Biases in the discovery of microbial species and phenotypes
- Undergraduate research project -

Supervisor
Stilianos Louca, PhD; Assistant Professor, Biology

Project breadth
Full independent research project, with the ultimate goal of publishing a scientific paper.

Project background
Microorganisms (notably bacteria) are the most ancient and the most widespread form of life on Earth. Their evolutionary history remains a largely unsolved puzzle in our understanding of Earth's geobiological trajectory. Due to the nearly complete absence of microbial fossils, microbial evolution is mostly reconstructed using phylogenetic methods. Estimated macroevolutionary rates (e.g., overall speciation rates, or trait-dependent speciation rates) of microbes from phylogenetic data can be substantially distorted if sampling biases (e.g., depending on phenotype) are not accounted for. While it is generally acknowledged that culturing and PCR-based methods (e.g., 16S amplicon sequencing) can be substantially biased, quantitative estimates of these biases are currently lacking.

Project objective
Estimate culturing & sequencing biases depending on microbial traits (e.g. presence/absence of specific metabolisms), by comparing massive global databases of named microbial species, sequenced genomes, metagenome-assembled genomes (MAGs) and 16S PCR-amplicon sequences. The project will focus on metabolic traits that are of particular relevance to environmental processes or important evolutionary transitions, such as photosynthesis, sulfur and nitrogen cycling, or the ability to consume cellulose.

Potential benefits to student
- Experience in conducting supervised serious research from A to Z
- Opportunity to author or co-author a scientific publication (depending on progress)
- Research credit

Prerequisites and commitments
- Experience in programing (e.g., R, bash or python), bioinformatics and statistics
- Interest in microbial ecology and evolution
- Strong motivation to learn independently and solve complex problems
- Scientific writing skills
- Professionalism and scientific integrity
- Willing to devote 150-300 hours of work, over the course of 1-2 years

Application procedure
Contact Stilianos Louca by email (contact details at www.loucalab.com). Please include CV and an explanation of why you think you are a good candidate for the project.