Greening the Red Planet

As the six-wheeled, buggy-like rover rolled out of its protective air-bag landing craft, its first and foremost objective was to capture a photograph. Over fifty million miles away, scientists were stunned by the resulting panoramic view that the Martian rover *Spirit* transmitted. The image showed a rust-red surface, strewn with rocks, much similar to some of the deserts found on Earth. In the distance, rolling hills, valleys, and thousands of meteor craters littered the exterior of the planet. Dust devils raged across the terrain like nobody's business. It was clear from this image that Mars was no more than a desolate wasteland.

Cold, dry, and radiation-prone, the fourth rock from the sun is home to some of the solar system's most extreme yet stunning geologic features, from its largest volcano and longest and deepest canyon to its most brilliant color. Despite its barren features, many sites—including dried up river valleys and channels—point to a past replete with warmer weather, flowing water, and a thicker atmosphere. This evidence has many asking if it is possible for Mars to return to these balmy days. While it is unlikely that the Red Planet will become warm and water-filled on its own, the chance of human intervention offers interesting speculation.

Our closest celestial neighbor, Mars, has always been a source of inspiration and wonder, ever since ancient times. Over the past fifty years, scientists have gained an innumerable amount of information about the planet's atmosphere, composition, and surface properties through the use of rovers, satellites, and probes that have been sent to explore it. Its current state—a thin, freezing, carbon dioxide-filled atmosphere—does not offer much promise for life to exist on its surface. However, many scientists believe that it is possible, over the course of hundreds to thousands of years, to transform Mars into an Earth-like, habitable planet. Such a process is known as terraforming. Through modern science, terraforming Mars is not only feasible but also necessary for human advancement and survival.

Why spend time and money engineering an entire planet? We might have to; Earth's natural resources and water supply are quickly running out. At the same time, threats of overpopulation and an asteroid collision loom overhead. A recent study conducted in England estimates that we will exhaust our planet's resources, causing the Earth to "expire" as early as 2050. Humans will eventually need a place to go, and it may be sooner than we think. Since an entire terraforming process can take up to a thousand years, plans should be implemented as soon as possible. Several methods of terraforming are currently under inspection, all of which must be taken into consideration if we are to colonize Mars.

It is undoubtedly a massive undertaking to completely renovate the environment of an entire planet, regardless of its size. Although Mars is only around half the size of the Earth and roughly fifty million miles away, according to Martin Rees, an astronomer and the author of *Universe*, its atmosphere is over ninety-five percent carbon dioxide—toxic to humans, to say the least. Another deadly component of Mars is its atmospheric pressure, which hovers around six millibars—slightly more than half of Earth's. If a man were to walk onto the surface of Mars unprotected, this dangerously low pressure would cause the oxygen in his blood to boil, instantly killing him. A final problem faced by Mars' surface is its temperature. The Red Planet's surface temperature averages around negative eighty-one degrees Fahrenheit, a temperature far too cold for water to exist as a liquid. However, experiments have proven that water does exist on Mars, albeit in the form of ice, frozen under the surface of its polar caps.

Despite these extreme factors, Mars has all the makings of a habitable planet; all it needs is a bit of warming and an influx of breathable oxygen and nitrogen. However, we need not send thousand-ton space heaters to Mars in order to heat the place up. Instead, we can apply greenhouse techniques that are currently being utilized here on Earth. NASA scientist Chris McKay agrees. He told *National Geographic* that, "You don't build Mars; you just warm it up and throw in some seeds." By introducing greenhouse gases into the atmosphere, the planet can begin to warm itself by capturing and redirecting sunlight. This will eventually raise pressure as well as temperature on Mars.

One way of hot housing is to introduce carbon dioxide, a viable greenhouse gas, into the Martian atmosphere. Since most of Mars' carbon dioxide lies frozen under the Martian dirt, something must be done to release this volatile into the atmosphere, where it can serve its purpose as a greenhouse gas. Perhaps the most logical method to kick start this massive global warming effort is to send crews to Mars to assemble factories that will spew gases directly into the atmosphere. By-products of this industrial revolution could include hydrocarbons—potent contributors to greenhouse heating, according to geologist Joseph Boyce.

Several other methods to stimulate global warming are science-fiction based, yet feasible. Massive, two hundred-kilometer mirrors could be constructed and sent to orbit Mars. These space mirrors would redirect beams of sunlight to melt the ice caps, releasing volatiles and allowing frozen water to thaw and flow, according to Boyce.

In addition, the solar system's asteroid belt lies just outside the orbit of Mars. It is possible to launch small vehicles to land on these rocky bodies and pull them out of their elliptical orbits around the sun, with the objective of crashing them into Mars. Asteroids have been recently discovered to contain large amount of ammonia—another essential greenhouse gas that can be taken advantage of to warm the Red Planet, says Boyce. Frequent collisions with the Martian surface would generate enough heat and kinetic energy to launch surface volatiles into the atmosphere. If employed, all of these methods could successfully turn Mars into a warm, normal-pressured planet, almost capable of housing humans.

Aside from warming the planet through the use of the greenhouse effect, other gases must also be taken into consideration. As global temperature and pressure increase, one issue still remains: low nitrogen and oxygen levels. In order for humans to be able to breathe unaided, nitrogen and oxygen rates must approach seventy and twenty percent of the atmosphere, respectively. While these levels may take several millennia to reach, steps can be taken to speed up the process. The addition of microbes and algae can promote photosynthesis- the process by which organisms on Earth convert carbon dioxide into oxygen. According to Kunzig, photosynthesis on Mars will create organic-rich minerals in the Martian soil, eventually allowing plants to grow. Recent studies conducted on extremophilic microbes give scientists hope that while massive measures must be taken to increase the pressure and temperature of Mars, microscopic terraforming is equally important.

One such microbe includes the species D. radiodurans. According to Rebecca Slotnik, this particular creature is able to withstand extreme conditions, some of which include freeze-drying, ultraviolet radiation, and desiccation. These three environments are rather crucial, mainly because they are all found on Mars. If scientists can utilize bacteria such as D. radiodurans, it would be wise to implement them in the terraforming process. While small extremophiles may not produce ground-breaking results overnight, this "microterraforming" is an important step in revolutionizing the Red Planet.

Several hundred years into the process of greening Mars, humans would be able to begin living on the Martian surface, with the protection of habitation modules and spacesuits. From there, towns and cities could be powered with the construction of turbines and nuclear reactors, according to Kunzig. Ideally, one thousand years into the process, temperatures, pressures, and breathable gas levels would have risen enough that humans could enjoy a casual stroll on the Martian terrain with scuba gear as their only protection. In essence, Mars would have been transformed from being red and barren to green and fertile.

Although plans and evidence seem to confirm the possibility of terraforming Mars, many are skeptical about the process. Some believe that greening the Red Planet will be too time consuming and risky, and will ruin our planetary neighbor. *SkyNews Magazine* editor Terrence Dickinson is one of these skeptics: "It would be very easy to mess up. To me that is the biggest danger, and you could end up with a man-made junk Mars." While tampering with the current state of the Red Planet will definitely alter its conditions, it is a challenge that humans must not be afraid of. Learning how to green a planet will provide an infinite amount of knowledge, not just about space travel and greenhouses, but also about man's capability to survive and thrive.

While terraforming Mars is certainly conceivable, it will take a long time and require not only brilliant minds, but also a substantial amount of money. We do not know the exact cost of a process of this magnitude- all the more reason to get started immediately, so we can see just what we're getting ourselves into, fiscally. If we ever plan on leaving our home planet to live somewhere else, terraforming Mars is the first step in understanding how to survive in the universe. Through the use of countless science-fiction-like processes, some of which include massive space mirrors, asteroid impacts, and extremophiles, it is possible to turn the Red Planet into an Earth-like, habitable place.

If this terraforming process works, fast-forward a thousand years into the future. As a boy roams his Martian backyard, he catches a glimpse of himself in his fish-filled pond. Upon seeing his reflection, he makes a fleeting realization: throughout the entire terraforming process, he and his family had become colonists. They were no longer Earthlings; they were Martians. What a sensation!

Works Cited

"Be Certain Mars Has No Dinosaurs." *New York Times* 22 Oct. 1991. *Gale Opposing ViewpointsIn Context*. Web. 10 Apr. 2011.

Boyce, Joseph. *The Smithsonian Book of Mars*. Washington, DC: Smithsonian Institution, 2008.Print.

Krauthammer, Charles. "Space Exploration Should Focus on Mars and the Colonization of OtherWorlds." *Weekly Standard* (31 Jan. 2000): 23-27. Rpt. in *Space Exploration*. Ed. DanielA. Leone. San Diego: Greenhaven Press, 2005. At Issue. *Gale Opposing Viewpoints InContext*. Web. 10 Apr. 2011.

Kunzig, Robert. "The Big Idea - Making Mars the New Earth." *National GeographicMagazine*. 15 Jan. 2010. Web. 10 Apr. 2011.

Rees, Martin, ed. *Universe*. New York: DK Publishing, 2008. Print.

Slotnick, Rebecca Sloan. "Extremophilic Terraforming." *American Scientist* 88.2(2000): 124.*Gale Opposing Viewpoints In Context*. Web. 10 Apr. 2011.

Taylor, Paul. "Turning the Red Green." *Globe & Mail* [Toronto, Canada] 11 June 2005: F9. *GaleOpposing Viewpoints In Context*. Web. 10 Apr. 2011.

Townsend, Mark, and Jason Burke. "Earth 'will Expire by 2050." *Latest News, Comment andReviews from the Guardian | Guardian.co.uk*. 7 July 2002. Web. 24 Apr. 2011.