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CHASING THE NORTHERN LIGHTS IN CANADA

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Sky at Night

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CUTTING EDGE

Terraforming Mars means growing food and making habitats... while building an atmosphere from scratch

ILLUSTRATION

Can we turn Mars green?

What scientists say it would take to make Mars habitable

This month, we're taking a different approach. Instead of reviewing a pre-print journal paper, we're looking at a summary guide on how humans might terraform Mars. Prepared by Devon Stork and Erika DeBenedictis of Pioneer Labs – a non-profit startup focused on engineering microbes for Mars – it served as background information for attendees of their 2025 Green Mars Workshop. And I think it does a good job of outlining how the Red Planet could one day be terraformed to support human life.

Today, Mars is a freeze-dried desert world, punishingly cold and exceedingly arid with only a minimal atmospheric blanket. But our exploration through the Space Age has revealed that the planet was once a much warmer, wetter place, and so efforts directed to terraforming the Red Planet effectively amount to trying to turn back Mars's planetary clock. Stork and DeBenedictis stress that this would require a multi-stage effort, maintained over centuries for full terraforming.

At first, human habitation of Mars would be much like the research bases currently in Antarctica: tiny pockets of life surrounded by a vast wilderness. These isolated outposts, possibly sheltering underground, would be made up of pressurised modules running life support systems, much like the International Space Station. These first Martian dwellers would need to be almost entirely self-sufficient, making the most use they can of local resources and growing their own food with 'closed-loop' agriculture.

Over the subsequent decades, large transparent domes – possibly spanning impact craters – could be built to house pocket ecosystems and support their human inhabitants in more spacious comfort. But the ultimate goal will be to transform the global environment of Mars to make it habitable: with a thick enough atmosphere to support liquid water once again on its surface, and enough oxygen that people could walk outside without a space suit.

In the early stages of this process, hardy pioneer microbes and lichens would be needed to tolerate the still-extreme conditions, but would begin creating a supportive soil and releasing oxygen. Further down the line, trees could be planted to create more complex ecosystems.

A long-term plan

Even at the end of this terraforming process, Mars would remain a chilly place, similar to an alpine climate. And Mars would still lack a planetary magnetic field, so this renewed atmosphere would be steadily stripped away by the solar wind. Stork and DeBenedictis say this loss could be ignored for at least a hundred million years. They also highlight key unknowns that need answering by ongoing research, as well as potential hurdles. For example, recent measurements found that there's a lot less frozen carbon dioxide at Mars's south polar region than previously thought, which is essential to provide an atmosphere. An alternative would be to redirect volatile-rich asteroids and comets to impact Mars and deliver gases to make up this shortfall, but this is a much more complex endeavour.

This is all very bold, long-term thinking, but necessary if humans are ever to turn the Red Planet green. We are already making our first steps to live on Mars, but this kind of planning is essential if we are going to ever stay there on a long-term basis, or even create a spare planet for humanity.

"At first, it would be like the research bases in Antarctica: tiny pockets of life surrounded by a vast wilderness"

Prof Lewis Dartnell is an astrobiologist at the University of Westminster

Lewis Dartnell was reading... *An Introduction to Mars Terraforming, 2025 Workshop Summary* by Devon Stork and Erika DeBenedictis
Read it online at: arxiv.org/abs/2510.07344