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Living on Mars

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The Red Planet, commonly referred to as Mars, is the fourth planet from the Sun in the solar system. Its similarity to Earth intrigues many, and it is often considered as a possible home for humans in the future. Mars and Earth share similar orbital characteristics that affect the length of days, months and years. Both possess approximately the same amount of dry-land surface area, irrespective of their drastically different sizes.[1] Earth is more than double the size of Mars, as indicated by the ratio of their diameters (1.88 :1).[2] Despite the similarities between the two planets, there are numerous differences that might restrict humans from inhabiting Mars. These include the atmospheric differences in that these planets have different gaseous compositions in their atmospheres. The temperatures vary drastically due to their varying climatic conditions. Some believe that when considering human life on Mars, these restrictions could be overcome in the future, as and when human inhabitance on Mars commences. Although humans have not inhabited Mars yet, the existence of other organisms on Mars has been researched. In 1996, a team of scientists at the *Johnson Space Centre*, led by Dr. David McKay, found a meteorite containing fossils of bacteria that possibly came from Mars.[3] Does this mean, is there life on Mars, and if so, could humans potentially live on Mars?

For millions of years, humans have lived on planet Earth, however, research suggests that humans could potentially live on Mars in the future. Heat levels and sun rays on Mars are at a similar level to that on Earth.[4] The amount of gravity on Mars is 38% of Earth's. Nonetheless, humans are still deemed to survive, as they need only 19% of the gravity found on Earth.[5] The human body can adapt to Mars' gravity, as humans have adapted to the high levels of gravity on Earth - much higher than what they require for survival. Another key similarity between Earth and Mars is the rhythm of day/night. A full rotation of the Earth takes 24 hours. Similarly, a full day on Mars takes approximately 24 hours, 39 minutes and 35 seconds (24.65 hours).[6] The fact that the difference in time each day is subtle makes Mars the most appropriate planet for humans to inhabit on, after Earth. This subtle difference is due to the fact that Mars and Earth are consecutive planets. Another characteristic of Mars that would support human life is the atmospheric layer, which, although is thin and contains different gases to Earth, yet provides the same protection from harmful radiation. Human survival can exist on Mars if they are protected from cosmic radiation - a type of ionizing radiation found in the solar system that interacts with the planet's atmospheres.[7] It can affect the human body on several levels, such as damaging the cardiovascular system, hardening arteries, eliminating blood vessel linings, which can lead to several cardiovascular diseases.[8] Thus, Mars has characteristics that would support human life, similar to that of Earth, allowing humans to potentially colonise Mars.

Although there are various similarities between Mars and Earth, there are many differences between the two that can adversely affect humans. The main atmospheric difference between Mars and Earth is the gaseous composition (**Table 1**). Mars' atmosphere is primarily carbon dioxide-based, while Earth's is rich in nitrogen and oxygen.[9] The trace gases found on Mars also includes carbon monoxide, which is an extremely harmful gas to humans as it disturbs the oxygen levels in the blood when inhaled. Another key difference between Mars and Earth is their soil and land surface. Scientists have not yet found organic matter in soil on Mars. They believe that Mars, instead, consists of a regolith, often referred to as Martian soil, which is primarily inorganic and lacks organic matter. The temperature and moisture levels in the regolith are not appropriate for plant growth, preventing oxygen emissions into the atmosphere, eventually restricting human survival on Mars.[10] Moreover, the atmospheric pressure on Mars

is different from that on Earth. At sea level, the atmospheric pressure on Earth is approximately 1,013 millibars, while on Mars it is approximately 6.5 millibars. As atmospheric pressure increases, the amount of available oxygen also increases. Because the atmospheric pressure on Mars is less than that on Earth, the breathable oxygen availability is limited.[11] This can negatively affect humans as it can weaken the respiratory system. In low atmospheric pressure conditions, human respiration decreases, resulting in severe illness or even death.[12] Therefore, Mars cannot fully cater to human life due to the atmospheric conditions and inorganic regolith.

Table 1. Gas composition on Mars.[13]

Gas	Mars	Earth
CO_2	95.97 %	0.035 %
Ar	1.93 %	0.93 %
N_2	1.89 %	78 %
O_2	0.146 %	20.6 %
CO	557 ppmv	0.2 ppmv
H_2O (variable)	~ 0.03 %	~ 0.4 %
O_3 (variable)	~ 0.01 – 5 Dobs	~ 300 Dobs

In order to potentially live on Mars, individuals need to apply, and only those who meet requirements are able to undergo a training process, on the pathway to settlement on Mars. The requirements include mental and physical resilience and high levels of adaptation. Candidates must meet physical requirements and can communicate and engage with others. Astronauts assisting the trial will provide strict technical training to ensure candidates attain proper support during their trial. Psychological training is also crucial to those partaking in the trial, as living on Mars is a lifelong commitment. Due to this, not everyone is currently eligible to live on Mars or partake in trials.[14]

Based on the above discussion, it is evident that living on Mars may be a possibility. However, significant alterations must be made to human lifestyle in order to withstand the harsh conditions on Mars. Mars and Earth share a considerable amount of similarities in terms of the gravitational attraction, rhythmic patterns in time and the existence of a protective atmospheric layer. Traits such as gravitational attraction ensure that the human body would not be negatively affected and could easily adapt to the conditions, unlike on most other planets. Likewise, the similarity in time patterns is helpful to support human life on Mars. The atmospheric layer on Mars acts as an essential protective layer, similar to Earth. Without this, planets would be exposed to harmful radiation. Regardless, there are many constraints to restrict humans life on Mars. The composition of gases in the atmosphere is somewhat dissimilar to that of Earth, as some gases in Mars' atmosphere are extremely harmful when inhaled by humans. Aside from this, Mars does not contain soil, but a regolith without organic matter. These conditions do not unconditionally support human life. In order to sustain human life on Mars, appropriate lifestyles need to be instilled into those intending to live on Mars in the near future. For this reason, stern training is required for those interested in participating in a trial for settlement on Mars. Overall, Mars is definitely an option for humans to potentially live on in the future. With some adaptations and rigorous training, humans may, one day, be able to colonise Mars.

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