



eco catalyzers

Research Experiences for Teachers

2026 Water Justice Focus Area - Project Description

Advancing the Design of Small-Scale and Low-Cost Water Desalination Devices

Research Advisor: Marissa Forbes, Ph.D., Assistant Professor, Mechanical Engineering

External Mentor: Theresa Talley, Ph.D., Coastal Specialist, California Sea Grant

Student Scholar / Technical Learning Assistant: Elizabeth “Lizzie” Simpson

Additional Project Support Personnel:

- Michael Massaro, Engineering and Computing Librarian
- V. Dozier, Education Librarian
- Steven Saxer, Mechanical Engineering Technician & Shop Manager
- Jason Addy, Engineering Laboratory Technician
- Jeff Hoit, Electrical Lab Technician

Introduction / Project Overview:

This applied research and development project outlines an exploration to advance the design of small-scale, low-cost water desalination devices. Desalination is the process of removing salt from seawater. Using desalination, along with additional water treatment such as filtration and boiling, ocean water can be turned into safe drinking water. Numerous researchers, entrepreneurs, and DIY-ers have developed small-scale desalination devices. This project will examine existing designs, build and test selected devices, and explore opportunities to improve their cost, accessibility, reliability, efficacy, and environmental sustainability.



Figure 1: San Diego County’s Pacific coastline. A local context for exploring seawater desalination and emergency water access



Figure 2: Inside the Carlsbad Desalination Plant. A regional example of large-scale seawater desalination

Climate Change/ Environmental Sustainability Connection

Access to safe drinking water is a basic human right. Incidents of extreme weather are projected to increase as a result of climate change, and access to clean drinking water is predicted to change in complex and unpredictable ways (such as due to floods and droughts, changing sea levels, weather-related emergencies, and pollutant and sediment runoff). Retaining access to clean water during system failures and/or extreme weather emergencies is critical, including in industrialized settings with historically unreliable access to safe drinking water. As such, there is a need for widely accessible, portable, energy-efficient, and effective drinking water treatment devices.

Research Questions:

- In coastal areas, like ours, how can ocean water be used as emergency drinking water using simple materials?
- How is desalination done at the large-scale (i.e. desalination plants), and what designs exist for small-scale and low-tech desalination?
- How can we improve the design of small-scale desalination devices to lower their cost and accessibility, increase their reliability/efficacy, and make their production more sustainable?
- What is the true cost (both financial and environmental) of these 'low-cost' water filters?

Research & Development Plan:

1. Conduct a comprehensive survey of existing low-tech, small scale desalination device designs and research done about them.
 - Conduct a literature review to see what's out there.
 - Try them—build and test!
2. Develop a testing protocol to assess the effectiveness of the desalination devices (should meet regulated drinking water standards for salinity).
 - Identify drinking water regulations and standards for water quality testing.
 - Identify, gather, and test materials needed to conduct water quality testing.
 - Assess the effectiveness of the preexisting designs.
3. Identify areas to improve the designs of the devices.
4. Design and test new prototypes.
 - Explore the use of locally sourced, waste-upcycled materials in your designs.