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Some Lessons Tought by Searching for Life in the Universe

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Actively searching for Life in the Universe requires that we understand "what" we are looking for and "how" to search for it. This is a transdisciplinary pursuit that involves observational, experimental and phenomenological work in areas such as Interstellar Chemistry, Planetary Exploration, Origin of Life, Evolution of Life and the frontier between Physics, Chemistry, Biology and Engineering. In the last decades we have put together a picture of the Evolution of the Universe where on the basis of a few basic principles we understand many features of how it has changed through its history and evolved into the morphologies we observe today: we even have sets of equations that encapsulate this. We have also learned that chemical evolution takes place in the Interstellar Medium, and are beginning to understand many details of the formation of planetary systems and their planets from chemically and gravitationally evolved building blocks. In parallel we have developed a deep understanding of the Co-Evolution of Life in our planet, and discovered an extraordinary number of features and properties of extant and extinct living systems so that the accidental from the regular can begin to be disentangled. Planetary discovered made in the last few years imply that the limits of habitability are wider than suspected just a decade or so ago. This is an important part of the theme for planetary exploration where technologies, strategies and instruments are opening new vistas. Even though our understanding of Life and Living Systems is still far from the more simplicity-based understanding that we have for the Universe at large scales, the above is helping to make make progress in pinning down the accidental from the regular in Biology and, eventually, can hope to be able engineer living systems from the "Top-down". In this talk we will give an overall review of this exciting area.