

“Life ... finds a way”: Discovering and deploying microbial solutions to emerging global challenges

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Modern economies increasingly rely on advanced materials and chemicals that are sourced from unsustainable sources. Moreover, these products are engineered for stability such that it is uneconomical to reclaim and reuse their building blocks at the end of their lifetime. Microbial systems, however, have evolved over millennia to extract all available energy and carbon from their environment, including wastes, to build complex organic molecules and biomacromolecules that support life. These microbially-sourced chemicals now form the basis of many modern medicines, viable drop-in bioenergy substitutes, commodity chemicals, and advanced materials. Innovations in bioprocessing, genetic engineering, and synthetic biology now rapidly enable the engineering of these microbial processes to optimize product formation and control the properties of the specific compounds made. These advances are further supported by integrated omics approaches (genomics, metabolomics, proteomics) that reveal a wealth of novel microbes from exotic ecosystems such as animal gut microbiomes that can consume and upcycle growing waste streams. In this talk, I highlight a few successes of microbial bioprocessing for sustainable chemical factories and advanced materials development. I will also discuss emerging opportunities and challenges to the onboarding of environmental microbes to process post-consumer plastics wastes and lignocellulosic biomass.