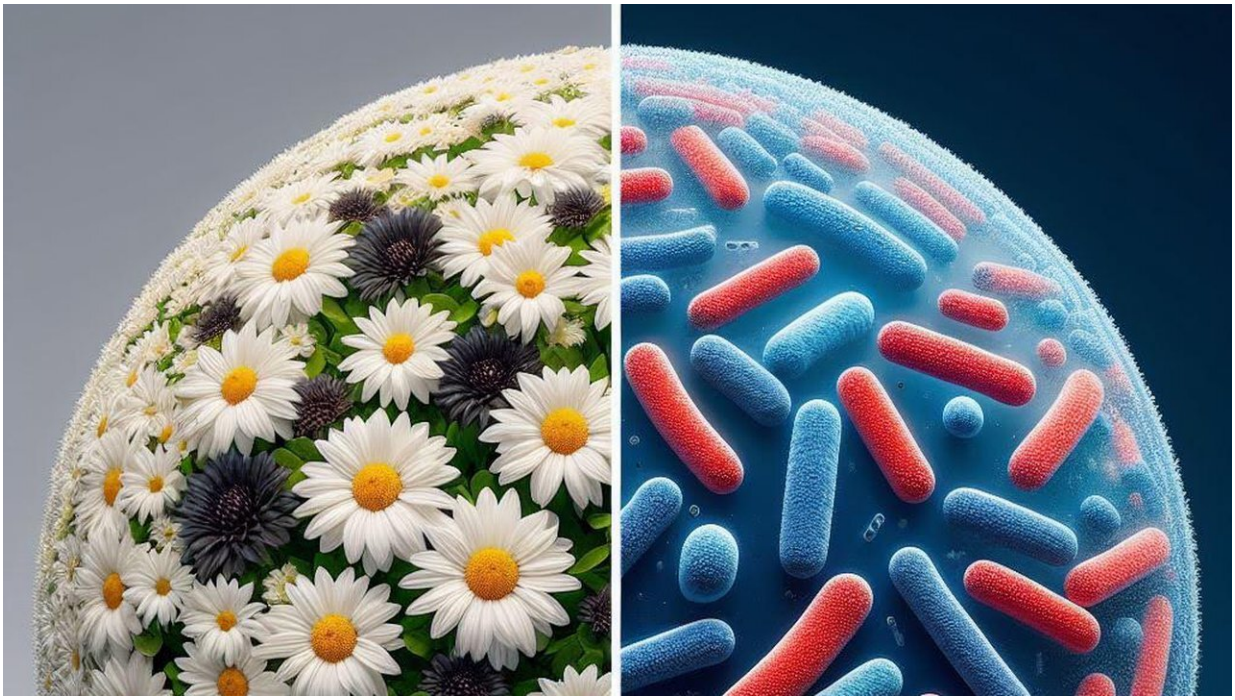
Life as a planetary regulator: Researchers propose an experimental test

February 15 2024



A new paper proposes an experimental setup that could test the classic Daisyworld model — a hypothesis of a self-regulating planetary ecosystem — in the lab via two synthetic bacterial strains. Credit: Victor Maull, created with Image Designer

According to the Gaia hypothesis, which was proposed by the scientists Lovelock and Margulis in the 1970s, our planet should have been getting progressively warmer for millions of years, while our oceans should have

been progressively more acidic as well. The fact that this hasn't happened suggests a planet-wide complex system that is self-regulating, with planetary life and geological processes working together to stabilize planetary geology and climate. Despite its importance, this idea could not be previously tested due to its planetary scale.

In a paper, published in the *Journal of the Royal Society Interface*, SFI External Professor Ricard Solé (Universitat Pompeu Fabra) and collaborators propose an experimental system that will test, on a small scale, the dynamics that regulate planetary processes. Using synthetic biology, they will test two engineered micro-organisms in a self-contained system to see if they can achieve a stable equilibrium.

This proposed setup is inspired by recent research in fermentation, which has typically required finely-tuned outside control, to achieve stable, regulated conditions, including a stable pH level. "There's been recent work in trying to see if you can engineer microorganisms for fermentation so that they can self-regulate," Solé says. "That was the key inspiration."

This experimental setup, which Solé and several of his students developed during a visit to SFI, has the potential to answer long-standing questions in the field about planetary-wide regulatory systems.

In this experimental setup, one strain will detect if the environment is becoming too acidic, and counteract the increasing acidity, while the other strain will detect if the environment is becoming too basic, and act to counteract this decreasing acidity.

"Because these strains act on the environment, and the environment affects them, this creates a closed causal loop," Solé said. "The idea is to show that under very broad conditions, they will stabilize to a constant pH level, as predicted by the original theory."

More information: Victor Maull et al, A synthetic microbial Daisyworld: planetary regulation in the test tube, *Journal of The Royal Society Interface* (2024). DOI: 10.1098/rsif.2023.0585

Provided by Santa Fe Institute