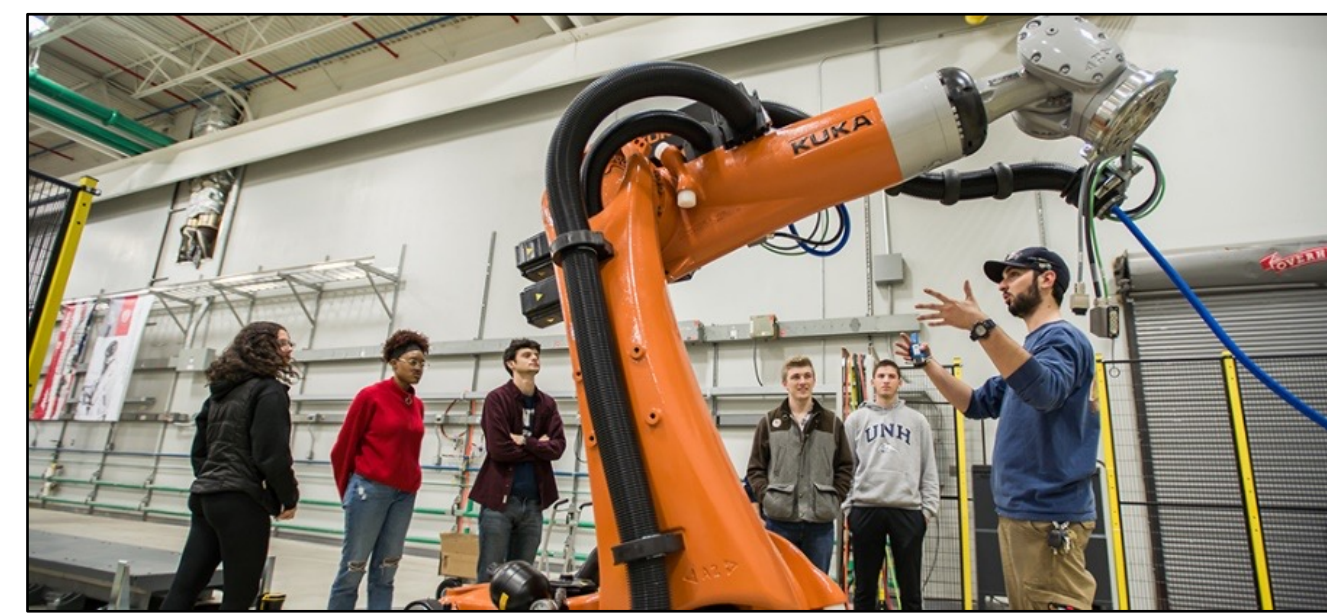


Figure 2: Students with a large robotic arm in the John Olson Advanced Manufacturing Center. Photo courtesy of the Advanced Manufacturing Cohort.

OCEAN & ENVIRONMENTAL SENSING COHORT

- Building and employing new research skills, e.g.:
 - Programming microcontrollers
 - Soldering & circuitry basics
 - Critical scientific thinking
 - Experiment planning and execution
- Use of common instruments, methods for oceanographic research



Figure 3: IMUs installed on simple floatation devices (bottom left) awaiting testing in the Chase Engineering Laboratory Wave Tank (right).

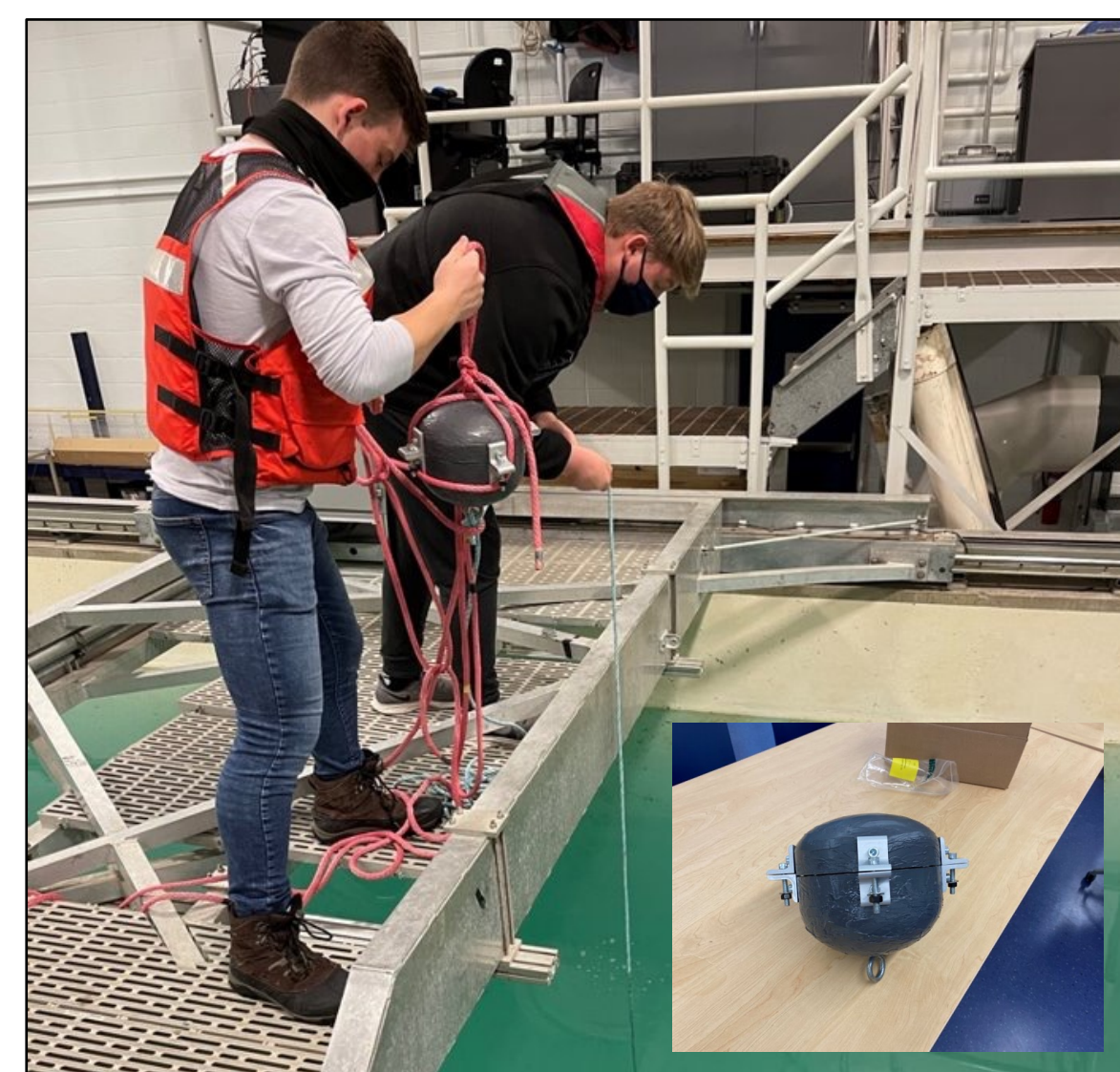


Figure 4: Students Steven Wilson (left) and Jackson Perkins (right) prepare to test the buoyancy of their 3D-printed wave buoy (inset) in the Chase Wave Tank.

COURSE OBJECTIVES

HAMPTON, NH SUNNY DAY FLOODING



Figure 5: A small ultrasonic sensor (center left, on the telephone pole) records the water elevation as it floods onto Hobson Ave.

- Significant increase in frequency and severity of flooding in the community during high tide and king tide events
- Since 2018, students in this cohort have been involved in data collection and monitoring efforts during this “sunny day” flooding



Figure 6: Left, the Innovation Scholars speak with business owners and residents about flooding during a 2021 trip to Hampton. Right, students visit a Hampton home being raised in response to flooding.

INSTRUMENT DEVELOPMENT

- Students tasked with designing simple, low-cost instruments to monitor conditions before, during, and after flooding
- Students perform all aspects of design: coding, wiring, design and manufacture, testing, troubleshooting, deployment, retrieval, and data analysis

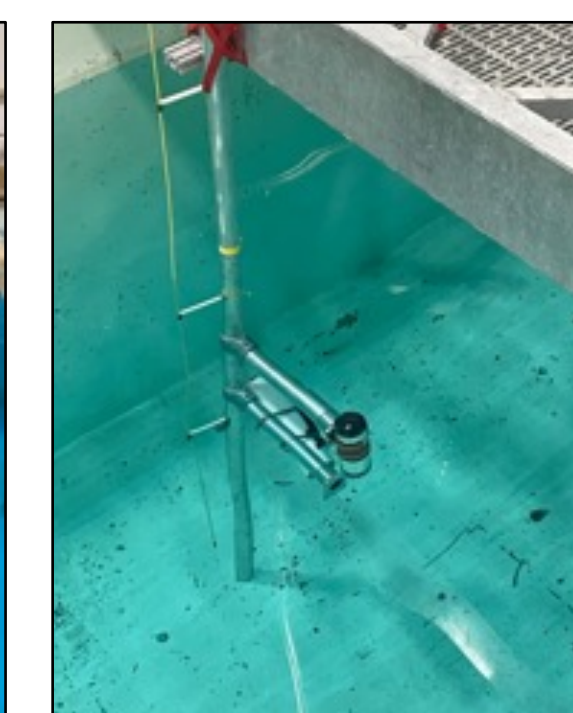


Figure 7: Left, students Anne Berg and Catey Selby manufacture electronics shelves for their instruments. Center, Anne prepares to test the waterproof seal on her instrument housing in the Chase Engineering Tank. Right, the same housing awaits testing under wave forcing in the Chase Wave Tank.

RESEARCH EFFORTS

WATER QUALITY

2020-2021: Students designed and deployed the “AWQuaS” (Analytic Water Quality Sensor), an instrument that monitors the pH, temperature, and conductivity of floodwaters. These observations may provide information on how flooding affects local infrastructure.

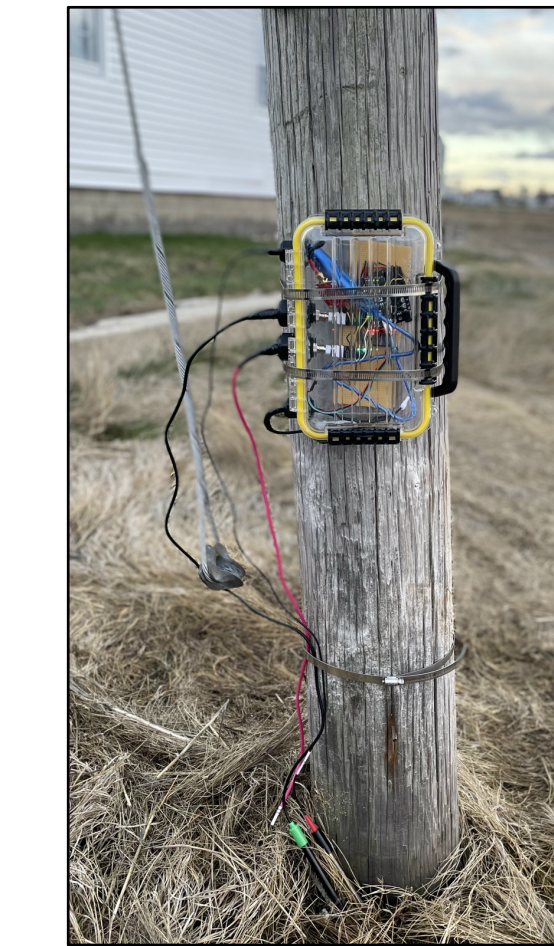


Figure 8: Left, the AWQuaS deployed in the spring of 2021 on a telephone pole at the end of Hobson Ave.

WATER LEVEL & TEMPERATURE

2021-2022: Students designed an instrument to collect floodwater pressure and temperature data. The instrument is a simpler version of the “BRPT” (Blue Robotics Pressure & Temperature instrument) designed by Spencer Marquardt (UNH ‘22G).

2022-Current: Students are implementing an improved housing design for the BRPTs and plan to deploy several in February 2023.

Observations from the BRPTs will provide information about the frequency and spatial extent of flooding.



Figure 9: Top left, the ‘21-’22 instrument. Right, the BRPT. Bottom left, the new ‘22-’23 housings.

WEATHER

2021-2022: Students designed and tested a preliminary weather station to collect meteorological data.

2022-Current: Students are continuing work on the weather station and plan to deploy it in February 2023. Localized weather data is useful for improving estimates of storm surge and wave transformation due to wind.



Figure 10: Left, the ‘21-’22 weather station during a test deployment on the UNH campus in the spring of 2022.

BEACH SLOPE

2022-Current: Students are collecting beach profile data at Hampton Beach using the Emery Method and GPS survey techniques. Data from these efforts will reveal changes in beach slope over time that may be impacted by flooding and severe weather.



Figure 11: Students at Hampton Beach after collecting beach profile data in October 2022.

ACKNOWLEDGMENTS

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