Building The Phylogenetic Tree of the Ocean Floor

By Grace Kim

Gabara's early interest in Environmental Studies

A sophomore from Murray Hill, New Jersey, and majoring in environmental engineering, Cassandra Gabara joined Dr. Katrina Edwards' lab last semester. Gabara's interest in environmental sciences was fostered in high school by her passionate environmental science teacher who instilled the importance of environmental conservation and activism in Gabara. Consequently, she decided to declare it as her major upon entering USC, with an emphasis in biotechnology.

Dr. Katrina Edwards' Lab

Dr. Katrina Edwards, professor of biological sciences, Earth sciences, and environmental studies, is devoted studying sub-seafloor life and the interaction between microbes and rock. Along with other research institutions, Dr. Edwards' Lab is drilling holes in the ocean floor in three different locations under the Atlantic ocean—the North Pond, Juan de Fuca and South Pacific Gyre. By doing so, they hope to study how life thrives in sediments and rock below the bottom of the ocean.

Since Gabara has only been at the lab for several months, she is still getting acquainted with common laboratory techniques including how to carry out PCR, bacterial transformations, ligation, and cloning. She frequently carries out the Polymerase Chain Reaction, more commonly referred to as PCR. This is a widely used molecular biology

technique for amplifying a small sequence of DNA across several degrees of magnitude. The technique itself utilizes thermal cycling, repetitive cycles of heating and cooling in order to replicate DNA. PCR is crucial for the replication of the rock's DNA, which must be replicated to create a database of the DNA before starting experiments.

After performing PCR, Gabara then uses the DNA obtained to perform ligations—joining DNA fragments together with covalent bonds—and transformations—the genetic alteration of a cell resulting from direct uptake and expression of foreign DNA.

Gabara states that she is excited to be a part of the Edwards research team because she is learning new things, whether it is a protocol or new information.

Building the Phylogenetic Tree of Sub-Seafloor Life

The goal of the lab is to obtain the DNA from the microbes living on the rock chips, amplify it through PCR, clone them into *E. coli* cells to grow, sequence the genes, and build a phylogenetic tree of sub-seafloor life. Gabara has been able to work closely with a graduate student during her semester of research. Her responsibilities included preparing the DNA obtained from mineral chip samples of Chalcopyrite and Olivine for genetic sequencing.

Significance and Implications of Research

Although it may be impossible to obtain a DNA sample from each bacteria, the overarching phylogenetic tree can provide a general picture of what organisms live down in the ocean floor and potentially elucidate how life originated. Therefore this project has vital implications to understanding the theory of evolution. The exact species of each bacteria cannot be determined, but it can be classified as specific as the phylum it belongs in.

One possible limitation to the study may be the fact that there are always four main bacterial species, and the ones that are not as concentrated will be underrepresented, potentially producing a bottleneck effect. Moreover, Gabara notes that there are some experimental roadblocks as well. She has noticed that it is sometimes difficult to obtain enough DNA samples. She also notes that PCR may not be successful, or the cloningvector may not be successfully integrated by the bacterial host.

Nonetheless, Gabara states that she loves working in the lab because the graduate students are helpful, encouraging, and always send her research papers regarding the topic. To undergraduate students seeking a research position, she advises that it does not matter if you have limited experience as long as you have a passion for research.