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Synthetic Astrobiology

Synthetic biology – the design and construction of new biological parts and systems and the redesign of existing ones for useful purposes – has the potential to transform fields from pharmaceuticals to fuels. Our lab has focused on the potential of synthetic biology to revolutionize all three major parts of astrobiology: Where do we come from? Where are we going? and Are we alone? For the first and third, synthetic biology is allowing us to answer whether the evolutionary narrative that has played out on planet earth is likely to have been unique or universal. For example, in our lab we are re-evolving the biosynthetic pathways of amino acids in order to understand potential capabilities of an early organism with a limited repertoire of amino acids and developing techniques for the recovery of metals from spent electronics on other planetary bodies. And what about the limits for life? Can we create organisms that expand the envelope for life? In the future synthetic biology will play an increasing role in human activities both on earth, in fields as diverse as human health and the industrial production of novel bio-composites. Beyond earth, we will rely increasingly on biologically-provided life support, as we have throughout our evolutionary history. In order to do this, the field will build on two of the great contributions of astrobiology: studies of the origin of life and life in extreme environments.