RI SURF 2020

RI Consortium for Coastal Ecology Assessment, Innovation, & Modeling

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Uncovering the effects of Narragansett Bay pollutants on vertebrate development

- Steven Weicksel (Bryant)

Project Location
Bryant University (Smithfield, RI)

Open to SURF Flex applicants?
Yes

Project Description
Using the model organism Danio rerio we aim to uncover the molecular basis for disruption of vertebrate development due to common Narragansett bay pollutants. In particular, we will focus on pollutants that are often introduced into the bay through micro-plastics. This data will allow researchers to better understand how many of these pollutants are affecting the biology of the bay.

This is an excellent opportunity for those that wish to answer questions that impact our local environment. In addition students will learn and gain valuable training in molecular biological techniques such as PCR, In Situ hybridization, and how to work with model organisms.

*This project is part of **RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants
None required.

Is student transportation needed for this project?
No

Changes to the surface glycans of the zooplankton *Oxyrhris marina* during resource deprivation

- Christopher Reid (Bryant)

Project Location
Bryant University (Smithfield, RI)

Open to SURF Flex applicants?
Yes

Project Description
Oxyrrhis marina is a globally distributed heterotrophic dinoflagellate commonly found in marine and saltwater coastlines. Their cell surface displays an array of polysaccharides, both N- and O-linked. These carbohydrates are used by cells for a multitude of functions including communication, adhesion, and regulation. In a previous study in our lab, changes to the *O. marina* neutral lipid content during starvation was observed, which ultimately has led to curiosity of starvation induced changes to the cell surface, in particular N-linked glycans. We will continue to use *O. marina* as a model to investigate the changes to the cell's surface N-glycans under satiated and starvation conditions. *O. marina* will be subjected to long term resource deprivation (21 days) and the changes to the cell surface analyzed. The N-glycans were liberated via enzyme treatment, and labeled with 2-aminobenzamide (2AB) via reductive amination. Derivatized glycan profiles were analyzed by MALDI-TOF mass spectrometry. The resulting glycan profiles were then annotated using available databases (ie Glycomod) and via manual analysis. Our characterization of the *O. marina* surface provides opportunities for a greater understanding of cell signaling and communication in saturation and starved conditions. In addition, this work will provide the first report of the N-linked glycome in this extensively studied marine dinoflagellate.

This project is part of ***RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

This project involves ***primarily lab or computer work***

Required/preferred skills for student applicants
basic microbiological skills

Is student transportation needed for this project?
No

Imaging and DNA barcoding the organisms of Narragansett Bay

- Joe DeGiorgis (PC)

Project Location
Providence College (Providence, RI)

Open to SURF Flex applicants?
Yes
This project is SURF Flex only : 20 hours per week for ten weeks. We will work two 8 hour days and one 4 hour day each week.

Project Description
This summer we will collect marine life from Narragansett Bay in order to identify, photograph, and DNA barcode the species found in this remarkable ecosystem. We will use a variety of collecting techniques including dip netting, piling scraping, plankton tow, and others. Each species will be photographed in the laboratory/photographic studio setting through macrophotography as well as brightfield, darkfield, phase contrast, DIC, fluorescent, confocal, and electron microscopy. We will used techniques of the polymerase chain reaction to amplify specific genes within our collected organisms as a means of identifying and cataloging each species. For a select few, we will use a small Minion DNA sequencer to obtain transcriptome (mRNA) and genome information. We will use bioinformatic analysis to identify the proteins expressed in these species. We will present our findings at the annual C-AIM symposium at the end of the summer.

*This project is part of **RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants
This work is amenable to student at all skill level. No prerequisites are required.

Is student transportation needed for this project?
No

Tolerating Intolerable Toxins: How does the Atlantic killifish survive in SuperFund sites?

- Jeffrey Markert (PC)

Project Location
Providence College (Providence, RI)

Open to SURF Flex applicants?
Yes

Project Description
I am interested in understanding how (or whether) creatures can adapt to harmful environmental changes. Our research group combines careful field work with state-of-the-art genetic technologies to understand the evolutionary mechanisms that sometimes allow populations to persist and thrive in heavily polluted habitats. This summer's project will focus on the evolutionary population genetics of the estuarine fish Fundulus heteroclitus.

Although releases of toxins into our waterways have nearly ceased since the 1970s, levels of pollution in local habitats can be quite high. For example, sediments in New Bedford Harbor (NBH) contain levels of polychlorinated biphenyls (PCBs) that are greater than 10,000 times above guideline levels. This is an important fact, given that PCBs are linked with a host of health problems in both humans and animals, including neurotoxicity, immunosuppression, developmental problems and carcinogenesis. Disturbingly, many coastal waterways along the U.S. east coast are similarly polluted, including some in Rhode Island.

While the most contaminated parts of NBH have impoverished biological communities, the plucky Atlantic killifish (*Fundulus heteroclitus*) is able to thrive in NBH and other highly contaminated habitats. Experimental evidence generated by our collaborators has demonstrated that fish from pristine habitats fare poorly when exposed to the toxins in NBH sediments, consistent with tolerance to PCBs having evolved in situ. Intriguingly, this tolerance has evolved recently on an evolutionary times scale. PCBs were not being released into NBH before the 1940s.

We are currently working with our collaborators at the EPA's Atlantic Coastal Environmental Sciences division in Narragansett on a long-term project aimed at addressing two distinct questions:

1) What is the population genetic context for the rapid and repeated adaptation to organic pollutants and heavy metals?

2) Which loci and alleles are associated with adaptation to pollution tolerance?

SURF students will gain direct experience working in the field to collect samples for this project, collecting genotype data, and learning the analytical tools needed to interpret these results.

This project is part of ***RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

This project involves ***both field & lab/computer work***

Required/preferred skills for student applicants

A passion for environmental biology, attention to detail, good record keeping skills, and a strong work ethic are the most important traits. The basic lab skills taught in an Introductory Biology class are a solid starting point. Students who have course or practical experience in genetics and an aptitude for the R programming language would be especially well-suited to this position, but these are not a requirement. A valid drivers license will be helpful.

Is student transportation needed for this project?

No

Students should be able to get to the Providence College campus during normal working hours (and sometimes a bit earlier). We will mostly use school vans for field expeditions.

PC student applicants may be able to arrange on campus housing for the summer.

Metabolic requirements of Narragansett Bay fish species for modelling input under changing scenarios of temperature and turbulence

- Anabela Maia (RIC)

Project Location
Rhode Island College (Providence, RI)

Open to SURF Flex applicants?
Yes

Project Description
The effects of climate change are particularly strong in estuarine habitats where animals are already exposed to a variety of stressors, including other anthropogenic pressures and changes in salinity. Summer temperatures in Narragansett Bay have seen a steady increase in the last decades, with even more pronounced temperature increases over winter months. Channeling and boat traffic have also changed the turbulence regimes of the Bay. These impacts are likely to affect fish metabolic demands, growth and ultimately productivity. Previous work from our lab has found that fish change their swimming ability with increased temperatures and that this is likely related to changes in population dynamics of black sea bass and scup. We aim to understand how the metabolic demands of different Narragansett fish species change under different temperature and turbulence regimes. We will measure specific dynamic action (energy required for digestion), basal metabolism (energy required at rest) and active metabolism (energy required for the fish daily activities, such as swimming) using respirometry by measuring oxygen consumption in a closed flow tank under different temperatures. We will also look at how changing the turbulence in the water affects fish species of the Bay. Our main goal is to inform modelers of fish productivity and metabolic demands to improve on our predictability of ecosystem changes in the Bay. We expect to see that metabolism will be affected differently in species according to their thermal sensitivity and body shape in the case of turbulence.

This project is part of ***RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

This project involves ***primarily lab or computer work***

Required/preferred skills for student applicants
Preferred skills: knowledge of fish husbandry; some physiology background (e.g. animal or human physiology course)

Is student transportation needed for this project?
No

Visualizing ecosystem dynamics in Narragansett Bay through large scale projection mapping

- Jennifer Bissonnette (RISD), Georgia Rhodes (RISD) & Stewart Copeland (RISD)

Project Location

Rhode Island School of Design (Providence, RI)

Open to SURF Flex applicants?

Yes

Project Description

RISD Nature Lab is working on the creation of a three-dimensional mobile visualization platform for viewing animations of ocean model simulations based on data obtained through C-AIM projects. Using publicly available LIDAR data created by NOAA, we have already created a complete polygonal mesh of Narragansett Bay and its bathymetry, resulting in a computer-generated model that can be 3D printed to create a scale model. The resulting 3D print is then used as a platform for projection mapping: a process by which computer software rectifies video signal to align a projected image to a complex physical surface.

In this project, a large scale public installation of these data visualizations projected onto a 10-foot long 3D model of Narragansett Bay, will turn C-AIM data into a mobile theatre, connecting scientists with the public and linking everyone to the bay. This visualization platform shifts viewers from spectators into participants as they interpret the relationships between static and dynamic properties in the represented environment. The ability to represent climate modeling and data simulations in a geospatially sound, three-dimensional environment will allow researchers to communicate complex dynamics and anthropogenic impacts in an engaging and compelling way.

The next iteration of this research is to develop a workflow from computer-generated physical dynamics simulations to the creation of novel visualizations contextualized within a 3-dimensional representation of Narragansett Bay. Data resulting from these simulations can be manipulated in professional animation software, such as Autodesk Maya. This will allow us to create true 3D animations of the data inside a virtual model. Dynamic projection possibilities will then be explored using our projection system and also online, where tactile experiences like the projection can be seen in virtual or augmented reality spaces. The SURF student will become an integral member of our animation team, learning about bay dynamics and working on creating dynamic visualizations of large scale ecological processes.

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*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants

A strong interest and skill set in computer science, animation and data visualization is most relevant. Ideally, the student(s) would have a good working knowledge of Autodesk Maya or similar 3D computer animation software. Although this project is a collaboration with RISD, previous experience or knowledge of art and design is not necessary.

Is student transportation needed for this project?

No

Sediment depth profile of *in-situ* anion (NO_3^- and PO_4^{3-}) assisted attenuated remediation of halogenated hydrocarbons

- Stephen O'Shea (RWU)

Project Location
Roger Williams University (Bristol, RI)

Open to SURF Flex applicants?
Yes

Project Description
Biochemical conversion is a valuable requisite for predicting the fate and rate with which xenobiotics may be transformed in the soil-water sphere. The goal of this research is to further understand the in-situ transformations of halo-organics (HCs) in core ocean sediment and wet land samples under various oxidation/reduction potential conditions of Narragansett Bay RI. The analysis of sediment and soil pore water by ion chromatography (anion/cation) will elucidate the primary micro-organismal metabolic catabolic oxidant and potential abiotic oxidant and allow to easily ascertain substrate halide release rates. Measuring directly a site's insitu capacity (soil/water) for transformation by treating it with a HC substrate that is capable of undergoing the fundamental processes of oxidation, reduction, and substitution lets the chemistry that occurs define the site. Both the nature and rates of these transformations can be assessed with carbon-labeled $^{13}C_2$ substrates and ^{13}C nuclear magnetic resonance spectroscopy analysis and head space gas chromatograph/mass spectroscopy. Many of the observed transformations HC substrates are facilitated micro-organismal enzymes. These transformations can be further enhanced by supplementation of limiting nutrients' nitrite, nitrate and phosphate to enhance microorganismal growth. Coupling of enhanced microorganism growth nutrients with exposure of HC substrates the in situ rate of transformation can be further assessed and to the extent to which microorganisms' are involved.

This project is part of ***RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

This project involves ***primarily lab or computer work***

Required/preferred skills for student applicants
Beginning junior science student -Chemistry, environmental science or biology major

Is student transportation needed for this project?
No

Monitoring the reproductive success of sentinel species in Narragansett Bay

- Jameson Chace (SRU)

Project Location
Salve Regina University (Newport, RI)

Open to SURF Flex applicants?
Yes

Project Description
Colonial nesting waterbirds occur on protected islands across Narragansett Bay and Osprey breeding populations have rebounded throughout many of the tributaries to the Bay. These species, collectively, have responded to environmental quality in the past and are sentinels of future changes in the ecosystem because of their position as top predators. During the breeding season we will monitor the reproductive health of these species and combine current with historic breeding information. Furthermore, we will quantify the bioaccumulation of toxins sequestered in the tissues of the young born this year.

*This project is part of **RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants
swimming ability is required
comfortable on small boats and climbing through brambles to check nests

Is student transportation needed for this project?
Yes
Boat access and shoreline access will occur at different locations in the state, students are expected to carpool as needed.

The response of habitat-forming seaweeds to stressors

- Lindsay Green-Gavrielidis (SRU)

Project Location
Salve Regina University (Newport, RI)

Open to SURF Flex applicants?
Yes

Project Description
Habitat-forming seaweeds such as rockweeds (Order Fucales) are ecosystem engineers that form dynamic habitats in cool-water regions and support complex food webs. Rockweeds, such as *Fucus* spp. and *Ascophyllum nodosum*, are dominant, temperate seaweeds in the intertidal and shallow subtidal of rocky shorelines. These seaweeds provide food and habitat to ecologically and economically important invertebrates and fishes and are generally long-lived. Changes in the distribution or abundance of habitat-forming seaweeds can have dramatic consequences for the associated food webs and ecosystem health. Recent research has shown that rockweed populations in Narragansett Bay have changed significantly over the past 30-40 years, with populations in the north of the bay declining and populations in the south of the bay increasing. To further understand these changes, field and laboratory research will be conducted on rockweed populations throughout the state to understand how they may respond differently to physical (e.g. climate change) and biological (e.g. non-native species) stressors. This data will shed light on why rockweed populations have been changing and may allow us to predict future changes in these vital marine habitats in the future.

This project is part of ***RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

This project involves ***both field & lab/computer work***

Required/preferred skills for student applicants
This project will consist of field and laboratory experiments and seaweed culturing. Required skills for this project include an ability to work carefully, comfort in working outside in summer weather, familiarity with microscopy, a flexible work schedule as some weekend work may be required, and a familiarity with Microsoft Excel.

Is student transportation needed for this project?
No
Personal transportation is preferred but not required.

Characterization of biofilm formation by marine bacteria from Narragansett Bay and development of *in vitro* conditions for screening of anti-biofouling materials.

- Anne Reid (SRU)

Project Location

Salve Regina University (Newport, RI)

Open to SURF Flex applicants?

Yes

Project Description

Climate change is poised to significantly alter ocean conditions, impacting species at every trophic level. Much like bacteria in other habitats, marine microorganisms form multi-species communities known as biofilms. Secondary to the colonization of surfaces by bacteria, larger organisms such as protozoa and algal spores can interact with the bacterial film, increasing the size and complexity of film communities. As primary colonizers of submerged surfaces, bacteria are important players in the biofouling process. This study aims to identify which Narragansett Bay microbes are involved in primary and secondary colonization of surfaces and determine how a changing climate might impact these interactions. The data generated from these studies will inform strategies to mitigate biofouling of submerged sensor components.

To date, 70 marine microbes belonging to 17 genera have been isolated in pure culture from Narragansett Bay. Several of these strains have exhibited strong pellicle and biofilm formation in standard lab assays. These efficient primary colonizers on glass and polystyrene surfaces will now be used to assay biofilm formation on PMDS coupons in vitro and to test the efficacy of antifouling coatings in reducing bacterial interactions with this sensor material.

Previous studies have shown that co-culture of microbes originating from the same environment can have synergistic effects on biofilm formation. Combinations of microbes (including pairings between phylogenetically-related and distantly-related bacteria) will be co-cultured and subjected to biofilm assays in order to identify microbial interactions that promote biofilm formation. These co-culture experiments are expected to identify pairs of microbes whose biofilm formation abilities go beyond those of individual strains, which will yield additional test conditions for anti-biofouling materials.

Our understanding of primary biofilm colonization events will be further extended by studies aiming to identify secondary colonizers from our collection of Narragansett Bay bacteria. The ability of bacteria to join existing biofilms will be assessed in order to identify secondary colonizers that will allow us to build more complex communities that better mimic naturally-occurring films. The ability of these multi-species biofilms to recruit diatoms will then be assessed in an effort to understand which combinations of primary and secondary colonizers are most likely to recruit higher trophic level organisms.

In order to better understand the distinctions between biofilms generated by primary colonizers, co-cultured bacteria, and primary plus secondary colonizers, the architecture of the biofilms will be examined by confocal microscopy. Attempts will be made to correlate these structural biofilm features to the potential of these films to recruit diatoms. By recreating the stages of biofilm formation in the laboratory using organisms isolated from Narragansett Bay, we hope to produce in vitro assays that effectively mimic the natural biofouling process in the Bay and that can be used to screen antifouling materials and/or coatings for use in sensor components.

*This project is part of **RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants

The following skills are preferred, but not required

- training will be provided to the successful candidate(s)
- preparation of agars and broths for bacterial culture
- aseptic technique and culture of microbes
- basic molecular biology skills (use of pipettor, agarose gel electrophoresis, PCR)

Is student transportation needed for this project?

No

Phytoplankton and optical variability in Narragansett Bay

- Colleen Mouw (URI-GSO), Virginie Sonnet (URI-GSO), Jessica Carney (URI-GSO), Kyle Turner (URI-GSO) & Audrey Ciochetto (URI-GSO)

Project Location

University of Rhode Island - Bay Campus (Narragansett, RI)

Open to SURF Flex applicants?

Yes

Project Description

Phytoplankton composition is a critical component of aquatic food web structure, societally import and fisheries, and human health. The SURF student will aid in the operation and data analysis of a continuous observatory of optical properties and phytoplankton composition with an Imaging Flow CytoBot (IFCB, http://mclanelabs.com/imaging-flowcytobot/). Continuous observations have been ongoing for the last 2 years (http://phyto-optics.gso.uri.edu:8888/GSODock) at the Graduate School of Oceanography's (GSO) dock. The historical and on-going data record at the dock enables a connection between phytoplankton identification and spectral signatures used by satellite radiometers. The location at the plankton survey site will allow the IFCB observations to be interpreted within a long-term context of varying environmental drivers of phytoplankton diversity. The SURF student will aid in maintenance and weekly sample collection and laboratory analysis that supplements the continuous observations. The student will also aid in data analysis of relationships between optical properties and phytoplankton composition variability.

*This project is part of **RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants

Some laboratory experience (could be through coursework) and interest in phytoplankton and coastal oceanography is a must. Additional experience with Matlab or other computer languages and a desire to improve your coding skills through applied data analysis is ideal, but not required.

Is student transportation needed for this project?

No

Benthic protist diversity in coastal Rhode Island

- Roxanne Beinart (URI-GSO) & Anna Schrecengost (URI-GSO)

Project Location
University of Rhode Island - Bay Campus (Narragansett, RI)

Open to SURF Flex applicants?
Yes

Project Description
Benthic protists (unicellular eukaryotes) have an important role in marine food webs and biogeochemical cycling. This project will examine the diversity, distribution, and abundance of benthic protists, with a focus on anaerobic ciliates, in coastal sediments in Narragansett Bay and around Rhode Island. The student intern will use molecular and microscopic approaches to assess the diversity and abundance of protists in relation to environmental characteristics, as well as will work with cultures of anaerobic protists from local marine habitats.

*This project is part of **RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants
This project is appropriate for students interested in microbial ecology, environmental microbiology, and/or marine biology. Experience with molecular biology and/or microscopy is preferred but not a requirement.

Is student transportation needed for this project?
Yes
Students will need to be able to drive themselves to coastal field sites to collect samples.

Observing the oceanic conditions within Narragansett Bay

- Andrew Davies (URI)

Project Location
University of Rhode Island - Bay Campus (Narragansett, RI)

Open to SURF Flex applicants?
Yes

Project Description
Observation is a fundamental area of science that underpins much that comes after, such as models, forecasting, experimentation and so on. In this project, we will be working with the Narragansett Bay Ocean Observatories, a series of high-tech buoys that aim to provide real time data on various hydrographic, biological and biogeochemical variables.

In this project, we will undertake three core activities: 1) Maintenance, servicing and calibration of the buoy infrastructure. These are activities essential to producing reliable data and ensuring that our instrumentation remains in good condition. 2) Develop new technologies for the buoys. We will work with 3D printing, computer controlled milling machines and open source electronics to build new capabilities for the observatories. 3) Data analysis and dissemination. We will also analyze our data, look for patterns and linkages, and disseminate these to the wider C-AIM community.

*This project is part of **RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants
Students will work within a highly motivated team that works with the observatories, so must demonstrate willingness to work in a team. You will need to have good problem solving abilities, good computer capabilities and a willingness to undertake fieldwork from small boats. Skills such as computer-programming, CAD and graphic design and prior experience of 3D printing would be beneficial.

Is student transportation needed for this project?
No

Assessing nutrient fluxes transported via submarine groundwater discharge (SGD) into Rhode Island coastal estuaries using radionuclide tracers and airborne thermal infrared (TIR) imaging

- Soni Pradhanang (URI), Rebecca Robinson (URI-GSO), Roger Kelly (URI-GSO) & Kyle Young (URI)

Project Location

University of Rhode Island - Bay Campus (Narragansett, RI)

Open to SURF Flex applicants?

Yes

Project Description

Submarine groundwater discharge (SGD) is a dominant water flux to coastal marine waterbodies, bringing with it nutrients and pollutants from terrestrial groundwater aquifers and representing a significant chemical transport mechanism in the hydrologic system. Previous studies indicate that SGD is likely a principle source of nutrient loading to Rhode Island coastal estuaries, though none have yet quantified the SGD-derived nutrient fluxes, their physical/chemical fate and transport, and their ecological impacts on these waterbodies.

We will use naturally-occurring chemical and radionuclide tracers, including Radon (Rn), Radium (Ra), and salinity, to quantify SGD into three coastal Rhode Island estuaries – Greenwich Bay, Ninigret Pond, and Green Hill Pond. We will concurrently measure nutrient concentrations of coastal waters, submarine porewaters, and terrestrial groundwater to determine the SGD-transported nutrient fluxes to these coastal ecosystems and to assess the physical and chemical mechanisms involved in their transport. We will also use an unmanned aircraft/drone to conduct thermal infrared (TIR) imaging of the coastal estuaries and we will quantify various terrestrial hydrogeologic properties – including hydraulic gradients, porosities, and hydraulic conductivities – to assess the spatial variability of SGD and its potential physical controls.

This project will integrate field work, lab work, and some data processing using GIS and excel. The field and lab work will be conducted from late May to early August, with 1 week of field sampling conducted by small boat in Greenwich Bay, Ninigret Pond, and Green Hill Pond, and 4-6 weeks of field work conducted from shore sites around the three estuaries. Each field day will be followed by preliminary radionuclide lab work at the URI Bay Campus. Additional lab work for radionuclide and nutrient analyses and preliminary data processing will be completed at URI Bay Campus and URI Main Campus throughout July.

*This project is part of **RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants

We are looking for undergraduate students who have taken general chemistry & lab, have an interest in earth/environmental science and/or oceanography, are able to work well on a team and follow detailed instructions, have relatively flexible working hours, and are willing to work in various environmental conditions including onboard a small research vessel.

Is student transportation needed for this project?

Yes

Student(s) must have transportation to/from URI Bay Campus where most field supplies will be staged and transported from. Transportation to/from field sites from URI Bay Campus will be provided.

Plastic ingestion in seabirds from the Gulf of Maine

- Anna Robuck (URI-GSO) & Rainer Lohmann (URI-GSO)

Project Location
University of Rhode Island - Bay Campus (Narragansett, RI)

Open to SURF Flex applicants?
Yes

Project Description
Seabirds in the Order Procellariiformes, like Great Shearwaters (GRSH; *Ardenna gravis*), are particularly prone to plastic ingestion, with 71% of sampled GRSH from 2005 – 2008 along the U.S. East Coast containing at least one piece of plastic (n = 17). Surface water plastic abundance is correlated with plastic production, and plastic production is slated to quadruple by 2050. Therefore, seabird plastic ingestion will likely increase with unknown consequences for seabird population resilience. This project will make use of an existing sample set of GRSH from the Gulf of Maine during 2007 – 2019, to provide one of the first comprehensive estimates of plastic ingestion by Great Shearwaters in the North Atlantic. The SURF student build upon previous work and will count, measure, and assess the color of ingested plastic debris from necropsied GRSH. The student will also determine patterns and trends between plastic identity, plastic fragment characteristics, and seabird biological measurements. The selected student may also have the opportunity to explore individual research questions using the project data set, within the framework of existing project goals.

This research will include some literature review (computer-based work) alongside regular lab-based work using a dissection microscope and/or a constant light source. Occasional opportunities for field work may include day trips in Massachusetts Bay, or necropsy lab work at Woods Hole Oceanographic Institute. Students can expect to interact with graduate students, postdocs, government scientists, and faculty members in various capacities.

*This project is part of **RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants
Required: biology and chemistry coursework, eagerness to learn, and a strong ability to work independently while communicating results to a team.

Preferred: chemistry or biology laboratory experience, basic experience using a dissection microscope, interest in seabirds, interest in plastic pollution. Excel and basic R skills preferred but not required.

Is student transportation needed for this project?
No
The student will be expected to work regularly in lab facilities at the URI-GSO campus, and will need to arrange reliable transportation to and from the campus facility. The student does not necessarily need their own car, and will not be expected to travel independently for the project.

Occasional opportunities for field work in Massachusetts Bay or lab work in Falmouth, MA will be coordinated with the graduate student mentor, and will not require additional transportation arrangements.

Spatial and temporal patterns of microbial community diversity in Narragansett Bay

- Ying Zhang (URI) & Zachary Pimentel (URI)

Project Location
University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?
Yes

Project Description
Microbes play pivotal roles in coastal ecosystems such as in biogeochemical cycling (i.e carbon and nitrogen cycles) along with animal and human health. In this project, we aim to explore the relative abundance and distribution of microbes in the surface waters of Narragansett Bay, with a focus on the population of bacteria and archaea. Using existing multi-year collection of samples preserved from the 0.2-0.5 µm fraction of filtered surface water samples, the dynamics of microbial community profiles will be inspected across multiple temporal and spatial scales in association with diverse environmental factors. Students will receive training in field sampling and various molecular technologies, including DNA extraction, PCR amplification, and 16S rRNA gene based community profiling. Additional opportunities will be provided for the students to gain skills in high-performance computing and molecular sequencing data analysis. Understanding the identity of the microbes in Narragansett Bay is the first step in elucidating their functions in ecologically and economically relevant processes.

This project is part of ***RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

This project involves ***primarily lab or computer work***

Required/preferred skills for student applicants
Course preparation in microbiology, biochemistry, or related fields. Prior experiences with DNA extraction and PCR is preferred but not required.

Is student transportation needed for this project?
No

Determining drivers of domoic acid production in Narragansett Bay

- Matt Bertin (URI)
- Bethany Jenkins (URI)

Project Location

University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?

Yes

Project Description

This is an exciting, multidisciplinary project to address fundamental questions about the Narragansett Bay ecosystem. Some marine diatoms in the genus *Pseudo-nitzschia* (*P-n*) produce the neurotoxin domoic acid (DA). Despite the long-term presence of members of this genus in Narragansett Bay, domoic acid has only recently been detected during diatom blooms (Fall 2016). Through weekly sampling of water in Narragansett Bay, our collaborative research groups have shown that different members of *P-n* are found in the bay throughout the year, and we observe seasonal peaks in DA production in June and September/October. The student in this research project will continue to assist with the collection of times series data focusing primarily on the extraction of phytoplankton samples and the determination of DA values by way of LC-MS/MS under the supervision of a graduate researcher. The student will also assist with cultivating *P-n* strains and designing laboratory experiments to determine how certain biotic and abiotic parameters affect DA production in culture. The student will be trained in several important areas including molecular biology, microbiology, and analytical chemistry.

This project is part of ***RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

This project involves ***both field & lab/computer work***

Required/preferred skills for student applicants

Student should have completed general chemistry and organic chemistry. Classroom or laboratory experience with analytical chemistry is preferred but not required.

Is student transportation needed for this project?

Yes

Every effort will be made to limit the need for student to provide own transport to field sites. However, the dynamic nature of field sampling may necessitate instances in which student will need to transport self to the Wickford Shipyard or Graduate School of Oceanography campus.

Monitoring biodiversity along environmental gradients in Narragansett Bay

- Carlos Prada (URI)

Project Location
University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?
Yes

Project Description
Progress has been made in documenting changes in biodiversity across Narragansett Bay (NB) in relation to nutrient, oxygen and salinity dynamics both spatially and temporally with positive impacts on ecosystem management, but two chief barriers remain. First, traditional surveys to record biodiversity are expensive, laborious and require taxonomic expertise. The second is that visual census techniques or quadrats result in lower biodiversity estimates. This project builds upon previous biodiversity surveys as well as continuous monitoring of physical and chemical parameters across NB to understand the impacts of ecosystem change associated with nutrient dynamics. The fellow will investigate ecological dynamics of marine communities in Narragansett Bay by using environmental (eDNA) widely available in the water column. Under our supervision, the fellow will develop skills in water collection and filtering, DNA extraction and sequencing, and species identification for fast and efficient biodiversity monitoring. By studying changes in species composition in NB, the fellow will also be able to document changes to the ecosystem, provide new estimates of invasive species and document the spatial and temporal dynamics of community structure across seasons.

This project is part of ***RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

This project involves ***both field & lab/computer work***

Required/preferred skills for student applicants
We seek a SURF student who would feel comfortable working in a molecular lab setting as well as going to the field with our lab technician to collect water samples. The fellow will have to be meticulously organized to be able to process large number of samples and keep track of all of them. As part of the project, the SURF student would also help to analyze DNA sequences computationally with the help of a postdoc.

Is student transportation needed for this project?
No

Microplastics in Narragansett Bay

- Coleen Suckling (URI) & Andrew Davies (URI)

Project Location
University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?
Yes

Project Description
Our oceans contain microplastic (MP) pollution and marine organisms have been shown to ingest these anthropogenic particles. Despite some species being able to egest MPs, they may cause physical damage along the digestive tract. Persistent organic pollutants and harmful bacteria (e.g. *Vibrio*) have been found to aggregate onto the surfaces of microplastics therefore posing additional health risks to marine organisms. Most of the available studies which determine how marine organisms respond to microplastic exposure and ingestion are modelled on plastic concentrations which are incredibly high and therefore not representative of concentrations found within the marine environment. This project presents an excellent opportunity for students to work towards understanding how environmentally relevant concentrations of microplastics occupy the marine environment and how they might impact filter feeding marine organisms within Narragansett Bay. Therefore, building on our knowledge of how anthropogenic pressures may impact Narragansett Bay ecosystems.

Students will focus on one or more of the following approaches depending on the project priorities during the fellowship: 1) applying a range of laboratory extractive collection techniques; 2) Developing an archive of digital imagery, characterization and quantifying microplastics; 3) Identification of microplastics using state-of-the-art spectroscopic techniques; 4) Setting up and running aquarium experiments assessing the responses of marine invertebrates to microplastics. It should be noted that any part-time students will focus on one of these described approaches only.

This is an exciting opportunity to gain hands on experience on topics important to RI C-AIM, using C-AIM facilities, to become familiarized with complex research issues and research tools. The student will work within the RI C-AIM's project community and their active projects which fall into several of their foci which include: i) Assessing biological and ecosystem impacts; ii) predicting ecosystem response through integration, and iii) visualization and imaging.

*This project is part of **RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants
Reliable, enthusiastic, driven, problem solving students are strongly encouraged to apply with time management skills. Depending on the student interests and the project needs, students will need to be flexible and adaptable to whichever priorities need to be met (e.g. aquarium work or laboratory tasks).

Any skills of clean laboratory working, microscope photography, image processing/analysis, aquarium and/or husbandry skills would be highly beneficial. Training will be provided where required to expand and exercise skill sets.

Is student transportation needed for this project?
Yes

Students conducting aquarium work (located on Bay Campus) will need to have a personal car for flexibility on timings between locations and work tasks. All other work will be conducted on the Kingston Campus.

Solutions to the Degradable Plastics Problem

- Matthew Kiesewetter (URI)

Project Location
University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?
Yes

Project Description
Plastics are entering the ocean at alarming rates. The oceans will hold approximately 155 million metric tons of plastic in 2025 – or a larger mass of plastic than fish by 2050. This problem is particularly prescient for RI, with its 400 miles of coastline. The quintessential degradable plastic, polylactide (PLA), has been shown to degrade under physiological conditions and in industrial composting environments; however, no studies on the degradation of PLA in real ocean water have been reported. Further, studies in a simulated ocean environment suggest minimal PLA degradation over the course of one year. In addition to environmental factors, the degradability of PLA depends on polymer properties, and these properties can be controlled during polymer synthesis. Our hypothesis is that minimal changes in materials properties will produce large changes in degradation rates, and degradability versus materials properties must be determined to guide plastics production towards the best, truly degradable, plastics.

*This project is part of **RI C-AIM Research Thrust 1 - Assessing Biological & Ecosystem Impacts***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants
completion of sophomore organic chemistry 1 and 2 lectures, completion of sophomore organic chemistry laboratory course(s)

Is student transportation needed for this project?
Yes

Bay Buoys, Drones, and Space!

- Baylor FoxKemper (Brown) & Lew Rothstein (URI)

Project Location
Brown University (Providence, RI)

Open to SURF Flex applicants?
Yes

Project Description
We are interested in collecting and analyzing physical data from buoys in the Bay, boats in the Bay, drones flying over the Bay, and high-resolution satellites. This data will be used to better evaluate models of the Bay, building toward a forecast system for Bay health.

Last summer, students collected physical and biological data during day cruises in the Bay and worked to analyze them in the lab. Next summer, we plan to fly drones to collect a new kind of data--velocities from surface waves! We are working together with RISD to improve computer visualizations of these data as well (e.g., https://www.youtube.com/watch?v=Jzb0q0pTJQ0).

*This project is part of **RI C-AIM Research Thrust 2 - Predicting Ecosystem Responses through Integration***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants
Experience with matlab or python highly desired. Majoring, minoring, or coursework in a quantitative field (e.g., math, physics, engineering, geophysics) will be helpful.

Is student transportation needed for this project?
No

Understanding the zooplankton community composition of Narragansett Bay

- Nicole Flecchia (URI-GSO) & Candance Oviatt (URI-GSO)

Project Location
University of Rhode Island - Bay Campus (Narragansett, RI)

Open to SURF Flex applicants?
Yes

Project Description
Narragansett Bay is dominated by two north-south channels, the East and West Passages, which are fed by offshore nutrients from the south (Rhode Island Sound) and human inputs from the north (e.g. the Providence River). From what we about circulation in the Bay, the East Passage gets more offshore water and the West Passage gets more Providence River water, but we have a limited understand how this affects the planktonic communities in the shallow embankments along the Passages. For this project a SURF student would go to Fort Wetherill and Greenwich Bay once a week to collect zooplankton samples. The student would then enumerate the samples on return to the laboratory. The results from both sites would be compared to each other and previous data collected throughout Narragansett Bay.

*This project is part of **RI C-AIM Research Thrust 2 - Predicting Ecosystem Responses through Integration***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants
Experience with microscopy and either MatLab, Python or R are preferred but not required.

Is student transportation needed for this project?
Yes

Examining the ecosystem effects of reductions in nutrient inputs to Narragansett Bay using a coupled physical/biogeochemical model

- David Ullman (URI-GSO)

Project Location

University of Rhode Island - Bay Campus (Narragansett, RI)

Open to SURF Flex applicants?

Yes

Project Description

A fundamental goal of RI C-AIM is to develop a coupled model of Narragansett Bay circulation and its ecosystem that can be used to provide predictions of the likely ecosystem changes resulting from climate change. In addition to climate forcing, the Bay is also subject to strong anthropogenic forcing which has changed markedly over the past decade. In particular, the upgrading of regional sewage treatment plants has significantly reduced dissolved inorganic nitrogen and phosphorous inputs to the Bay. Since these compounds are essential nutrients for marine flora (phytoplankton) that form the base of the foodweb, this reduction may be strongly influencing the ecosystem function and processes. This SURF project will focus on comparing the model-simulated ecosystem of the Bay under the historical nutrient input regime with the present one. The interested student will learn the fundamentals of ocean biogeochemical modeling, how the predictions of these models are verified using ocean observations, and how the model results can be used to determine the effects of the nutrient reductions on the Bay ecosystem.

*This project is part of **RI C-AIM Research Thrust 2 - Predicting Ecosystem Responses through Integration***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants

Because numerical circulation/biogeochemical models produce very large datasets, computer programs are needed to process and analyze the results. The interested student will preferably have at least moderate computer skills and the desire to improve them.

Is student transportation needed for this project?

No

Vertical distribution of mesozooplankton in Narragansett Bay

- Jeremy Collie (URI-GSO), Maggie Heinichen (URI-GSO), Austin Humphries (URI) & Annie Innes-Gold (URI)

Project Location
University of Rhode Island - Bay Campus (Narragansett, RI)

Open to SURF Flex applicants?
No

Project Description
Food web dynamics tend to generalize two major pathways of production; a pelagic and benthic route. The pelagic pathway has zooplankton as the primary consumers facilitating energy transfer to higher trophic levels, while the benthic pathway begins with detritus feeding benthos. However, diet studies of fish and macro-invertebrates of Narragansett Bay suggest that demersal and pelagic fish species can prey upon both zooplankton and benthos. These unexpected diet linkages could be the result of movement of the predators or the prey. This study hopes to gain a better understanding of the distribution of small prey in the water column at different times of the day. Our goal is to discern the potential habitat crossover of traditionally classified benthos and mesozooplankton species. Many species have documented diel vertical migrations so that different parts of the water column are used by the species in the day versus night. The student will utilize camera and other trap technologies to sample small invertebrates throughout the water column at the GSO dock. There will be data collection in the morning and early evening to account for the possibility of diel vertical migrations. The student can expect to work hands-on with equipment deployment, identification of zooplankton and benthos in the lab, and data analysis of trends with assistance from graduate mentors and faculty advisors as needed.

*This project is part of **RI C-AIM Research Thrust 2 - Predicting Ecosystem Responses through Integration***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants
Skills using microscopes for species identification. Willingness to have a couple of early mornings or late evenings for sample collection. Experience using field sampling technology would be beneficial in camera or trap equipment troubleshooting.

Is student transportation needed for this project?
Yes
Work will take place at URI's Bay Campus. Self-transportation would be useful but RIPTA buses are available from URI main campus (~1/hr)

Evaluating the effectiveness of no discharge policies in RI

- Tracey Dalton (URI)

Project Location
University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?
Yes

Project Description
To prevent the introduction of microorganisms, nutrients, and chemical products from boaters' sewage waste, Rhode Island implemented a law in 1998 that prohibited the discharge of treated and untreated waste from boats in state waters. Facilities where boaters can pump the sewage waste from their boats (pumpouts) are located at marinas throughout the state. While this program has been in place for years, there are still many unanswered questions about how it is working. Are marinas providing easy, affordable access to pumpouts? Are boaters aware of the no discharge policies? Are they using the pumpout facilities? Which pumpout facilities are they using? How much are boaters willing to pay to use pumpout facilities? This SURF fellow will help to answer these questions by working on a team to conduct surveys of boat owners and marina operators in Rhode Island. During the summer 2020, the team will visit marinas in Greenwich Bay (and possibly Newport) at different times of the day and days of the week to talk with boaters about their boating behaviors, knowledge of the no discharge policy, and use of pumpout facilities.

*This project is part of **RI C-AIM Research Thrust 2 - Predicting Ecosystem Responses through Integration***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants
We seek a fellow who is comfortable working on a team and talking with recreational boaters.

Is student transportation needed for this project?
Yes
The team will need to travel to marinas in Greenwich Bay (and possibly Newport) a few times per week.

Investigating the impact of artificial reefs on recreational fishing in Narragansett Bay

- Tracey Dalton (URI), Austin Humphries (URI), Emi Uchida (URI) & Annie Innes-Gold (URI)

Project Location

University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?

Yes

Project Description

The SURF student would be involved in an on-going project to collect and analyze data on human use of coastal resources along Narragansett Bay. This particular project focuses on how a sub-set of coastal users (recreational fishermen) are affected by a newly implemented habitat enhancement project (installation of artificial reef modules) at Sabin Point, a public access site in the upper Narragansett Bay. The SURF student will work on a team to conduct in person structured surveys at Sabin Point. Days/times will be randomly selected during the summer. Each survey is expected to last about 10 minutes. Survey questions ask about users' perceptions of site conditions, artificial reefs, and the potential of artificial reefs to enhance the quality of fishing. Survey data from this summer ("after reef installation") will be compared to survey data collected last summer ("before reef installation"). This project is conducted in collaboration with the RI DEM.

*This project is part of **RI C-AIM Research Thrust 2 - Predicting Ecosystem Responses through Integration***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants

We seek students that feel comfortable working on a team and talking with coastal users at a public access site.

Is student transportation needed for this project?

Yes

Transportation needed to get to the survey site.

Towards a better understanding of recreational fishing behavior in Narragansett Bay

- Austin Humphries (URI), Jeremy Collie (URI-GSO), Tracey Dalton (URI), Emi Uchida (URI), Annie Innes-Gold (URI), Maggie Heinichen (URI-GSO) & Coronado Refulio (URI)

Project Location

University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?

Yes

Project Description

Implementing ecosystem-based fisheries management creates a number of human dimensions challenges. Given the complexity of human behavior, it is difficult to predict how fishers behave and respond to management regulations. Thus, it has been shown that the uncertainty created by fisher behavior is a key source of management failure in fisheries. This SURF project will use novel methods to study the patterns and behavior of recreational fishing in Narragansett Bay using secondary data from social media sources. The goal will be to learn about recreational fishers' preferences in terms of species, size, fishing location, and time of year. This project will involve literature review of ways social media data have been used to study recreational fishing dynamics and computer-based coding to extract and analyze recreational fishing photos from social media. Students can expect to spend their time interacting with graduate students and faculty members at various capacities.

*This project is part of **RI C-AIM Research Thrust 2 - Predicting Ecosystem Responses through Integration***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants

Strong coding skills and a background in computer science preferred. Interest in resource economics and experience in ArcGIS are a plus. A strong willingness to work independently as well as with others.

Is student transportation needed for this project?

No

Assessment of biofilm communities in continuous and fragmented environments

- Christopher Reid (Bryant)

Project Location
Bryant University (Smithfield, RI)

Open to SURF Flex applicants?
Yes

Project Description
Biofilm formation on instrumentation deployed in the marine environment is one of the biggest challenges of long term monitoring activities. It is well known that microbial diversity determines the biomechanical and physicochemical properties of biofilm as well as response to antibiofilm strategies. As part of the RI C-AIM sensor development effort microfluidics-based devices are currently in development. These devices are not larger than a couple of centimeters and some of their features (microchannel and microwells) are in the order of tenths of microns. Biofilm formation studies have been performed using different size samples up to 6 cm, however to our knowledge only small size ranges (less than 5 mm) have evaluated the effect of sample size on composition and biodiversity of biofilm. This project will focus on identifying the differences in the marine microbial species that colonize varying Polydimethylsiloxane (PDMS) surface areas using quantitative PCR and next generation sequencing

*This project is part of **RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants
basic microbiological skills

Is student transportation needed for this project?
No

Diagnostic Laboratory experience and research

- Roxanna Smolowitz (RWU) & Allex Gourlay (RWU)

Project Location
Roger Williams University (Bristol, RI)

Open to SURF Flex applicants?
Yes

Project Description
The RWU Aquatic Diagnostic Laboratory provides diagnostic services to the aquaculture community. As such, this position will involving learning many different procedures used in the molecular diagnosis of several oyster and clam diseases including collecting samples, extraction and DNA quantification and use of PCR and qPCR methods of agent detection. The laboratory will be conducting direct infection experiments this summer to understand the transmission of a neoplastic cell from infected to non-infected clams. The student will be primarily involved in this work. The student will also help in the development of qPCR methods for diagnosis of this neoplastic disease using hemolymph (blood) samples.

*This project is part of **RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants
The student should have a strong interest learning molecular methods and have taken a genetics course.

Is student transportation needed for this project?
No

Array electrochemical detection of nitrate, nitrite, and phosphate ions in marine environments

- Clifford Murphy (RWU)

Project Location
Roger Williams University (Bristol, RI)

Open to SURF Flex applicants?
Yes

Project Description
This proposal is to extend ongoing work in the development of electrochemical and optical sensors for key analytes in seawater. Initially funded in part by a RI-STAC award and in part as a prior RI C-AIM SURF project, we developed a sensor to detect thiocyanate in seawater. This work has resulted in a successful patent award as of October 1, 2019 (Clifford Murphy, Clifford Timpson "Method and Device for Detecting Thiocyanate Ions in Marine Environments", U.S. Patent No. 10,429,368). In the patent nitrate ions were identified as an interferent for the sensor in the 1-10 ppb concentration range.

From the RI-C-AIM perspective, this sensitivity to nitrate is a useful behavior of our existing metalloporphyrin chemosensors, and while a signal due to thiocyanate would be problematic, cyanide is mostly likely introduced as anthropogenic pollutant (wood processing, wood stains, paper mills) it is still on point. The goals of this project as undertaken this summer would be to:

- Synthesize additional metalloporphyrin sensors, and expand the current metals used (iron III, ruthenium III, zinc II, copper II, cobalt II, manganese II) to other metals (chromium III, vanadium II) in an effort to tune the specificity of response to analytes

- Using our Princeton Applied Research VersaSTAT potentiostat in addition to a BASF potentiostat, and potentially additional devices created for portable detection, test arrays of these chemosensory electrodes in the same water sample for specific determination of multiple different anions present in seawater simultaneously.

Materials produced towards free-base tetraphenylporphyrins will be characterized by UV-visible spectroscopy, 1H-NMR, and 13C-NMR. Metalloporphyrins will be characterized by UV-visible spectroscopy and electrochemistry. Metalloporphyrins will also be tested for sensitivity to nitrate and phosphate ions in prepared seawater solutions by both UV-visible spectroscopy and electrochemistry.

Metalloporphyrins that show promise as nitrate sensors will be synthesized with amine or aldehyde functional groups at the para-position on the 5 and 15 phenyl groups. Functionalized porphyrins will be coupled to ITO or FTO substrates that have been functionalized with an aldehyde-terminated or amine-terminated silane layer via amide-bond formation. Electrodes prepared for array detection will use a different architecture – blading a 6mm wide x 20 mm long titanium dioxide strip on FTO glass substrates 10 mm wide x 25 mm long, with a "blank" end for clipping to potentiostats.

*This project is part of **RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants

In all cases, students who have successfully completed a full year of General Chemistry is the baseline requirement.

For students working primarily on the construction of electrodes, having completed one semester of organic chemistry is a plus, as is experience with obtaining and interpreting data from NMR, FT-IR, and UV-Vis spectroscopies.

For students interested in device construction, a background in electrical engineering with completion of basic electronics, circuit design courses preferred.

Is student transportation needed for this project?

No

Organic synthesis of metal-ligand complexes and evaluation as detectors of pollutant ion.

- Lauren Rossi (RWU)

Project Location
Roger Williams University (Bristol, RI)

Open to SURF Flex applicants?
Yes

Project Description
The assessment of nutrient and pollutant ions within aqueous solutions is an important goal aimed toward determining the health of freshwater/ marine environments and impacted communities of the Narragansett Bay ecosystem. Various Schiff base proligands are to be synthesized and reacted with metal salts, to form organometallic complexes. It is the intention of this project to: 1) apply/ extend the iron- complex synthesis to other metal ions and other substituted amines or nitrogen-based functional groups, 2) modify scaffold to provide greater water solubility of the metal complexes, and 3) assess the ability and detection of metal-complexes toward highly oxygenated ions (nitrate and/or phosphate) within aqueous media.

*This project is part of **RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants
Students should be open to learning and applying concepts from prior general chemistry/ organic chemistry laboratory experience. Students will develop/further:

- Read and discuss primary scientific articles relevant to the reactions to be conducted.
- Setup bench-top and/or microwave chemical reactions.
- Safe handling of different chemicals.
- Setup, operate, and assess the progress and success of a chemical reaction (TLC, GC, NMR)
- Purify organic molecules (chromatographic techniques)
- Maintain a research notebook
- Safely operate and interpret data from instruments (GC, IR, NMR)
- Schlenk techniques (air sensitive/ reactive)

Is student transportation needed for this project?
No

Nanostructured electrochemical sensor for seawater nutrients detection

- Bernard Munge (SRU)

Project Location
Salve Regina University (Newport, RI)

Open to SURF Flex applicants?
Yes

Project Description
An alternative approach to SERS is electrochemical detection. Nanostructured sensor surfaces will be specifically designed and coupled to microfluidic sample delivery system for electrochemical detection of PO_4^{3-}, NO_3^- and NO_2^- in seawater samples. This project aims to advance the EPSCoR C-AIM research themes: "What new innovations in sensors are needed to improve the collection of data on the physical, bio-geo-chemical, and ecological processes as well as anthropogenic stressors (e.g., pollution) that are impacting Narragansett Bay?" and will be undertaken in collaboration with Dr. Jason Dwyer (University of Rhode Island, Department of Chemistry). A number of strategies have been used for Phosphate determination including calorimetry, electrochemistry, and fluorescence emission spectroscopy. On the other hand, most nitrate detection methods indirectly measure nitrate by first converting it to nitrite. This conversion is mostly commonly facilitated by copperized cadmium columns. The use of toxic cadmium columns can be avoided by using UV radiation to convert nitrate to nitrite, but this technique is not suitable for on-site measurements. The most ubiquitous spectroscopic technique is the Griess Assay, a reaction that produces a colored azo chromophore whose concentration can be used to infer nitrate concentration. Nitrite detection methods include fluorescence spectroscopy, absorption spectroscopy, and Raman spectroscopy. These techniques rely on the conversion of the ion to an optical signal. Although highly accurate, spectroscopic techniques require expensive and time consuming of-site analysis and are therefore not suitable for use in resource limited areas. Moreover, optical methods unlike electrochemical detection techniques present a major challenge when used in turbid water samples. Microfluidic devises (Lab –on-chip) coupled to electrochemical detection are an ideal means for rapid on-site measurements as they allow for miniaturization and automation of laboratory based protocols, leading to the development of simple, low cost, portable, compact devices. The use of microliter volumes results in a reduction in reagent consumption, waste production and analysis time compared to standard lab protocols. The nanostructured electrochemical sensors will be fabricated on our in-house screen printed electrode (SPE). In contrast to most lab based electrochemical procedures, the mass production of SPE sensors could provide a more economically viable and technologically realizable platform for commercial exploitation. Two summer undergraduate research fellows (SURF) will be recruited to continue this project in the summer of 2020. Students will be exposed to various research techniques including electrochemical sensor development, microfluidic fabrication (Salve and URI), screen printing, synthesis of nanoparticles, spectroscopic characterization and surface characterization (URI). Students will also learn how to analyze and present their research work enhancing their written and communication skills. An integral part of students training also involve doing literature searches, analyzing and presenting the journal articles retrieved from various data bases such as scifinder scholar, acs.pubs.org, www.sciencedirect.com etc.

*This project is part of **RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants
Student should have successfully completed General Chemistry I & II

Is student transportation needed for this project?
Yes

Colors of the Bay

- Melissa Omand (URI-GSO)

Project Location
University of Rhode Island - Bay Campus (Narragansett, RI)

Open to SURF Flex applicants?
No

Project Description
In this project, the fellow will build a sensor that measures the color spectrum of underwater sunlight. The sensor will be deployed in Narragansett Bay and then the data will be compared with the color spectrum measured by satellite. The fellow will gain experience in technology development, data analysis and coastal field work.

This project is part of ***RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

This project involves ***both field & lab/computer work***

Required/preferred skills for student applicants
Some coding knowledge is preferred but not required. The project involves elements of ocean engineering - the student should have an interest in this field.

Is student transportation needed for this project?
Yes

Plankton process rates in a changing ocean – Assessing plankton production and respiration from O_2 budgets

- Pierre Marrec (URI-GSO) & Menden-Deuer (URI-GSO)

Project Location
University of Rhode Island - Bay Campus (Narragansett, RI)

Open to SURF Flex applicants?
No

Project Description
Phytoplankton, microscopic algae, and zooplankton, microscopic animals feeding on phytoplankton, are the basis of the food web in the ocean. In addition to be the first stage of the food chain, phytoplankton is often described as the second lung of the Earth, the first one being land vegetation, because they produce about the half of the O_2 we breathe by photosynthesis by simultaneously catching and storing a large amount of atmospheric CO_2 in the ocean interior.

Members of the Menden-Deuer lab have strong expertise in plankton ecology and our research focuses on the interactions between prey (phytoplankton) and predators (zooplankton), on the diversity of these small organisms and on the plankton process rates as growth, production and respiration. We seek to link environmental conditions with plankton dynamics, in order to deepen our understanding of the factors governing the basis of the food web in a changing ocean. We investigate plankton dynamics using various approaches such as lab experimentation on natural and culture samples, field work on board research vessels and theoretical approaches. The different rates we measure are an essential part of integrative models, which simulate and predict conditions in the present and future ocean.

The main objective of the student led project will be to develop a method to estimate O_2 production by plankton (primary production) and consumption (respiration) using innovative and user-friendly O_2 sensors. The student will work on the improvement and the optimization of the O_2 method by performing various lab tests on natural and culture plankton samples. The performance and the limitations of the O_2 sensors will have to be clearly defined to meet state-of-the-art criteria allowing the use of the method for research. Ultimately, the method developed by the student will be apply during a research cruise in July 2020 (07/24 - 07/29) on board the R/V Endeavor.

The research cruise is part of the NES-LTER project (Northeast U.S. Shelf Long-Term Ecological Research, https://nes-lter.whoi.edu/), which aims to understand and predict how planktonic food webs are changing in the region, and how those changes may impact the fisheries of the Northeast U.S. Shelf. There might be an opportunity to participate in the cruise.

The student will be exposed to a range of microbiological and oceanographic techniques and will have access to numerous lab facilities. The student will be an integral part of Menden-Deuer lab and will work in a dynamic environment with several graduate students and post-docs. There will be potential for collaboration with federal research partners located on the Bay campus.

This project is part of ***RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

This project involves ***both field & lab/computer work***

Required/preferred skills for student applicants

Autonomy in a lab environment. Interest in quantitative techniques. High level of motivation. Professionalism and reliability.

Is student transportation needed for this project?

No

Students must be able to come to Narragansett Bay Campus. Some bus service is available with RIPTA.

Towards the development of the Multipurpose Autonomous Underwater Vehicle (MAUV) for coastal water ecosystem studies: hydrodynamics and modeling

- Mingxi Zhou (URI-GSO)

Project Location

University of Rhode Island - Bay Campus (Narragansett, RI)

Open to SURF Flex applicants?

No

Project Description

At the Smart Ocean Systems (SOS) Laboratory, we are developing a multipurpose autonomous underwater vehicle (MAUV) to provide unique samples for coastal water ecosystem studies. Compared to existing AUVs, MAUV will be integrated with multiple types of actuation systems allowing a spectrum of operation modes including horizontal flying, vertical profiling, drifting, and position holding.

Currently, the team is seeking a undergraduate student to construct a simplified 6-DOF vehicle model. The model is essential for the vehicle prototyping and construction and developing low-level controllers. During the summer, the student are expected to perform the following tasks.

1. Construct a dynamic model in MATLAB simulation environment, and investigate the vehicle maneuverability.
2. Optimize the hydrodynamic performance of the MAUV by adjusting the fairing shape.
3. Perform hydrodynamic analysis in SOLIDWORKS.
4. 3D print MAUV shape candidates and perform towing test in the URI indoor tow tank.

*This project is part of **RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants

1. Strong background in Physics and Math, particularly linear algebra and differential equations.
2. Experience with SOLIDWORKS, especially using advanced tools for designing streamline body.
3. Experience with dynamic system modeling using MATLAB.
4. Enthusiastic in marine robotics and would like to pursue career in robotics.

Is student transportation needed for this project?

No

Computer programming (coding) to better understand nature one molecule at a time

- Jason Dwyer (URI) & Brian Sheetz (URI)

Project Location
University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?
Yes

Project Description
In our research group we build and modify tools to investigate how nature works ONE MOLECULE AT A TIME. We have nanofluidic tools that we push single molecules through in order to "take their pulse"--analyzing the millions of data points that we can collect requires computer analysis. If you are interested in doing computer coding/programming, we can present you with interesting problems to solve in science and engineering that will help us to better understand and design for the molecular world around us.

*This project is part of **RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants
Prior coding experience in any computer language, Python preferred.

Is student transportation needed for this project?
No

Algae-nanoparticle sensors for detection of contaminants in natural waters

- Arijit Bose (URI) & Daniel Roxbury (URI)

Project Location
University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?
Yes

Project Description
Low levels of nitrate ions in ocean waters can affect phytoplankton growth, and this can have adverse consequences all the way up the food chain. Conversely, excessive levels of nitrate and phosphate ions in water, coming from agricultural or wastewater runoff and by flooding, can create large algae blooms. Local dissolved oxygen levels then drop precipitously, affecting all aquatic life. Additionally, many of these algae, such as red tides, are toxic to humans. Other toxins in water include heavy metal ions, such as cadmium and lead, arising from mining operations, battery disposal and from old pipes. UV-Vis spectroscopy and colorimetry are used currently for monitoring these analytes, but neither technique can detect below the EPA-determined limiting concentrations; accurate and robust detection of these ions in the complex ocean water environment remains a challenge. Towards this end, we propose a novel technique that exploits the robustness and the ability of sea lettuce algae to naturally accumulate ions. The algae leaves will be doped with nanoparticles that are specifically responsive to targeted analytes. The doped algae will draw in contaminants, expose them to the sensing particles and thus enable detection. While we will focus on detection of nitrate, phosphates and heavy metal ions using these doped algae, this method will be a platform technology that can be used for the detection of a wide variety of contaminants.

*This project is part of **RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants
Interest in hands on laboratory work; sophomore or higher standing.

Is student transportation needed for this project?
No

Fabricating highly tuned surface enhanced Raman spectroscopy particles for detection of analytes in water

- Arijit Bose (URI)

Project Location

University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?

Yes

Project Description

Surface Enhanced Raman Spectroscopy (SERS) is a powerful tool for the detection of a wide range of analytes in water. Inherently weak Raman scattering signals can be amplified significantly if the incident laser wavelength and the surface plasmon resonance wavelength of the Raman-active particles are closely matched. We use poly-L-lysine coated carbon black particles as templates for the precipitation of gold. By varying the PLL concentration, we are able to modulate the morphology of the gold precipitate, and thus the plasmon resonance wavelength. The current strategy results in broad absorption spectra, and is this not optimum for SERS. The proposed research will explore alternate strategies for fabricating SERS active particles that result in narrow but tunable absorption spectra, and deploying these particles as sensors for low levels of analytes in ocean and freshwater.

This project is part of ***RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

This project involves ***primarily lab or computer work***

Required/preferred skills for student applicants

Completion of sophomore level classes

Is student transportation needed for this project?

No

Evaluation of marine biofilm properties

- Vinka Craver (URI)
- Kayla Kurtz (URI)

Project Location

University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?

Yes

Project Description

Biofouling can occur by the settlement of microbes, microscopic algae, and animals on surfaces in marine environments. When the settlement occurs on sensitive instruments that are submerged, it can disrupt data collection and lead to erroneous findings. Their capacity to function properly can be severely curtailed by the formation of biofilms and other biofouling on their surfaces. Thus, fouling tests are essential to determine how long these sensors will be able to be deployed before their functions are impaired by biofouling.
This study focuses on determining the optimum conditions for biofouling tests to ensure the replicability of results.

Student(s) will work on improving, modifying, and testing a water jet system that is currently used to determine the adhesion strength of biofilm on surfaces deployed in marine environments. Student(s) will participate in a variety of activities such as the collection of algae spores in the field, culture of microorganisms, biofilm formation, and calculations of shear stress applied to samples. Additionally, several microscopy techniques and materials analysis are part of this study as well.

*This project is part of **RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

*This project involves **both field & lab/computer work***

Required/preferred skills for student applicants

Is student transportation needed for this project?

Yes

Fabrication of liquid cell for Raman microscopy

- Irene Andreu (URI)

Project Location
University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?
Yes

Project Description
Raman spectroscopy is a useful technique for characterization of microorganisms, pollutants in water ecosystems and industrial additive characterization. Although Raman spectroscopy requires almost no sample preparation, analyzing liquid specimens such as water samples is challenging due to liquid evaporation under the powerful lasers used in Raman spectroscopy.

The project will consist on designing and fabricating a leak-free liquid cell for use with confocal Raman microscopy. Ideally, the cell would be reusable, to reduce waste generation, and use materials and fabrication techniques that are widely accessible. You will design and fabricate a cell using mouldable polymers and/or 3D printers available at URI, test it for leaks and Raman detection performance, and check the cell reusability. The liquid cell design will be available for other users of the Rhode Island Consortium for Nanoscience and Nanotechnology, a multi-user core facility at URI, so you will be impacting the research of the scientific community in Rhode Island.

*This project is part of **RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants
Required:
- Creative
- Handy

Preferred:
- Experience with PDMS moulding
- Knowldedge of 3D printing and 3D modeling

Is student transportation needed for this project?
No

Field-deployable device development for sensitive and continuous detection of marine pollutants in coastal ecosystems

- Geoff Bothun (URI), Timo Kuester (URI) & Muzahidul Anik (URI)

Project Location

University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?

Yes

Project Description

Reliable data with high resolution in both time and space is needed to better assess, model, predict, and respond to the impacts of climate change on coastal ecosystems. New chemical sensors based on micro- and nano-structured materials and devices show great promise for achieving the spatiotemporal resolution needed, but strategies are needed to enable field deployment. This includes improving analyte selectivity and minimizing interference, minimizing power requirements and cost, preventing biofouling, and benchmarking sensor and device stability to enabling long-term operation. This project will focus on the development of sensing devices integrating Surface Enhanced Raman Scattering substrates within microfluidic and 3D-printed millifluidic platforms for continuous online detection of nitrate, nitrite, and phosphate. The SURF fellow will join an inclusive team of students at URI focused on engineering the next generation of marine sensors, building both technical and professional skills over the duration of the summer.

*This project is part of **RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants

Motivation and team work are key in our group. While a background in engineering, chemistry, and/or physics will be helpful, we are excited to work with students who are innovative, who are scientifically curious, who like to push themselves, and who have a positive attitude.

Is student transportation needed for this project?

No

Near-infrared fluorescent sensors for detecting phosphate in seawater samples

- Matthew Card (URI) & Daniel Roxbury (URI)

Project Location
University of Rhode Island - Main Campus (Kingston, RI)

Open to SURF Flex applicants?
Yes

Project Description
The near-infrared (NIR) fluorescence from single-walled carbon nanotubes is unique in its ability to penetrate through visibly opaque materials and shift its color based on variations in the local environment. Here, by functionalizing nanotubes with specific polymers, we are developing nanosensors that selectively respond to phosphate ions in aqueous samples. The proposed work will address efforts to optimize the selectivity and sensitivity of the designed nanosensors in solution.

*This project is part of **RI C-AIM Research Thrust 3 - Enabling Technologies for Improved Detection***

*This project involves **primarily lab or computer work***

Required/preferred skills for student applicants
Basic wet laboratory skills (pipetting, weighing materials, sonicating); experience in optical microscopy is desired; statistical data analysis is preferred.

Is student transportation needed for this project?
No