# General Information

**Program sponsor:** Princeton Environmental Institute  
**Position number:** C1WAR  
**Project title:** Microbial Control of Nitrous Oxide Production and Consumption in the Ocean  
**Organization/research group:** Ward Lab  
**Primary location(s) of internship:** Princeton University, Guyot Hall  
**Additional cities and/or countries to be visited (if applicable):** n/a

**Note:** If this internship is located in a country with an International SOS risk rating of High or Extreme, final candidates must participate in a travel review process overseen by the Travel Oversight Group (TOG), and obtain safety guidance prior to departure. The University reserves the right to revoke support and funding for travel at any time there has been a significant deterioration in the safety and security conditions surrounding travel arrangements, or in the sector of the country, or countries, where travel is to occur.

# Faculty Sponsor(s)/Host Information

**Name(s):** Bess Ward  
**University Department(s):** Geosciences  
**E-mail:** bbw@princeton.edu  
**Website:** [http://www.princeton.edu/nitrogen](http://www.princeton.edu/nitrogen)  
**Phone:** 609-258-5150

# Internship/Research Project Information

**Internship/project description:**

Nitrous oxide (N2O) is a potent greenhouse gas and the ocean contributes 35% of the total atmospheric flux. About a third of that flux comes from a very small fraction of the ocean volume, where oxygen is completely depleted. In those regions, microbial processes produce and consume N2O, but the regulation of those processes by environmental variables (such as oxygen, organic matter, substrate concentration) is poorly understood. We will be analyzing samples collected on a recent research cruise to investigate those environmental controls, as well as the composition of the microbial community responsible for N2O transformations. While both production and consumption of N2O are thought to occur only in the absence of oxygen, we have found evidence for both processes in the surface ocean, i.e., where oxygen is abundant. Using molecular biological methods, we will search for the microbes responsible and quantify their distributions throughout the water column.

**Student's role and responsibilities:**

The intern will apply PCR (polymerase chain reaction) and quantitative PCR to determine the distribution of genes that encode the N2O transformation reactions. This will involve extraction of DNA and RNA from seawater samples, PCR and cloning, followed by DNA sequencing to identify the microbes involved, an to ascertain which of them are actively expressing the genes at the time of sampling. Exploration of the existing database of genes/enzymes involved in N2O production and consumption suggests that current assays may be missing important components of the microbial assemblage that is involved in N2O transformations. Thus, the intern will be able to design and test new PCR primers and to optimize the PCR assays for discovery of new microbes. Functional gene microarrays will also be used to explore the diversity of the N2O transforming microbial assemblage. The student may also participate in the analysis of metagenomic samples collected with the N2O experiments.
Internship/project learning objectives:
The student will learn a suite of state of the art molecular biological methods and will acquire basic laboratory skills for handling and analyzing nucleic acids.

PROGRAM REQUIREMENTS

Academic background and any course pre-requisites:
Introductory biology and chemistry desirable.

Technical skills:
using micropipets, spectrophotometer, microbalance, standard chem lab protocols

Additional training(s):
 n/a

Equipment:
laptop would be useful

Physical demands:
n/a

Language abilities/competencies (if applicable): n/a

Additional information about the internship/project:
The student will become a member of a vibrant lab group and have the opportunity to learn about several oceanographic research projects by participate in group meetings. Participating students will need to complete biosafety and lab safety trainings prior to the start of the internship.

INTERNSHIP/PROJECT SUPERVISOR(S)

Name and title of primary supervisor: Bess Ward
Email: bbw@princeton.edu

Name and title of additional supervisor, if applicable: Amal Jayakumar
E-mail: ajayakum@princeton.edu
Phone: 609-258-6294

PROGRAM DATES AND FUNDING INFORMATION

Weekly Stipend: $500
Number of Positions Available: 1-2

Tentative Start Date (mm/dd/yyyy): 06/10/2019
Number of Weeks: 8-9

Tentative End Date (mm/dd/yyyy): 08/09/2019

Note: PEI funding is for full-time work, 35 hours per week minimum, and for a period of at least 8 continuous weeks.

Application Deadline: January 11, 2019