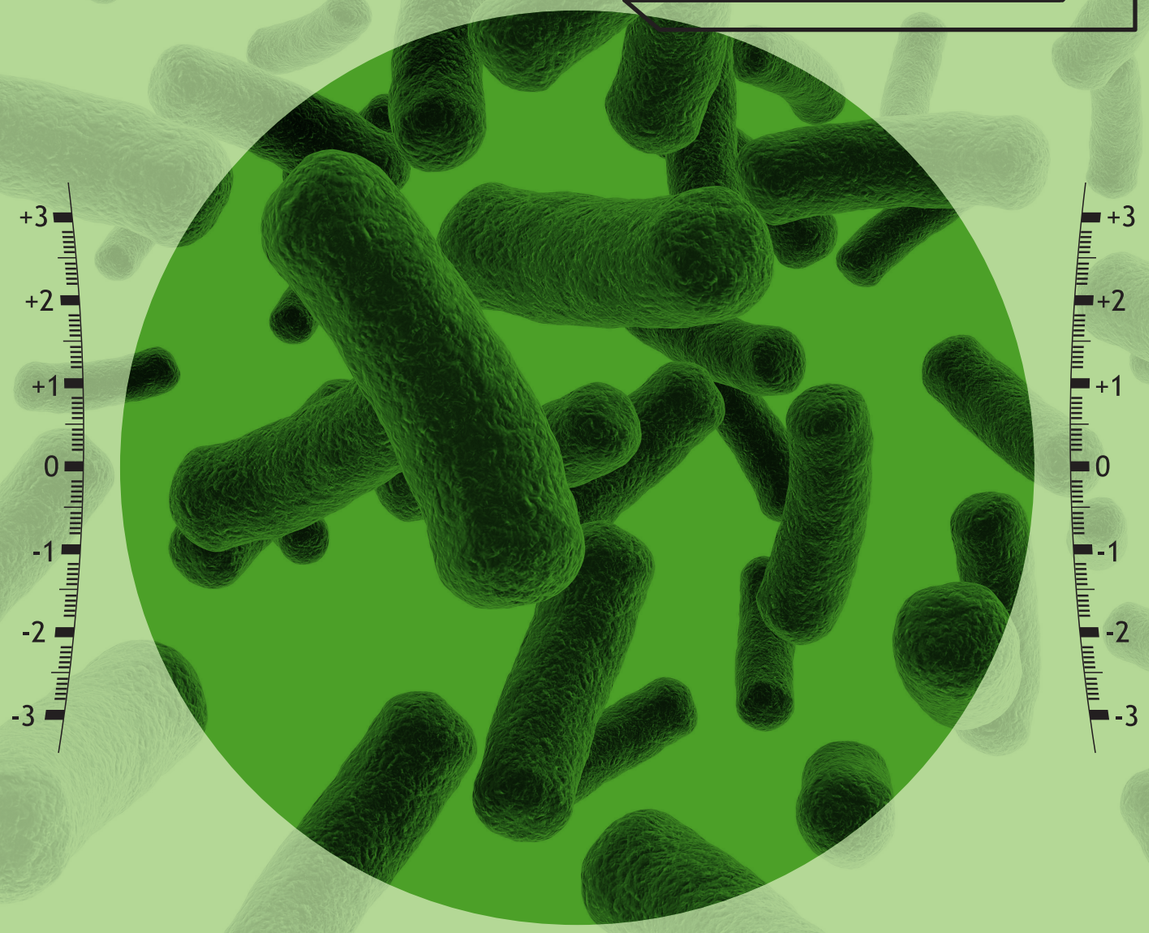
Bringing wastelands to life –

how extremophiles could help us 'green' other planets

By Hanna Landenmark
PhD student at the UK Centre for Astrobiology, The University of Edinburgh

Astrobiology is an exciting, emerging research field which incorporates virtually every science under the Sun (pun intended). Finding an appropriate and comprehensive definition of astrobiology can be a challenge for a topic concerned with the study of life in the universe. Few researchers would class themselves as pure astrobiologists, as their research is often linked to multiple areas and sits at the interface of many of the classical sciences, such as chemistry, biology, geosciences, astronomy and physics. In the broader sense, if you've ever wondered about the rest of the Universe and whether we are truly alone, you've already ventured into the realm of astrobiology.



The day-to-day life of an astrobiologist varies greatly. Some are microbiologists and spend their day characterising microbes from extreme environments, such as hydrothermal vents or very salty lakes. Others are geoscientists and could be creating artificial fossils in the lab or studying the imprint of early microbes in rocks. Physicists-or-engineers-turned-astrobiologists could be sleeping during the day and working overnight to gather data from telescopes on exoplanets orbiting other stars.

Meanwhile, there are researchers on field trips collecting data all over the world, from snow algae near the poles, to drought-resistant organisms in scorching deserts. There are even people working on the social science aspects of astrobiology, such as thinking about the laws that prevent potential planetary cross-contamination, or doing psychological studies on groups of volunteers who simulate working on a Mars base. If you were to join any of these research groups, one thing is certain: you'd be working in a team of scientists from very different backgrounds, all bringing their expertise to the table.

Even though astrobiology might seem fundamentally concerned with life beyond the Earth, many of the discoveries are equally important for advancing our understanding of life on our own planet. One example is studying how land masses become colonised by life, in other words, how we go from barren, desolate stretches of rock to soils and lush vegetation. Even though Earth's land masses have been colonised for a very long time, this process still occurs today, as volcanoes create new lava fields that slowly cool and are colonised by bacteria, archaea (another type of microorganism), fungi and plants. For instance, one of the most famous volcanic eruptions in the last decade was the Icelandic Eyjafjallajökull, which shut down air traffic across most of Europe, and created extensive lava flows in the surrounding area.

The first colonisers to inhabit these hostile environments have to be extremely hardy to establish themselves, and have to survive by using nutrients extracted from rocks and whatever tiny particles are brought in by wind and rain. At the same time, if you're living on a rock surface, you're exposed to the elements, and have to be able to survive wetting and drying cycles, wind, UV radiation and drastic temperature fluctuations. Thankfully, many microorganisms are very versatile and adapted to exactly these kinds of alterations, and have no problem colonising newly exposed rock – in fact, some species thrive while living a little on the edge. Over time, the first colonisers will weather the rock surface and make the environment a little less hostile and richer in nutrients, enabling other, less hardy species to move in.

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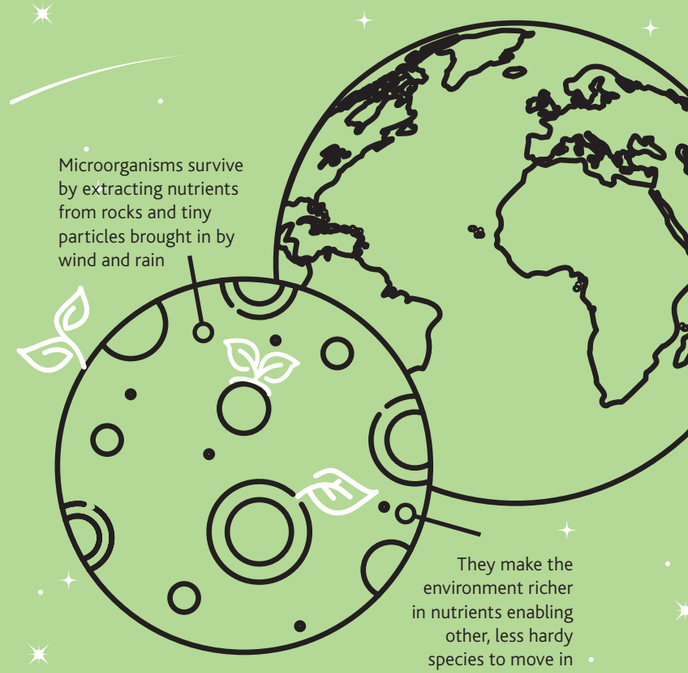

Over time, volcanic rocks turn into rich, fertile soils that are excellent for agriculture. This type of research can help us understand how land was colonised on the early Earth, and can also give clues to similar potential phenomena on Mars.

Much in the same vein, there has been a lot of thought about how microorganisms could be utilised to facilitate human space exploration, for example for food production in space environments. People have suggested that microorganisms could be used in terraforming – the concept of changing other planets or moons to more Earth-like conditions. One step could be to use ecosystems of microorganisms from Earth that are well known for their capabilities to break down rocks to accelerate soil formation or extract useful elements.

There are, however, many obstacles to consider – many conditions need to be right for terrestrial microbes to survive in these novel environments, such as access to all necessary nutrients, clement temperatures and protection from harmful radiation. There are also ethical questions to consider: do humans have a right to alter other planetary bodies that could potentially already host life, perhaps in a way that we don't recognise, or where life could emerge in the future if left to its own devices? These fascinating questions continue to inspire both professionals and the public, ensuring that terraforming remains a compelling topic of research and conversation.

If you are interested in studying astrobiology and tackling some of these questions yourself, there are many routes to take. Although there are currently no undergraduate degrees in astrobiology in the UK, many universities offer introductory courses that give an overview of the topic. Being a very interdisciplinary subject, it is possible to study virtually any STEM subject in school or university before embarking on a research career within the scope of astrobiology. So, whether you are interested in questions involving tiny microbes, or the future of human space exploration and colonisation, there's something within astrobiology for everyone.