

**Environmental Engineering**

**and Earth Sciences**

**EEES Department Seminar**

**‟** **Plants and Their Microorganisms and How They Control the Fate of Contaminants in the Environment”**

**Presented By**

**Dr. Lucia Rodriguez-Freire**

Assistant Professor, New Jersey Institute of Technology

<https://clemson.zoom.us/j/5783910968>

**Abstract**

Rhizosphere horizons are particularly susceptive to heavy metal and organic contaminants accumulation, due to their specific biogeochemical processes enhanced by high organic matter and nutrient content. In our research, we investigate the role of the plant endophytes and rhizosphere microorganisms as main drivers for contaminant bioavailability. In particular, we have focused on the microbiome role on contaminant plant uptake and plant toxic response on PFAS remediation and REE accumulation in two main projects. (1) Endophytic microbial community decreased the phytoaccumulation of a mixture of per- and polyfluoroalkyl substances (PFAS) to *Poa reptans* seedlings. Plant response to PFAS as reactive oxygen species (ROS) secretion into the root zone was reduced in the presence of endophytic microbes. PFAS exposure resulted in damage to the root hairs and lack of internal cyclosis only in the absence of bacteria (bleached seeds). Also, PFAS exposure altered the microbiome of *Arabidopsis thaliana* in hydroponic experiments. Ongoing research is continuing to investigate PFAS mixtures to elucidate the differences between different functional groups, C-chain length, and different biochemical properties, and to promote PFAS degradation in root systems by stimulating the production of ROS. (2) The endosphere microorganism *Methylobacterium extorquens* relies on rare earth elements (REE) for methanol dehydrogenase activity. When exposed to cerium oxide nanoparticles (CeONP), *M. extorquens* increased its growth rate and accumulated CeONP, with an uptake rate proportional to the initial concentration, as per digestion and analysis of harvested cells. Cellular cerium (Ce) was detected by SEM-EDS in purified harvested bacteria and TEM ultrafine-structure images show CeONP incorporation and accumulation near the nucleoid. Current research experiments are investigating the role of *M. extorquens* as driver for enhanced CeONP uptake by plant seeds (*Poa annu* and *Zea mays)* colonized by *M. extorquens* in comparison to sterilized seeds, with the objective to promote Ce bioleaching for resource bio recovery. This work is expected to provide a holistic understanding of role of plant-microbe response to the fate and transformation of contaminants within the various environmental compartments, and it will inform future remediation strategies and exposure prevention alternatives.

**Bio:** Dr. Rodriguez-Freire is an Assistant Professor of Environmental Engineering at the John A. Reif, Jr. Department of Civil and Environmental Engineering at the New Jersey Institute of Technology. Lucia’s Laboratory of Applied Biogeochemistry for Environmental Sustainability objective is to understand and control the complex mechanisms of contaminant transformations in natural and engineered environments, in order to engineer remediation and resource recovery technologies mimicking natural sustainable processes. Lucia earned a B.S. in Chemical Engineering from the University of Santiago de Compostela, Spain, and she has a M.S. and a Ph.D. in Environmental Engineering from the University of Arizona. She also did two postdoctoral works, one at the University of Arizona, and another at the University of New Mexico. Her work is currently funded by the EPA, the New Jersey Water Resources Research Foundation, and industry partners.

***Friday, November13, 2020***

***2:30 PM***

***Online via Zoom***

***“Attendance is mandatory for graduate students enrolled in EES 8610, EES 9610, and GEOL 8510.”***