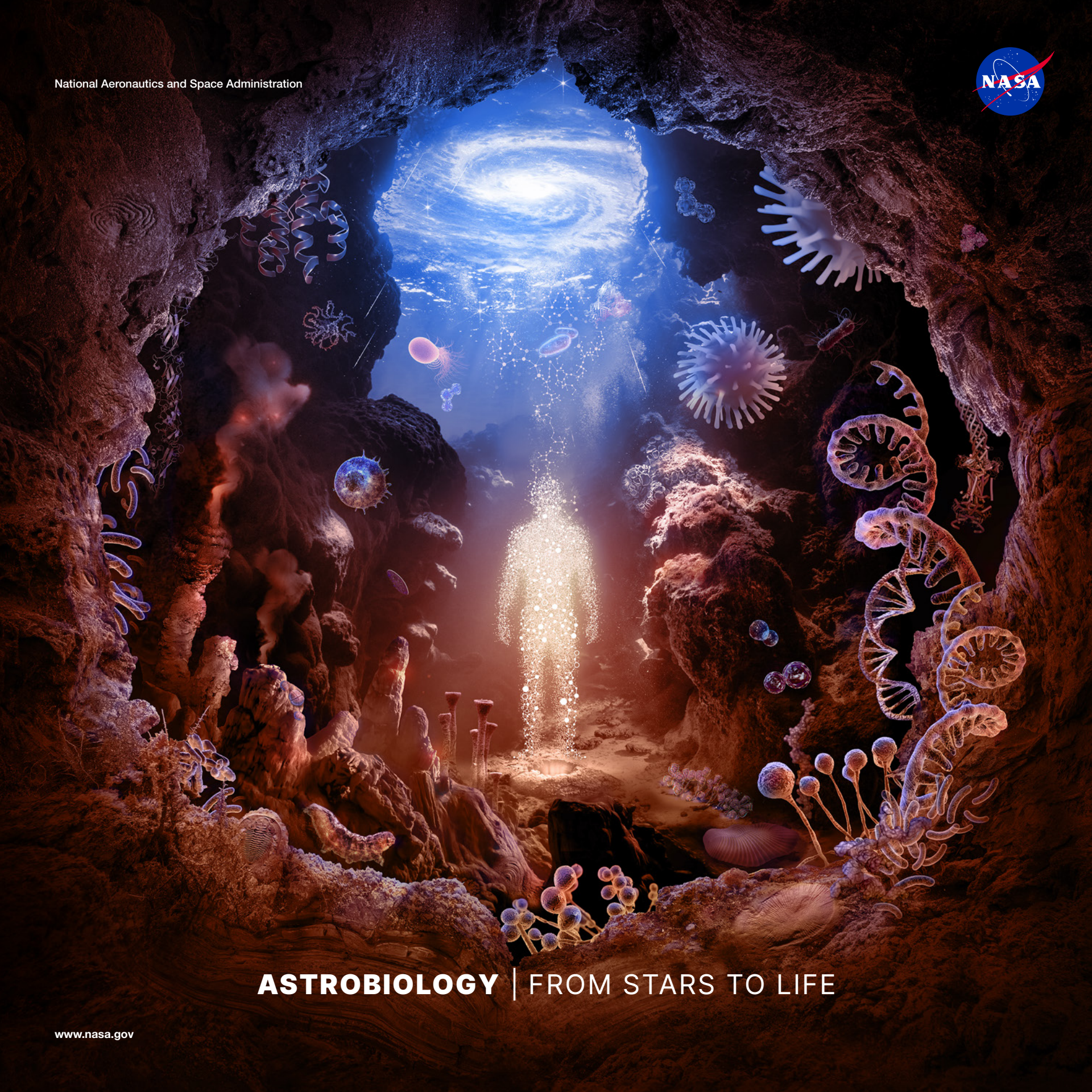
National Aeronautics and Space Administration



ASTROBIOLOGY | FROM STARS TO LIFE

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Astrobiology is the scientific study of life's origin, evolution, and distribution in the Universe. It includes learning about all aspects of life on Earth and environments and processes beyond to understand the potential for life elsewhere in the Universe. Life is ubiquitous on Earth, surviving by many metabolic pathways, and is easily identified from space, but our search for signals of life elsewhere – and the prebiotic processes that lead to life – is ongoing. The research of NASA's Astrobiology Program continues to expand humanity's understanding of how life as we know it works, how and why it persists on Earth and the potential for finding similar (or completely different) life out amongst the stars. It examines how Earth became a place where life could form, from the creation of important elements in stars to the formation of planetary systems, the development of conditions that make planets habitable, the evolutionary path that life has taken in response to changing environmental conditions, and the search for signatures of currently or previously alive organisms beyond Earth.

ANSWERING FUNDAMENTAL QUESTIONS

Astrobiology is a science driven by interdisciplinary questions investigated by a diverse and collaborative scientific community. What is life? How did we get here? Are we alone? These questions unite researchers from historically separate scientific fields, such as biology, chemistry, geology, astronomy, and engineering, together in a collaborative effort to understand our place in the Universe. Astrobiology is for everyone! All scientists interested in understanding our place in the Universe are welcome and can contribute to the work of astrobiology.

UNDERSTANDING LIFE'S ORIGINS

Earth initially formed as a lifeless planet, composed of molten rock and gas, with no signs of life. Over time, as the planet cooled and conditions stabilized, chemical reactions occurred in this "primordial soup," and the building blocks of life began to emerge. These building blocks eventually came together in increasingly complex reactions to give rise to life as we currently know it. How this happened is still largely a mystery. Astrobiologists study prebiotic chemistry under the wide range of environments and conditions present early in Earth's history and on other planetary bodies; it not only sheds light on how life eventually arose on Earth but also informs our understanding of the steps that might lead to the evolution of life elsewhere, including life as we don't know it. By studying these prebiotic reactions, astrobiologists can better assess the likelihood of life existing elsewhere and guide invest gations on other planetary bodies beyond Earth where the ingredients for life may exist. Life might be a rare occurrence if the processes leading to life require highly specific conditions. However, if life can form from diverse prebiotic ingredients, we could have a universe absolutely teeming with life!

CHARACTERIZING HABITABLE ENVIRONMENTS

Astrobiology research informs NASA's missions that look for habitable environments in our solar system and beyond. Today, Earth is the only known example of a world inhabited by life. However, thanks to scientific studies, laboratory experiments, mathematical simulations, and missions in space, we now know that Mars once had and still has environments capable of supporting life as we know it. Other locations in our solar system, such as icy ocean moons like Europa and Enceladus, could also have habitable environments capable of supporting living organisms in the past or even today. Beyond our solar system, planetary systems are being discovered around other stars in our galaxy. Astrobiologists work to understand if and how these planets might be amenable to life.

SEARCHING FOR SIGNS OF LIFE

Microbial life on Earth is very abundant and has been for most of its history. By extension, microorganisms may be the first type of life we find elsewhere. Astrobiologists are figuring out how to search for signs of microbial life – past or present – on the planets and moons in our solar system and beyond. Key questions astrobiology looks to answer include: How do you detect evidence of biology when you can't hold a sample in your hand? Does life leave its mark on a planet so that we can detect its presence remotely? Or is our life-filled Earth rare and unique or is life common?

https://go.nasa.gov/astrobiology
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