2018 RI SURF

RI Consortium for Coastal Ecology Assessment, Innovation, and Modeling

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Evaluating the Ocean State Ocean Model

Mentor(s)
Dr. Baylor Fox-Kemper (Brown University)
Dr. Lew Rothstein (University of Rhode Island, GSO)

Project Description
An undergraduate student is needed to compare physical variables (temperature, salinity, velocity) simulated using the different versions of the Ocean State Ocean Model--an implementation of the Regional Ocean Modeling System (ROMS)--versus observations collected in Narragansett Bay.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project
Better understanding of ocean models, fluid dynamics, and statistics.

Applicant required/preferred skills
Ideally, this student should be familiar with quantitative software (e.g., R, matlab, or python), fluid mechanics, and statistics.

Examining Observations of Narragansett Bay for Data Quality and Understanding

Mentor(s)
Dr. Baylor Fox-Kemper (Brown University)
Dr. Lew Rothstein (University of Rhode Island, GSO)

Project Description
An undergraduate student is needed to examine the physical variables (temperature, salinity, velocity) that have been collected in the bay through moorings, Nu-Shuttle data, Narragansett Bay Commission profiles, and other resources already openly available in Narragansett Bay. This student will be tasked with using statistical tools to identify outliers and form protocols for quality control, as well as to define summary metrics (e.g., time-averages over what timescale?) suitable for preparing this data for sharing through the Rhode Island Data Discovery Center.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project
Matlab, statistics, phenomena typical of the Bay, types of observations collected for oceanography, working with large datasets carefully.

Applicant required/preferred skills
Ideally, this student should be familiar with quantitative software (e.g., R, matlab, or python) and statistics.

Rhode Island Data Discovery Center: An International Database on Narragansett Bay

Mentor(s)

Dr. Jeff Morgan (Brown University)
Kia Huffman (Brown University)

Project Description

Pollution throughout Narragansett Bay has been studied for decades. Vast amounts of historical data are available and new data on water quality and the ecosystem is arriving daily from sensors deployed throughout the Bay. Help us build and assemble a comprehensive database that will be used by scientists in Rhode Island and around the world to understand and someday predict the effects of climate change on the Bay. The Rhode Island Data Discovery Center.

We've identified multiple collections of long-term historical water quality data for the Bay. Some of these collections contain physical & chemical water quality data (temperature, salinity, pH) sampled at a few specific locations in the Bay, but others contain more comprehensive water quality data sampled from many locations around the Bay during many years. In some cases, the data goes back to the 1970's.

These collections are currently maintained by multiple scientists and groups in the state (Brown, URI, Department of Environmental Management, DEM) and in some cases by regional groups such as NERACOOS. The goal of this project is to work with the curator of each collection to gather the relevant data, pre-process and format the historical data into a common format, so it can be incorporated into the Rhode Island Data Discovery Center. In most instances the historical data is available in digital format, such as Excel spreadsheet, that can be converted to CSV format, then into NetCDF format (widely accepted format for storing/sharing oceanographic data). Part of this project involves modifying and adapting various scripts to facilitate the above described workflow.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project

- Get introduced to what goes into designing and building a large complex database.
- Learn to work with a wide range of water quality data sets, working with multiple groups and agencies that collect and maintain these water quality data sets.
- Learn to work with scripts on the Linux operating system to convert data sets into NetCDF format.

Applicant required/preferred skills

- Experience with computers required.
- Experience working with data or environmental data would be useful but not mandatory.
- Experience with some scripting language, such as Python, PHP or similar would be helpful, but not mandatory.

Designing a visual platform for exploring climate change impacts in coastal plant communities

Mentor(s)

Dr. Timothy Whitfeld (Brown University)
Jennifer Bissonnette (Rhode Island School of Design)
Lucia Monge (Rhode Island School of Design)

Project Description

The 1950s represent a key inflection point for many measures of global climate change: temperature and the concentration of greenhouse gasses have increased since then and development across the state has intensified. These factors have all had dramatic impacts on habitats in Rhode Island, in particular those around the coast of Narragansett Bay. How these changes have influenced plant diversity is not clear: have coastal plants gone extinct because of the impacts of climate changes or habitat destruction? Are invasive species more abundant as development increases and the environment changes? These questions and others are difficult to address with any certainty because there is very little data in the herbarium record over the past 75 years.

This project will work to document 21st century plant diversity in dune and salt marsh habitats around Narragansett Bay in order to record changes resulting from climate change. We will collect herbarium specimens and create images of all field sites and species present, with the aim of comparing present day diversity to historical diversity records from online herbarium resources dating back to the early 1800s. Using a range of technologies and design strategies, we will explore the visualization and representation of changes in plant diversity and the extent of coastal dunes and marshes through time. This will serve as a case study for developing interactive, highly engaging data narratives with the goal of expanding public interest in and understanding of the effects of climate change in Rhode Island.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project

- Identification of coastal plant species
- Techniques for making scientific collections
- Principles of visual communication
- Software platforms for computer-aided visualization of change through time of coastal habitats and species diversity.

Applicant required/preferred skills

Preferred skills:

- Field botany
- Data visualization
- An interest in fieldwork and willingness to be outdoors in potentially challenging conditions

Lipid biomarkers in marine planktonic predators

Mentor(s)
Dr. Christopher Reid (Bryant University)

Project Description
Lipids are fundamental, high yield energy sources and thus play a central role in biological systems. This project characterizes and quantifies the lipid metabolism in herbivorous protists, key marine planktonic organisms. Results will be used to better understand food web dynamics, including trophic upgrading of lipids, which can affect commercially and ecologically important species and their interactions with anthropogenic and naturally occurring stressors. Characterization and quantification of lipids in marine herbivores provides opportunities to use lipids as biomarkers for energy demand and status in marine microbial predators and improve coastal ecosystem models. Students will learn lipid extraction and enrichment techniques as well as analysis of lipids and sterols by gas chromatography-mass spectrometry and high pressure liquid chromatography.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project
- lipidome extraction and enrichment techniques
- lipid derivitization
- gas chromatography-mass spectrometry (GC-MS)
- high pressure liquid chromatography

Applicant required/preferred skills
- completion of freshman chemistry

Electrophoretic Separations with Conductivity Detection for Phosphate and Nitrate

Mentor(s)

Dr. John Breen (Providence College)

Project Description

One of the long-term goals of the RI C-AIM is the development of deployable autonomous sensors for phosphorus (in the form of phosphate) and nitrogen (in the form of nitrate). Continuous monitoring of these two eutrophying nutrients is important for an accurate and timely evaluation of the Narragansett Bay ecosystem. To this end and during the summer of 2018, my group will constructing and evaluating capacitively-coupled contactless conductivity detectors (C^4D) for sea water separations using capillary zone electrophoresis (CZE). The application and evaluation of C^4D for separations on microfluidic platforms is planned for future years.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project

- CZE separations
- simple circuit building and evaluation
- signal processing

Applicant required/preferred skills

- Completion of General Chemistry required
- Completion of Physics and Analytical Chemistry preferred.
- An interest in hands-on experimental chemistry and instrumentation preferred

Predicting predatory impact of jellyfish in coastal ecosystems

Mentor(s)

Dr. Sean Colin (Roger Williams University)
Dr. Jack Costello (Providence College)

Project Description

Understanding complex ecological processes requires a mechanistic understanding of the interactions that occur in the ecosystem. Jellyfish are important predators in coastal ecosystems that are capable structuring food webs. However, their trophic role is often highly variable and difficult to predict. This difficulty arises from our lack of understanding of the mechanisms that determine their predatory impact. In an effort to better enable scientists the ability to predict and model the role of jellyfish predation we will examine the mechanisms that determine post-encounter outcomes of predatory-prey interactions. Post-encounter events have been shown to be the rate limiting steps that are most influential (but least quantified) in determining jellyfish prey selection.

In this project students will use laboratory videography to observe and quantify the predator-prey interactions of the primary jellyfish species which occur in the Narragansett Bay. The jellyfish vary in the morphology of their capture surfaces (oral arm and tentacle structure). Capture surface morphology is hypothesized to be directly related to prey selection and feeding rates. Students will quantify predator-prey interactions in order to determine how capture surface morphology relates to predation and prey selection of different types of prey (small (< 100 microns) and large (> 500 microns)). These data will enable us to predict the predatory impact of jellyfish under different conditions when different jellyfish and prey species dominate the water column.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project

Students will help design the experiments to be conducted. They will culture and maintain multiple jellyfish species used in the study. They will use 3D videography techniques to quantify predatory prey interactions. They will use image analysis software to analyze the video and Microsoft Excel to analyze the data.

Applicant required/preferred skills

Previous experience analyzing video is preferred.
Note: this project will take place at the Marine Biological Laboratory in Woods Hole, MA

Assessing the impact of biofouling communities on food flux in an oyster aquaculture system.

Mentor(s)

Dr. Dale Leavitt (Roger Williams University)
Matt Griffen (Roger Williams University)

Project Description

Shellfish aquaculture is a growing industry in RI waters that not only provides economic benefit to the state from a marine related industry but also may serve as a platform for monitoring changes in ecosystem dynamics in our coastal waters. One aspect of holding shellfish species (primarily oysters) in a culture system is the use of containment devices, such as plastic mesh bags, to exclude predators from accessing the on-growing shellfish juveniles. By placing these semi-rigid structures in the waters, we are providing substrate for establishing fouling communities on the aquaculture gear. The structure of the fouling community is seasonally and geographically variable but is somewhat predictable based on monitoring the community throughout the summer fouling interval. Furthermore, the impact of the fouling community on the overall productivity of the shellfish growing system can be severe due to potential reduction of flow through the bag structure resulting in less food availability to the growing shellfish, i.e. a reduction in food flux.

The project proposed for this study would be to characterize a baseline on the development of the fouling community on oyster growout bags and cages at two farm locations in the vicinity of RWU and the impact that the developing fouling community may have on food flux through the culture system. Through the combination of observation/description of the development of the fouling community with measurements of food flux through the oyster bags, we can provide a baseline of information on the fouling community in the region as well as an evaluation of the impact of that community on food flux in the oyster growout system.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project

- Fouling community assessment and species identification.
- Experimental design and data analysis.
- Measuring flow dynamics and food flux within a contained system.
- Oyster farm management practices.
- Outreach and communication with participating or interested farmers.

Applicant required/preferred skills

- Interest in shellfish aquaculture.
- Willingness to get wet and muddy working in the field.
- Patience to assess and analyze fouling community structure through standard ecological methods, including species identification through dichotomous keys and field guides.
- Some degree of familiarity with local marine flora and fauna, particularly invertebrate animal species.

Applying metalloporphyrin functionalized transmissive conducting electrodes to the detection of nitrate and phosphate ions in Narragansett Bay

Mentor(s)
Dr. Clifford Murphy (Roger Williams University)

Project Description
This proposal is to extend ongoing work in the development of electrochemical and optical sensors for key analytes in seawater. Currently this funded in part by a RI-STAC award to develop and commercialize a sensor to detect thiocyanate in seawater, which has application to the marine ornamental aquarium trade to combat cyanide fishing. In the process of identifying potential interferents for this sensor, it was tested with 1-10 ppb nitrate ions in seawater, and a signal was observed. From the cyanide fishing perspective, this poses a problem of separating thiocyanate responses from nitrate responses, particularly as fish contribute nitrate to the seawater. But from a RI C-AIM perspective, this 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:

1. Analyze existing sensor materials for their responses to nitrate ions in seawater, and differentiate those responses from other potential interferents (thiocyanate, nitrite, phosphate, chlorate, etc.)

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

In the longer term, promising materials after this summer would be investigated for incorporation into portable sensors. Also, if collaborators can be identified, see if these sensors could work directly or in parallel cooperation with surface enhanced Raman spectroscopy (SERS) to improve specificity of response.

Characterization. Materials produced towards free-base tetraphenylporphyrins will be characterized by uv-visible spectroscopy, ^{1}H-NMR, and ^{13}C-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 Solid-state chemosensor materials. 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.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project
Students working on this project will develop and enhance their skills in synthesis and characterization of molecules and chemical modification of surfaces; they will be trained in cyclic voltammetry and

contact angle measurements for the sensor materials; if students with a background in electrical engineering can be identified, we will also continue to work to integrate these sensor materials into portable sensor devices.

Applicant required/preferred skills

Students applying to this project must have successfully completed a full year of general chemistry. Because a portion of this work is synthetic chemistry, students who have a background in organic chemistry and/or inorganic chemistry are desired. Students with a background in electrical and or chemical engineering would also be very welcome, particularly for aspects of the project involving incorporation of sensor materials into portable devices.

Rapid determination of halogenated hydrocarbon transformations from *in situ* sediment/soil cores by HPLC/IC, GC/MS and ^{13}C NMR

Mentor(s)

Dr. Stephen O'Shea (Roger Williams University)

Project Description

Elucidating potential biogeochemical conversions 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 redox abiotic and to easily ascertain HC's substrate halide release rates. Measuring directly a site's *in situ* 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 transformation can be assessed with carbon-labeled $^{13}C_2$ substrates and ^{13}C nuclear magnetic resonance spectroscopic analysis and head space gas chromatography/mass spectroscopy.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project

This project gives hands on approach to environmental bioorganic chemistry and will complement a student's science major's courses. The project will allow the students to expand their breadth of knowledge in chemistry and will expose them to a number of varied techniques (not experienced in the general laboratories) making them more marketable in their career choices. From this study they will gain an appreciation of the biological processes at the mechanistic level and an understanding of the many subtleties in developing new compounds for applied applications. The students will employ traditional laboratory instruments, (UV/Vis, FTIR, NMR, ICP-OES) which will be concurrent with the more sophisticated HPLC and GC with inline various detectors notably IC and MS.

Applicant required/preferred skills

- Chemistry, environmental science or biology major
- Junior standing

Separation of microplastic beads and phytoplankton using thermal flow field fractionation

Mentor(s)

Dr. Jennifer Pearce (Roger Williams University)

Project Description

Microplastic beads are small plastic particles less than 5mm in length used as abrasives in a variety of health and beauty products such as body wash and toothpaste. Although these have been banned in products since 2015, larger plastic debris can break down to these small sizes and lead to accumulation in ocean waters. These small particles are comparable in size to species of phytoplankton used as a food source for zooplankton, and their ingestion by copepods has been observed in the laboratory. However, data on their concentration and distribution is scarce due to the difficulty of sampling.

We have used a lattice Boltzmann based simulation to investigate the use of thermal flow field fractionation to separate microplastics from phytoplankton and to enhance the concentration of beads. Our preliminary results suggest that we can increase the concentration by over 30%. Thermal flow field fractionation uses a temperature gradient to cause species to migrate in the fluid flow channel towards one of the walls. This decreases the mean velocity of the species in the channel. Solutes that migrate more because of the temperature gradient pass through the channel more slowly than those that stay closer to the middle of the channel. We have found that the deformability of phytoplankton causes it to accumulate closer to one of the walls of the channel than the microplastics.

This study would continue this work. We would explore how long a channel would have to be to separate the two species. In previous work we have also not included fluid flow. We would incorporate that into the project this summer.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project

- Computational fluid dynamics
- Coding
- Unix

Applicant required/preferred skills

n/a

Studying nitrate content in coastal marine environments

Mentor(s)
Dr. Lauren Rossi (Roger Williams University)

Project Description
Bioinspired catalysts have been developed to reduce highly oxidized pollutant ions, such as nitrate (NO^{3-}) and perchlorate (ClO^{4-}). An example of one such catalyst, developed by Dr. Fout of the University of Illinois, Urbana-Champagne, resulted from the iron (II) coordination with a tetradentate tris(pyrrolyl-α-methyl)amine ligand. It is our aim therefore to synthesize a similar catalyst to assess and reduce nitrate ions within aqueous samples, such as that of the Narragansett Bay ecosystem.

This research project will then: 1) extend the literature iron catalyst synthesis to other substituted amines or nitrogen-based functional groups, 2) assess the ability and detection limit of such iron-based catalysts with highly oxygenated ions within aqueous media.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project
- Read and discuss primary scientific articles relevant to the reactions to be conducted.
- Setup bench-top and 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)

Applicant required/preferred skills
Prior laboratory experience with organic chemistry techniques is valued, but not required.

Investigating the Impact of The Microbial "Plastisphere" on Microplastics Transport Throughout Food Webs in Narragansett Bay

Mentor(s)
Dr. Koty Sharp (Roger Williams University)

Project Description
In the proposed work, we will use wild, in situ sampling from local sites in Narragansett Bay to characterize abundance and distribution of microplastics and associated microbes in local waters and filter-feeding organisms. Plastic-associated microbial biofilms will be characterized using well-developed molecular approaches (16S amplicon sequencing and oligonucleotide probe-based microscopy). Based on the results from wild-collected samples, we will conduct laboratory experiments where filter-feeding organisms – the local coral *Astrangia poculata*, and its planktonic copepod prey – will be exposed to microplastics that have been experimentally treated with wild microbial biofilms, laboratory-controlled biofilms, or both. Through these experimental manipulations, we will investigate the impact of microplastics and microbes – each alone, and in combination – on feeding behavior and performance of the organisms that ingest them.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project
- Microbiology and molecular biology fieldwork/collection techniques
- Sterile technique
- Basic aquarium husbandry
- Bioinformatics & sequence analysis
- Molecular benchwork, including DNA extraction and polymerase chain reaction (PCR)
- Dissecting and Epifluorescence Microscopy/Imaging
- Fluorescence in situ hybridization (FISH) of microbes in animal tissue/particles
- Data processing/generation of figures

Applicant required/preferred skills
Preferred:
- Basic molecular biology benchwork
- Sequencing analysis
- Aquarium husbandry
- Histology/microscopy imaging

Fabrication and Evaluation of a Prototype, simple, low cost Microfluidic Device with Integrated Nanostructured substrate for Reliable, Rapid SER detection of Seawater Nutrients

Mentor(s)

Dr. Bernard Munge (Salve Regina University)
Dr. Jason Dwyer (University of Rhode Island)

Project Description

Our research activities involve development of simple, low cost nanomaterials-based ultrasensitive sensor arrays coupled to simple microfluidic sample delivery systems. Activities involve synthesis/characterization of nanoparticles with different surface chemistries and using them to nanofabricate highly sensitive sensors for various applications. We also design and print electrode arrays in our fabrication facility using our recently acquired DEK horizon screen printer.

Activity: Craft a microfluidic housing for a SER substrate, allowing multiple fluid inputs.

In collaboration with Drs. Zheng, Dwyer and other team members, we will with start this thrust by designing a simple prototype microfluidic devise fabricated using Polymethylmethacrylate (PMMA) and Polydimethylsiloxane (PDMS). This microfluidic system will be tested/evaluated by integrating nanostructured substrates tailored for SERs detection of sea water nutrients including Nitrates and Phosphates.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project

- Fabrication of microfluidic devices
- Synthesis of gold nanostructures
- Surface characterization techniques using Atomic Force Microscope (AFM), Scanning electron Microscopy (SEM) and Transmission electron microscopy (TEM)
- Microfluidic device evaluation/characterization using SER and complimentary Electrochemical technique

Applicant required/preferred skills

n/a

Understanding the role of *Ulva* species and their symbiotic bacteria in Narragansett Bay aquatic ecosystem

Mentor(s)

Dr. Anna Radovic (Salve Regina University)

Project Description

For the last several years, a team from Salve Regina University led by Professor JD Swanson, in collaboration with Professor Carol Thornber from the University of Rhode Island, studied an important component of the Narragansett Bay ecosystem, the green macroalgae from the *Ulva* Genus, by following the bloom identity of the two species (*Ulva compressa* and *Ulva rigida*), as well as analyzing the bacterial populations associated with either species at various locations. The collected data follow the seasonal fluctuations of these organisms, which we are now correlating with geographical, climatic, and other important ecological factors, including elevation, availability of nutrients, and proximity of farm land. The laboratory portion of this project mainly focuses on algal DNA extraction, analysis, and sequencing; identification of factors required for the algal growth, as well as isolating, sequencing, and identifying the bacterial species associated with them.

We have started work on comprising the genomic library for both *Ulva* species. We are currently anticipating completion and publishing of *Ulva* genome as part of the summer project, thus allowing using comparative genomic analysis to further understand origin, ecological dynamics, and potential of these organisms. Additionally, unique structure of *Ulva* species as colonial organisms (there are just a few known species with such organization, all belonging to the Protist kingdom) might pour some light on understanding the mechanisms underlying multicellularity.

May through September is sample collection season. The samples need to be collected and analyzed regularly; thus it is essential, that the students participating in this project can be present at the location and available to do field work on daily basis.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project

The students should be able to regularly and reliably collect samples, store and analyze them promptly using the following techniques:

- DNA extraction
- Bacterial cultures
- Tissue cultures
- PCR amplification and gel electrophoresis
- Sequencing using the iSeq100 Sequencing System (Illumina)
- Constructing and utilizing genomics libraries

Applicant required/preferred skills

The required qualifications include at least 2 years of completed course work in Biology, a minimum of 3.4 GPA, and at least 3 months experience working on the current or related project.
Students with affiliations with local environmental groups/clubs, and experience with any environmental projects are preferred.

Evaluating linkages between *Pseudo-nitzschia* species composition and the contribution of partner bacteria to domoic acid production in Narragansett Bay

Mentor(s)

Matthew Bertin (University of Rhode Island)
Dr. Bethany Jenkins (University of Rhode Island)

Project Description

While strains of the diatom *Pseudo-nitzschia* have been present in Rhode Island waters, the detection of significant quantities of the neurotoxin domoic acid is a recent and troubling development, beginning in the fall of 2016. An increase in bloom events of *Pseudo-nitzschia* and domoic acid production represents a significant risk to the state's shellfish industry and local populations as domoic acid is responsible for amnesic shellfish poisoning. Little is known with respect to the ecological drivers of domoic acid production as areas with high *Pseudo-nitzschia* cell counts may have little domoic acid production. The proposed project will examine both abiotic and biotic factors as drivers of domoic acid production and toxin composition.

The overarching goal of this research project is to identify biotic and abiotic drivers of *Pseudo-nitzschia* bloom formation and domoic acid production from strains of diatoms that persist in Narragansett Bay. We will accomplish this goal by means of biological profiling of toxic *Pseudo-nitzschia* strains and chemical profiling of domoic acid at sampling sites in Narragansett Bay. Furthermore, we will investigate the associated bacteria community of *Pseudo-nitzschia* and determine the effect of heterotrophic bacteria on the production of domoic acid in laboratory cultivated strains.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project

- Chemical extraction of filtered *Pseudo-nitzschia* cells
- Sample preparation implementing ion-exchange chromatography of both water and cell samples
- HPLC analysis to determine domoic acid presence
- LC-MS/MS analysis to detect and quantify domoic acid
- Web-based MS/MS-based molecular networking analysis

Applicant required/preferred skills

- Two semesters of general chemistry required
- Two semesters of organic chemistry preferred but not required

Fractal Particle Templated Gold Nanoshells for Contaminant Detection Using SERS

Mentor(s)
Dr. Arijit Bose (University of Rhode Island)
Dr. Akram Abbasi (University of Rhode Island)

Project Description
A range of fractal nanoparticles (e.g. carbon black, fumed silica) will be used as templates for the deposition of gold nanoshells from an aqueous gold salt solution. The fractal nature of the particles implies several 'hot spots' on their surfaces, which will lead to dramatic enhancement of SERS signals. The ability of these particles to detect organic contaminants at ultra low concentrations in sea water from Narragansett Bay will be explored.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project
Nanoparticle synthesis; Imaging using scanning and transmission electron microscopy; Raman spectroscopy.

Applicant required/preferred skills
Preferred qualification: Freshman level chemistry, physics and mathematics. An ability to work safely in a laboratory, and record observations carefully.

Distribution, diversity, and drivers of human activities in and around Narragansett Bay

Mentor(s)
Dr. Tracey Dalton (University of Rhode Island)

Project Description
This project will use a combination of research methods to collect data on human uses, local ecological knowledge, and attitudinal factors related to how people interact with Narragansett Bay resources. As part of a collaborative research team, the SURF fellow will participate in the following activities during the summer of 2018: (1) review scientific literature, reports, policy documents, and websites to compile existing information on human uses in Narragansett Bay; (2) conduct observational surveys to collect data on human uses at various sites along the Bay; and (3) conduct in person surveys to collect data about what users do in and around Narragansett Bay and what they think about this environment and their interactions with other users. The SURF fellow will also be involved in data analysis and stakeholder outreach.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project
- Learn and strengthen skills in conducting reviews of the literature & policy documents, observational surveys, and in person surveys
- Learn and practice the collection, coding and analysis of social science data
- Work in a collaborative team setting
- Potentially collect and analyze spatial GIS data

Applicant required/preferred skills
- Student should feel comfortable talking with Narragansett Bay users and residents
- Student should be willing to travel to various sites around Narragansett Bay to conduct observations and surveys
- Student should be willing to work on a team with other students and faculty
- GIS skills would be useful, but are not required for this project

Performance Testing and Optimization for Surface Enhanced Raman Spectroscopy

Mentor(s)
Dr. Jason Dwyer (University of Rhode Island)

Project Description
Surface Enhanced Raman Spectroscopy (SERS) is a powerful technique for (bio)analytical chemistry, producing spectroscopic fingerprints of analytes. Nanostructured surfaces are used to dramatically--as much as a millionfold--the Raman signal from analytes near to the surface. The degree of enhancement is tremendously sensitive to the nanostructuring (thus it can be used as a probe of the nanostructuring), and performance can be significantly degraded by surface (bio)fouling in real-world samples. This project will center on using a variety of techniques to evaluate and optimize SERS substrates, SERS device operating parameters, signal processing and analysis, and chemical assay workflows. The student will learn about instrumental chemistry, nanofabrication, surface science, and device development (that is, how to create and improve tools for exploring the molecular world with greater ease and detail). While the focus is on environmental samples, SERS and other techniques and principles learned performing this work are broadly applicable to biomedical diagnostics, that is, performing disease diagnosis in a clinical setting.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project
The student will learn about instrumental chemistry, nanofabrication, electronic signal processing, surface science, and device development (that is, how to create and improve tools for exploring the molecular world with greater ease and detail). While the focus is on environmental samples, SERS and other techniques and principles learned performing this work are broadly applicable to biomedical diagnostics, that is, performing disease diagnosis in a clinical setting.

Applicant required/preferred skills
Key experimental steps will require the fine motor control necessary to manipulate small (~3mm diameter) nanofabricated elements. Students in our group have had backgrounds in chemistry, physics, mathematics, computer science, and engineering, either alone or as combined degrees; the research work will provide hands-on training in the skills needed for success for those students with training in chemistry, physics, or engineering.

Microbiomes of oysters in RI coastal waters: The role of host-microbial interactions on oyster health

Mentor(s)

Dr. Marta Gomez-Chiarri (University of Rhode Island)
Dr. Rebecca Stevick (University of Rhode Island)

Project Description

Oysters have important ecological and economical functions. This study will use novel methods of analysis and visualization of microbial metagenomes and metatranscriptomes to characterize the relationship between oyster health and microbial communities along the estuarine gradient of Narragansett Bay and the coastal ponds. Oysters will be collected from selected sites in Rhode Island coastal waters representative of a variety of environmental conditions. Samples will also be included from a field experiment in which the combined effect of temperature and increased nitrogen was tested. Genetic material (DNA and RNA) from the gut of oysters will be extracted for metagenome and metatranscriptome analysis. The relationship between patterns of microbial composition and function, host responses and health, and environmental conditions will be examined.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project

- DNA and RNA extraction
- Bioinformatics analysis
- Cytoscape visualization

Applicant required/preferred skills

Microbiology, some knowledge of computer language - coding.

When does too much of a good thing become a bad thing? Assessing the impacts of seaweed accumulations on benthic habitat quality through benthic invertebrate community analysis

Mentor(s)

Dr. Lindsay Green-Gavrielidis (University of Rhode Island)
Dr. Niels Hobbs (University of Rhode Island)

Project Description

Narragansett Bay has been plagued by large accumulations of seaweed, known as seaweed blooms, for many decades. The main drivers of seaweed blooms are nutrient enrichment, also known as eutrophication, and decreased herbivory. The Rhode Island Department of Environmental Management has mandated significant reductions in the amount of nutrients released from wastewater treatment plants. These reductions have been achieved and are hypothesized to decrease seaweed blooms, yet we still see significant accumulations of seaweeds in Narragansett Bay. Seaweed blooms have been documented to have many negative economic and ecological consequences, but these seaweed accumulations can also provide food and shelter for organisms. Assessing benthic invertebrate communities (i.e. invertebrates that live in sand/bottom substrate) has been used to determine the health of ecosystems for many decades, but this approach is very time consuming. Our research aims to determine the effects of seaweed blooms on benthic invertebrate communities, with the goal of identifying when algal abundance has a positive effect on invertebrates and when algal abundance becomes so great that the effects become negative. We will also examine the effects of anthropogenic stressors on benthic habitat quality by examining the temporal and spatial variability in seaweed and invertebrate communities. Identifying thresholds in seaweed abundance will provide coastal and resource managers with a faster method to assess benthic habitat quality by assessing seaweed abundance rather than having to collect, sort, and identify the benthic invertebrate community.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project

Students will:

- learn how to identify bloom-forming seaweeds and benthic invertebrates using microscopy and likely molecular approaches
- conduct field-based surveys (using quadrats) to quantify seaweed abundance
- collect benthic invertebrate samples in Narragansett Bay
- gain an understanding of design, implementation, and analysis of ecological field experiments
- assess the linkages between benthic habitat quality and anthropogenic stressors

Applicant required/preferred skills

Required skills for this project include an ability to work carefully and independently, comfort in working outside in inclement weather, ability to work with microscopes (primarily dissecting) for long periods of time, a flexible work schedule as some weekend work may be required, and a familiarity with Microsoft Excel. It is preferred, but not required, that the student has experience in identifying marine macroalgae (seaweed) and/or invertebrates.

Renewable Polymers for Switchable Surfaces: Smart Anti-biofouling Coatings

Mentor(s)
Dr. Matt Kiesewetter (University of Rhode Island)

Project Description
We will be synthesizing ester-functionalized cyclic carbonate monomers and conducting ring-opening polymerization from a surface functionalizable chemical handle. Post polymerization, we will attach the polymer to a surface and cleave the esters, demasking carboxylates that can either be attracted or repelled from the surface depending on its charge state. In conjunction with Prof. Jason Dwyer of URI Chemistry, we will cycle the surface charge from attractive to repulsive and cause a hydrophobic to hydrophilic change in the surface character, which is one strategy to expel biofouling. Because we are custom-functionalizing, we can tune our molecular 'windshield wipers' to be more or less aggressive by changing the carboxylate density in the polymer chain.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project
The student will learn the techniques of a synthetic polymer chemist. These skills include air-free technique, chemical synthesis, working in inert atmosphere, extraction and separation techniques, analysis (including NMR spectroscopy and mass spectrometry), scientific record keeping and data analysis. The skills of a polymer chemist are those above but also include molecular weight analysis, chemical kinetics, thermodynamics and reaction mechanism.

Applicant required/preferred skills
The student should have completed organic chemistry by the beginning of the project, with a preference for those that have completed an organic chemistry lab course. Analytical chemistry experience is also desirable.

Color-Changing Sensors for Ion Detection in Marine Environments

Mentor(s)
Dr. Mindy Levine (University of Rhode Island)

Project Description
The presence and concentration of certain key ions in marine environments is crucial for the health of the aquatic ecosystem, with certain ions facilitating healthy ecosystem development and others causing serious harm. The development of methods to detect these ions in ways that are sensitive for small amounts of ions, selective for the ions that we are looking for within a complex environment, and generally applicable for a wide range of temperatures, salinities, and other conditions are crucial in facilitating researchers' understanding of the effects of climate change and other stressors on coastal marine environments. We will develop such sensors using paper-based devices that turn color in the presence of the ion of interest. Such color changes can be seen using naked-eye detection, with a laboratory-grade colorimeter, or with commercially available computer programs and mobile apps. We will develop, optimize, and test every part of this high impact sensor in this exciting and impactful research project.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project
Paper based device fabrication; chemistry of surfaces, analytical techniques for color analysis, real-world field testing of aqueous environments

Applicant required/preferred skills
An interest in science, willingness to learn new things, and desire to contribute to meaningful research projects in a tangible way.

Developing bioinformatics procedures for metabolic pathway annotation using Omics data

Mentor(s)
Dr. Ying Zhang (University of Rhode Island)
Dr. Bethany Jenkins (University of Rhode Island)

Project Description
Metabolism is one of the central processes mediating organismal growth and hence governing the adaptation and population dynamics of different species. Despite the significant needs in identifying metabolic pathways from large-scale Omics data, existing bioinformatics pipelines are often limited in the precise prediction of metabolic substrates. This calls for the development of new computational procedures for predicting metabolic processes either within single organisms, or among multiple organisms in a collaborative community. In this project, students will participate in developing and benchmarking new computational tools for the identification of missing metabolic functions from mining Omics data. Results from this project can be used to enhance the modeling of metabolic processes in various ecosystems.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project
Students will learn basic skills in setting up and running bioinformatics tools at the command line interface and will be trained in the broader area of metabolic pathway modeling and Omics data analysis.

Applicant required/preferred skills
n/a

The microbial ecology of benthic habitats in Narragansett Bay

Mentor(s)
Dr. Roxanne Beinart (University of Rhode Island, GSO)

Project Description
Student will use cultivation, microscopy, and molecular-based approaches to explore the diversity and functioning of benthic microbes in Narragansett Bay, with a particular focus on carbon cycling and anaerobic protists.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project
Cultivation of protists, light and epifluorescent microscopy, molecular identification of microbes via PCR.

Applicant required/preferred skills
Any microbiology or molecular biology laboratory experience would be preferred, but is not required.

New technologies for monitoring the health of the Bay ecosystem

Mentor(s)
Dr. Chris Kincaid (University of Rhode Island, GSO)
Dr. David Ullman (University of Rhode Island, GSO)

Project Description
On this project we will be developing a new, first of its kind, monitoring system for the Narragansett Bay ecosystem. For years we have been able to gather time series data (or data points at minute or second intervals) on coastal ocean physics. The problem has been collecting time series data on ecosystem parameters to go along with these (chemistry and biology). These instruments are expensive and delicate, requiring routine maintenance. The coastal ocean is hard on these instruments. Problems range from biofouling to vandalism. On this project we sidestep such problems by placing ecosystem instruments on shore, in a safe, controlled, accessible environment, and pumping water to them. We will place a mooring in the water along which three hoses terminate at different depths. These will run into the Castle Hill Lighthouse (Lower East Passage). Water will be pumped into the lighthouse and into a flow-through chamber where an array of ecosystem data types will be collected.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project
Students will be part of the team that deploys the moorings and develops the one of kind pump house facility. There is the water supply facility. But there is also adding instruments into the flow-through system. A large part of this is working with their hands, helping to make things fit and work together. Students will also get experience with handling diverse data sets, downloading data and initial processing of data.

Applicant required/preferred skills
Students need to be good with their hands. They need also to be good problem solvers. There will be routine visits to the pump house to check on instruments and perform simple tasks. But with any coastal data collection, there will be issues that need to be addressed.

Temperature effects on plankton population dynamics

Mentor(s)

Dr. Susanne Menden-Deuer (University of Rhode Island, GSO)
Dr. Gayantonia Franze (University of Rhode Island)

Project Description

The student will participate in an ongoing NSF project evaluation the physiological response of marine planktonic organisms to temperature changes. The student will be exposed to a range of microbiological and oceanographic techniques. There is an opportunity to participate in regular sampling of the Narragansett Bay Estuary and potentially a short research cruise to the New England shelf area.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project

- microscopy
- particle analysis

Applicant required/preferred skills

- interest in quantitative techniques
- high level of motivation

Phytoplankton Imaging in Narragansett Bay

Mentor(s)

Dr. Colleen Mouw (University of Rhode Island, GSO)
Audrey Ciochetto (University of Rhode Island, GSO)

Project Description

Phytoplankton composition is a critical component of aquatic food web structure, societally important fisheries, and human health. The SURF student will aid in the operation and data analysis of continuous observatories for phytoplankton composition with an Imaging Flow CytoBot (IFCB, http://mclanelabs.com/imaging-flowcytobot/). Two sites will be setup with IFCBs; one at the Graduate School of Oceanography's (GSO) dock and another at the location world's longest-running plankton survey located in Narragansett Bay (http://www.gso.uri.edu/phytoplankton/). The dock location will also have continuous optical observations enabling 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 phytoplankton composition variability at each site and between the sites.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project

- Analysis of large datasets
- Phytoplankton identification
- Field instrument maintenance
- Water filtration
- Spectroscopy

Applicant required/preferred skills

Some laboratory experience (could be through coursework) and an interest in phytoplankton and coastal oceanography are 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.

Laboratory and field tests of a new benthic lander system for measuring oxygen and nutrient fluxes

Mentor(s)

Dr. Rebecca Robinson (University of Rhode Island, GSO)
Dr. John King (University of Rhode Island, GSO)

Project Description

The exchange of nutrients between sediments and the overlying water column is an important part of the biogeochemical budget of an estuary. One way to quantify this exchange is using a benthic chamber. A chamber encloses a volume of water and area of sediment and, in more sophisticated chambers, sensors and water samplers allow for the measurement of chemical changes in the water. A new benthic chamber system will be purchased as part of the EPSCoR C-AIM program this spring and it will be tested both in the laboratory and the field. The engaged SURF student will participate in the laboratory and field testing of this instrument through the design and implementation of simple experiments, to be performed in shallow water or a mesocosm setting. The aim will be to conduct creative experiments to test the efficacy and flexibility of the benthic lander before it is deployed in deeper waters by boat. Collected samples will be analyzed for nutrients and other properties. In reality, the measurements will depend on the student's experiments. In the event that the lander is not ready for this work, the student will deploy a simple benthic chamber, making analogous measurements in the laboratory, without the new lander's automation.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project

- Experimental design
- Field sampling
- Sample measurements
- Data analysis

Applicant required/preferred skills

Some course work in Chemistry is preferred

The secret lives of plankton in Narragansett Bay

Mentor(s)
Dr. Tatiana Rynearson (University of Rhode Island, GSO)
Dr. Stephanie Anderson (University of Rhode Island, GSO)

Project Description

Plankton are key components of the Narragansett Bay ecosystem and yet most of them are nearly invisible to the naked eye. In this project, a student will work with members of the Rynearson lab to examine plankton activities in Narragansett Bay using an array of methods including DNA analyses. The project will include both laboratory experiments and weekly field sampling of Narragansett Bay waters. The project requires a student who is interested in learning about lab and field techniques to assess biodiversity, is willing to work outdoors and able to carry up to 10L of water at a time and is interested in learning computational skills and bioinformatics.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project

- Field sampling of phytoplankon
- Assessment of phytoplankton abundance
- Bioinformatics
- Potentially flow cytometry
- Experimental design

Applicant required/preferred skills

The project requires a student who is interested in learning about lab and field techniques to assess biodiversity, is willing to work outdoors and able to carry up to 10L of water at a time and is interested in learning computational skills and bioinformatics. Strong quantitative skills a must.

Development of an enhanced circulation/ecological model of the Narragansett Bay region

Mentor(s)

Dr. David Ullman (University of Rhode Island, GSO)

Project Description

This SURF project will be focused on developing an enhanced computer model of the circulation and ecology of the Narragansett Bay region. An advanced model of lower trophic level ecology will be coupled with an existing ocean circulation model of the region to provide the capability to simulate ecological processes that are influenced by the circulation in the Bay. Depending on the computer programming skills of the student, he/she will assist in one or more of the following tasks: (1) coupling the ecological and circulation model, (2) incorporating new bathymetric information into the model grid, (3) preparing ocean boundary and river forcing files for the model, and (4) running the model to produce a year-long simulation of the seasonal cycle of the ecology of the Bay and comparing these results to available observations to assess the model fidelity.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project

Because this project is focused on the development of enhanced computer models, the primary skills necessary for the student will be computer related. The student will learn how computer models of ocean circulation and ecological processes are structured, how they are set up and run, and how the results are visualized and analyzed. The successful student will gain experience in writing computer code to produce model forcing files and to read the model output in order to produce analyses of the simulation results.

Applicant required/preferred skills

The student will need to have some computer programming skills (Fortran, C, or MATLAB for example).

Imaging of large (>150µm) marine plankton and particles

Mentor(s)

Dr. Melissa Omand (University of Rhode Island, GSO)
Dr. Ben Knorlein (Brown University)
Noah Walcutt (University of Rhode Island, GSO)

Project Description

The SURF student would work with Dr. Melissa Omand, grad student Noah Walcutt and Brown CCV scientist Ben Knorlein to use *in situ* imaging techniques (ie. holography, standard CCD cameras) to look at large plankton and particle size classes that the Imaging Flowcytobot does not capture. They will build/use a raspberry Pi-based camera for underwater deployment. They will manually ground-truth image data (quantifying size and taxomony when applicable). After vetting by Omand/Walcutt they will provide these datasets to the RI Data Discovery Center.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project

Image analysis, holographic microscopy, Matlab, Programming of low-cost single-board computers for image acquisition.

Applicant required/preferred skills

Robotics interest/experience (ie Raspberry Pi, Arduino).

Narragansett Bay Monitoring network data analysis

Mentor(s)

Dr. Candace Oviatt (University of Rhode Island)
Dr. Kristin Huizenga (University of Rhode Island, GSO)

Project Description

The student working on this project will compile long term trend data on primary production, zooplankton and nutrient trends for Narragansett Bay. Data on pH and oxygen will be available from the Narragansett Bay fixed site and buoy monitoring network (14 stations) and from a bi-weekly to monthly collection of surface nutrient samples from Narragansett Bay (13 stations). A primary production model will be available to estimate primary production from raw oxygen or pH data. Zooplankton data has been collected but not counted and could be a valuable contribution to the long term data sets available on Narragansett Bay. The data will be used to ascertain the managed nutrient reduction and the resulting reduced levels of metabolism and fauna.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project

Skills in computer programing and packages such as excel will be required. Skills in Matlab, R, Jump and other statistical programs would be useful. The student may work with zooplankton experts to acquire skill to identify and count zooplankton in preserved samples.

Applicant required/preferred skills

Courses in biology, chemistry, physics and mathematics will be required.

Coastal cultural ecosystem system services of Narragansett Bay

Mentor(s)
Talya ten Brink (University of Rhode Island)
Dr. Tracey Dalton (University of Rhode Island)

Project Description
For this project, SURF students will interview Warwick recreational fishers that are fishing in and around Narragansett Bay to understand their fishing behavior and recreational place-based values. This project also responds to interest from the URI Coastal Resources Center, to gather data on views and perceptions from underrepresented communities to be incorporated into the Narragansett Bay Special Area Management Plan (SAMP). The SURF fellow will (1) review existing literature on recreational fishing and cultural ecosystem services, (2) assist with participant outreach, (3) aid in developing an interview protocol, (4) help conduct interviews in Spanish and English, (5) aid in transcription of the interviews. This study will include participants of diverse ethnicities so that the results can be used to inform sustainable and equitable development interventions along the coast of Narragansett Bay in the future.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project
- Develop skills in reviewing scientific literature
- Develop skills in creating interview protocol and conducting interviews
- Work with team members
- Learn and practice conducting interviews in English and Spanish
- Learn and practice transcribing and coding interviews in English and Spanish

Applicant required/preferred skills
- Student should be fluent in Spanish
- Student should be willing and able to travel to Narragansett and Warwick
- Student should be willing and reliable team member
- Student should feel comfortable talking to recreational fishers around Narragansett Bay

Parasites in the Bay

Mentor(s)
Dr. Chris Lane (University of Rhode Island)

Project Description
Parasites play an important ecological role in marine ecosystems, but their diversity and abundance is poorly understood. We're interested in apicomplexan parasites of invertebrates and parasites of algae that are closely related to their hosts. By generating data on the prevalence of these understudied parasites, we will identify their impact on the flora and fauna of Narragansett Bay.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project
DNA extraction, PCR, Sequence data analysis, culturing methods.

Applicant required/preferred skills
n/a

Isolation and characterization of marine bacteria in Narragansett Bay

Mentor(s)
Dr. Anne Reid (Salve Regina University)

Project Description
The isolation of bacteria from marine environments continues to be a great challenge. Many of these microbes are in low abundance, do not grow readily in the lab environment and/or rely on interactions with other microbes in their natural environment for growth. The first aim of this project is to compare the ability of several growth media and growth conditions to support the recovery of marine microbes from Narragansett Bay. Media tested will include some commercially-available low-nutrient media (e.g. R2A, marine agar), as well as media prepared by adding a gelling agent (e.g. agar, agarose) to filtered Narragansett Bay seawater. The effect of nitrogen availability on bacterial recovery will also be tested by supplementing media with inorganic nitrogen sources (e.g. ammonium chloride, sodium nitrite). Several sample sizes will be trialed in order to determine which water sample size yields the highest variety of microbial species. Isolated bacteria will be identified by PCR amplification and Sanger sequencing of the 16S rRNA gene and comparison of gene sequences to online databases (e.g. NBCI BLAST). Isolated microbes, particularly those for which there is no match in the 16S rRNA database, will be further characterized with respect to growth requirements, cellular morphology and enzymatic activities. Overall, these studies will result in the development of an efficient recovery method for bacteria from Narragansett Bay, and may lead to the identification of one or more microbes that could serve as biomarkers for changing conditions in the Bay.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project
sampling and filtration, aseptic technique, preparation of growth media, bacterial culture and isolation techniques, microscopy, PCR, analysis of DNA sequencing data, experimental design, troubleshooting, data analysis, keeping a scientific notebook, scientific communication

Applicant required/preferred skills
- student must be highly motivated, conscientious and detail-oriented, and able to work independently as well as within a team setting
- knowledge of basic microbiology skills (media preparation, bacterial culture) preferred

Examining harmful algae ecology and microbial interactions in Narragansett Bay

Mentor(s)

Alexa Sterling (University of Rhode Island)
Dr. Bethany Jenkins (University of Rhode Island)
Matt Bertin (University of Rhode Island)

Project Description

In Narragansett Bay, we're interested in members of the phytoplankton genus *Pseudo-nitzschia*, some of which produce a potent neurotoxin called domoic acid that can bioaccumulate in shellfish and be transferred up the food chain. This project will involve collecting water samples and accompanying metadata from several sites in Narragansett Bay, filtering samples for DNA analysis in order to examine the species composition of *Pseudo-nitzschia*, and isolating *Pseudo-nitzschia* and its associated bacteria from the Bay for future lab experiments. The cultures of isolates growing in the lab will be identified through molecular techniques such as Sanger sequencing. The student will examine the sequencing results and phylogenic relationships between the cultures. Time permitting, the student will contribute to experimental design and data analysis.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project

- Water sample collection and accompanying metadata in the field
- Filtering water samples
- Sterile media preparation including liquid media and agar plates
- Dissecting scope work to isolate single cells
- Isolating and growing bacteria cultures
- Phytoplankton cultivation and growth monitoring
- DNA extraction
- Sequence analysis to identify phytoplankton and bacteria cultures
- Experimental design and testing (hypothesis, control/treatment, etc.)
- Research notebook maintenance

Applicant required/preferred skills

Preferred qualifications include basic microbiology and aseptic laboratory technique experience. No prior field experience required, but student should be aware some water sample collections may occur while on a small boat offshore.

Effect of seawater temperature on reproductive success in a Narragansett Bay marine invertebrate.

Mentor(s)

Dr. Steven Irvine (University of Rhode Island)

Project Description

In order to assess the current and possible future effects of climate changes in Narragansett Bay and beyond, it is necessary to understand how the environment influences marine organisms. This project aims to determine the effects of elevated temperatures on the reproduction of *Ciona intestinalis*, a common sea squirt in Narragansett Bay, and what physiological limits are crossed above the temperature maximum for normal reproduction. The project will involve setting up temperature-controlled aquaria to rear animals, and tests of reproductive success relative to both parental rearing temperatures and embryonic rearing temperatures. In the lab, we will also be monitoring the expression levels of genes that may be important for coping with temperature changes. *C. intestinalis* is an ideal animal for these studies, since we have extensive knowledge of normal reproduction and development processes and much information and tools for studying how genes allow the animal to respond to changes in temperature.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project

- Experimental animal husbandry of marine invertebrates
- Data analysis, statistics and graphing
- Molecular biology techniques, especially nucleic acid isolation and quantitative PCR.

Applicant required/preferred skills

Some experience in molecular biology techniques is preferred.

Investigation of responses to parasite exposure in the eastern oyster, *Crassostrea virginica*

Mentor(s)
Dr. Dina Proestou (University of Rhode Island)
Dr. Tal Ben Horin (University of Rhode Island)

Project Description

Wild and cultured populations of the eastern oyster, *Crassostrea virginica*, are threatened by disease-causing parasites. Deaths from disease have led to significant decreases in the ecosystem services and economic benefits provided by oysters, yet we know relatively little about how the host and parasite interact. The primary objective of this project is to investigate how oysters respond to the disease-causing parasite *Perkinusus marinus*, causative agent of Dermo disease and to measure variation in those responses across genetically different oyster strains. A variety of techniques will be used to characterize oyster responses to the parasite including laboratory controlled disease challenge experiments, the molecular quantitation of parasite density within host tissues via DNA extraction and qPCR, and the analysis of host gene expression profiles over the course of the challenge experiments. By focusing on host response to *P. marinus* exposure, we hope to gain information about disease susceptibility and transmission that can inform the management of wild shellfish populations and accelerate breeding for disease-resistant eastern oysters used in aquaculture.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project

Students will be exposed to a wide variety of skills. They include maintenance of culture systems, animal husbandry (oyster), DNA extraction and quantitation, quantitative PCR, genetic and genomic analysis, and routine data analysis.

Applicant required/preferred skills

Required to have a B or better in Introductory Biology Course. Preference for students interested in marine invertebrates, marine ecology, and genetics.

Lab-to-field: Nanostructured sensors for monitoring pollutants in coastal ecosystems

Mentor(s)
Dr. Geoff Bothun (University of Rhode Island)
Timo Kuester (University of Rhode Island)

Project Description
Small, low cost sensors are needed to improve our ability to detect and monitor environmental pollutants that harm coastal ecosystems. Critical to the success of any sensor is the ability to integrate it within existing instrumentation that is used in the field to monitor coastal ecology. Through this project, students will translate experimental research on nanostructured sensors and device design to field research where the sensor devices are connected to buoys and/or autonomous vehicles. The nanostructured sensors will be created using gold and silver nanomaterials to provide sensitive detection of nitrogen and phosphorus, both nutrient pollutants, via Surface Enhanced Raman Spectroscopy (SERS). Specific goals of this work will include designing and characterizing nanostructured sensor elements, integrating these elements into 3D printed devices and with field instrumentation, and optimizing sensor design by engineering selective surface coatings.

This project involves **both field and lab work**

Skills & techniques that will be learned/used as part of this project
Skills learned will include nanomaterial characterization via spectroscopy, microscopy, and light scattering; 3D printing and associated need to control fluid flow; ability to collaborate in a diverse research group; technical communication via presentations at weekly group meetings.

Applicant required/preferred skills
Engineering or physical science background preferred.

Multiplexed Optical Detection of Heavy Metal Contaminants in Seawater

Mentor(s)
Dr. Daniel Roxbury (University of Rhode Island)

Project Description
Current methods to detect heavy metal contaminants in water supplies involve bulky and expensive equipment, i.e., atomic absorption spectroscopy (AAS) or inductively coupled plasma-mass spectroscopy (ICP-MS), prohibiting their use in portable on-site testing. Single-walled carbon nanotubes are an ideal candidate in the construction of next-generation sensors. Their intrinsic fluorescence is exceptionally photostable, with emission properties that are responsive to single molecules. It has been demonstrated that the fluorescence from nanotubes responds to the presence of heavy metal ions. Additionally, in the near infrared imaging window of 900-1400 nm, there exist >20 species (chiralities) of nanotubes that can be separated from a mixture, functionalized, and utilized for multiplexed optical sensing. Here, we will create a family of functionalized nanotubes to quantify concentrations of heavy-metal contaminants in seawater samples. Nanotubes appropriately functionalized with small-molecule or aptameric chelators of heavy-metal ions will have the capacity to simultaneously monitor bulk concentrations of up to 20 distinct species of heavy metal contaminants. Upon specific binding of a heavy-metal ion to the chelator-nanotube complex, a characteristic red-shift is expected in the near-infrared emission spectrum due to perturbations in the localized dielectric environment of the nanotube. By sequentially separating by nanotube species and conjugating specified chelating agents, we propose to engineer specificity and selectivity to the optical nanosensors.

This project involves **primarily lab work**

Skills & techniques that will be learned/used as part of this project
Nanoparticle preparation and characterization, UV/Vis spectroscopy, Dynamic Light Scattering, NIR fluorescence microscopy, Statistics and data representation

Applicant required/preferred skills
Experience with UV/Vis spectroscopy. Experience with inverted microscope.