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## **Synthetic Biology and the Search for Extraterrestrial Life**

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**Abstract:** “Are we alone?” is one of the primary questions of astrobiology, and whose answer defines our significance in the universe. Unfortunately, this quest is hindered by the fact that we have only one confirmed example of life, that of earth. While this is enormously helpful in helping to define the minimum envelope for life, it strains credulity to imagine that life, if it arose multiple times, has not taken other routes. To help fill this gap, our lab has begun using synthetic biology – the design and construction of new biological parts and systems and the redesign of existing ones for useful purposes – as an enabling technology. One theme, the “Hell Cell” project, focuses on creating artificial extremophiles in order to push the limits for Earth life, and to understand how difficult it is for life to evolve into extreme niches (<http://2012.igem.org/Team:Stanford-Brown/HellCell/Introduction>). In another project, we are re-evolving biotic functions using only the most thermodynamically stable amino acids in order to understand potential capabilities of an early organism with a limited repertoire of amino acids. This should lead to a more universal theory of the origin of life based on materials found commonly in meteorites and other pre-biotic settings.