Comparative genomics and **molecular evolution** studies can work synergistically bridging important areas in biological and **biomedical research**. Together, they can help us to reach a system-based understanding of the **phenotypic diversity** and evolution of organisms from the molecular perspective, the processes that shape molecular variation and **genome plasticity**, and ultimately elucidating the interactions between molecules, organisms, and communities in diverse environments.

The major questions guiding my research include: 1) How can we connect genomic information to **phenotypic diversity** and **metabolic capabilities** of organisms? 2) What processes shape the evolution of **protein families** generating the **functional diversity** that we observe in the contemporary organisms? 3) How can we infer biological **adaptations** to **different environments** from the analysis of **protein families** across diverse organisms?

My research integrates computational and experimental analyses of members of **protein families**, aiming to contribute to the understanding of the **biology** and **evolution** of organisms from the **molecular perspective**. Basically, I apply **phylogenomic approaches** to explore the mechanisms that shape the **evolution** of **sequence**, **structure**, and **function** of proteins to generate the great deal of diversity that we observe today. My work focuses on **protein families** that participate in key **biological processes** and have an impact on human health. Among the proteins of interest are the PLP-dependent **aminotransferases**, **photolyases**, and **chryptochromes**.

This and other selected **protein families** constitute excellent targets for analysis for various reasons including: 1) extraordinary record of **experimental data** as a result of decades of investigation in genetics, biochemistry, physiology, and so on; 2) availability of a huge amount of **sequence data** and a significant number of **crystal structures**; 3) importance of roles played in biological processes with relevance to **biomedical research**, biotechnological applications, and studies of the **origin of Life**.

Taken as a whole, these approaches can provide insights to guide **experimental design** with further elucidation of **gene expression**, **regulation**, and **function of genes** and gene products. Ultimately, my research will improve the interpretation of **genomic data** to understand the diversity of **molecules and organisms** looking for potential applications to **biomedicine** and **biotechnology**. This framework will provide research staff and students with the opportunity to be involved in **interdisciplinary research** by equipping them with a solid background in biochemistry, molecular biology, microbiology, genomics, and bioinformatics. A highly collaborative environment is essential to develop such an integrated research.