Microorganisms are extraordinary chemists. They arose early in Earth’s geologic history and for nearly 4 billion years have co-evolved with their ever-changing environment and shaped the geochemistry and biodiversity of nearly every crevice of Earth’s crust. Despite their ubiquity, most microorganisms we observe using molecular-based identification tools (e.g., 16S rRNA gene sequencing) are functionally enigmatic, meaning we see them, yet we have no idea what roles they play in the environment. Microbial processes, like nitrogen fixation, are integral to a functioning ecosystem. Yet measures of rates are lacking, especially in the Great Lakes. Interestingly, Cyanobacteria are key nitrogen fixers in surface waters. Additionally, many of the species that fix nitrogen also form harmful algal blooms. Cyanobacterial Harmful Algal Blooms (cHABs) are increasing in frequency, duration, and severity in freshwater ecosystems. While the lower Laurentian Great Lakes (Lake Erie and Ontario) are prone to toxin-producing cHABs, Lake Superior has not seen regular cHAB occurrences, likely due to its cold temperature and oligotrophic nature. Here I will talk broadly about the nitrogen fixation across the Great Lakes, Cyanobacteria we observed seasonally in Lake Superior,  who is responsible for the cyanobacterial bloom in 2018, and the implications for past and future blooms.