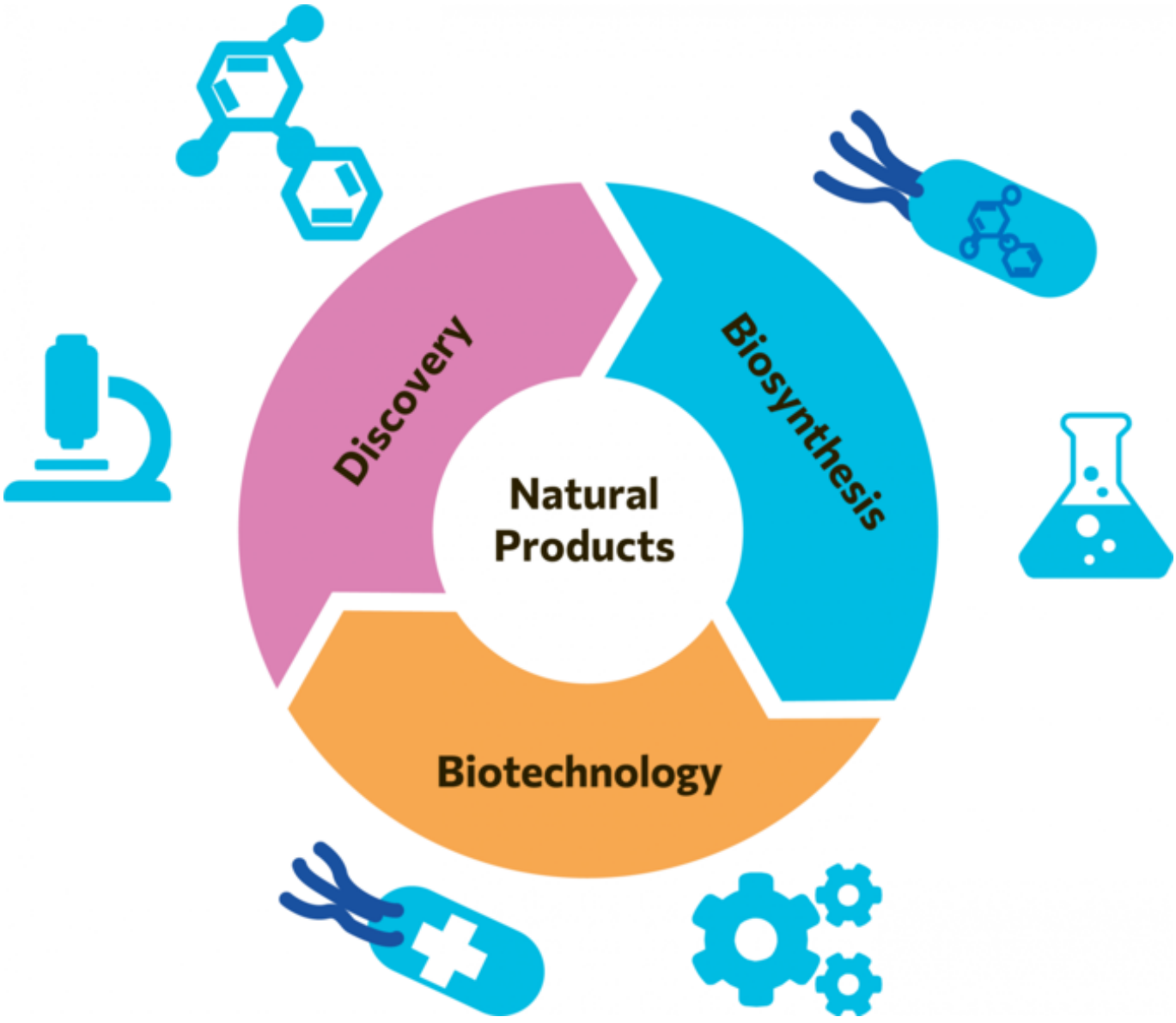
Until 2024

Discovery, biosynthesis, and synthetic biology of microbial natural products



A quick overview...

Our main research focus:

- Functional genomics of cryptic biosynthetic gene clusters
- Comparative metabolomics using mass spectrometry
- Microbial physiology of specialized metabolites
- Biosynthesis of natural products (enzymes, cofactors, toxins)
- Synthetic biology of natural products (“Pathway Engineering”)

Bacteria are incredibly resourceful organisms. They produce natural products like **antibiotics, cofactors, or toxins**. Antibiotics are important for the treatment of infectious diseases. Cofactors serve as vitamins. Toxins can act as insecticides, for instance. Our aim is the **discovery of novel biosynthetic routes** useful for pharmacology, biotechnology, or agriculture. Therefore, we investigate **cryptic biosynthetic pathways,** i.e. pathways with as-yet-unknown products found encoded in microbial genomes. We combine functional genomics and comparative metabolomics to link biosynthetic gene clusters to their corresponding natural products. **Functional genomics** comprises techniques to perform targeted activation or inactivation of genes or to transfer and “re-factor” whole gene clusters for expression in an optimized host organism (**Synthetic Biology**). **Comparative metabolomics** refers to the systematic comparison of “as many metabolites as possible” found in an organism. We employ high-resolution mass spectrometry and computational analyses to find novel specialized metabolites. In addition, we investigate the **physiological role** of the metabolites we discovered and study single biochemical steps in detail. Finally, we use **synthetic biology to engineer biosynthetic pathways**: By channeling biomass into the biosynthetic route the yield of the natural product can be increased. Recombining pathways can lead to the production of **novel metabolites with enhanced properties** for various applications.

Currently, we are investigating new (and rare) cofactors from bacteria, e.g., of mycobacteria. Rare cofactors such as **coenzyme F_{420}** or **mycofactocin** are involved in specialized physiological processes, e.g. growth on unusual carbon sources, resistance to antibiotics, or their biosynthesis. Our goal is therefore to elucidate the biosynthesis and physiological function of the cofactors and to foster their biotechnological use.