TERRAFORMING THE MOON, WOULD IT BE EASIER THAN MARS?

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THE MOON, MARS AND EARTH

Characteristics	Moon	Mars	Earth
Mass in Metric Tons	**7.35×10^{19}** **1.2% of Earth's**	**6.42×10^{20}** **a little over 10% of Earth's**	**5.97×10^{21}**
Gravitation Force	**$1/6^{th}$ of Earth**	**37.7% of Earth**	**1g 9.8 m/s^2**
Magnetic Field	**Essentially none**	**Minute levels. Some magnetic rocks at surface**	**Significant strength. Protective shielding diminished by polar reversal**
Distance from Earth	**average distance 250,000 miles or 400,000 km**	**Up to 400 million km /280 million miles** **closest is 58 million km/36.4 million miles**	**There is a slight variation in distance to the Moon. Huge difference in distance to Mars. Can up to 7 times greater distance away from closest approach**
Surface Area	**37.3 million sq kms 14.6 million sq miles**	**145 million sq. kms/56 million sq. miles**	**504,million sq km (197 million sq miles) (81% is ocean & ice)**
Surface Materials	**Minerals, ice, frozen volatiles no organic content**	**Minerals, ice, frozen volatiles, no organic materials**	**Water, ice, soil, vegetation, minerals**

MASS OF THE MOON, MARS, & EARTH AND THEIR ATMOSPHERES IF MADE EARTH -LIKE

	EARTH	Mars	Moon
Mass in Metric tons	5.95×10^{21}	6.40×10^{20}	$7{,}39 \times 10^{19}$
Mass in Metric tons of their atmosphere if measured at at 1g weight	5.5×10^{15}	9×10^{12} .09% of Earth's atmosphere	70×10^{9} 0 .000077% of Earth's atmosphere

CHALLENGES TO TERRA-FORMING MOON OR MARS

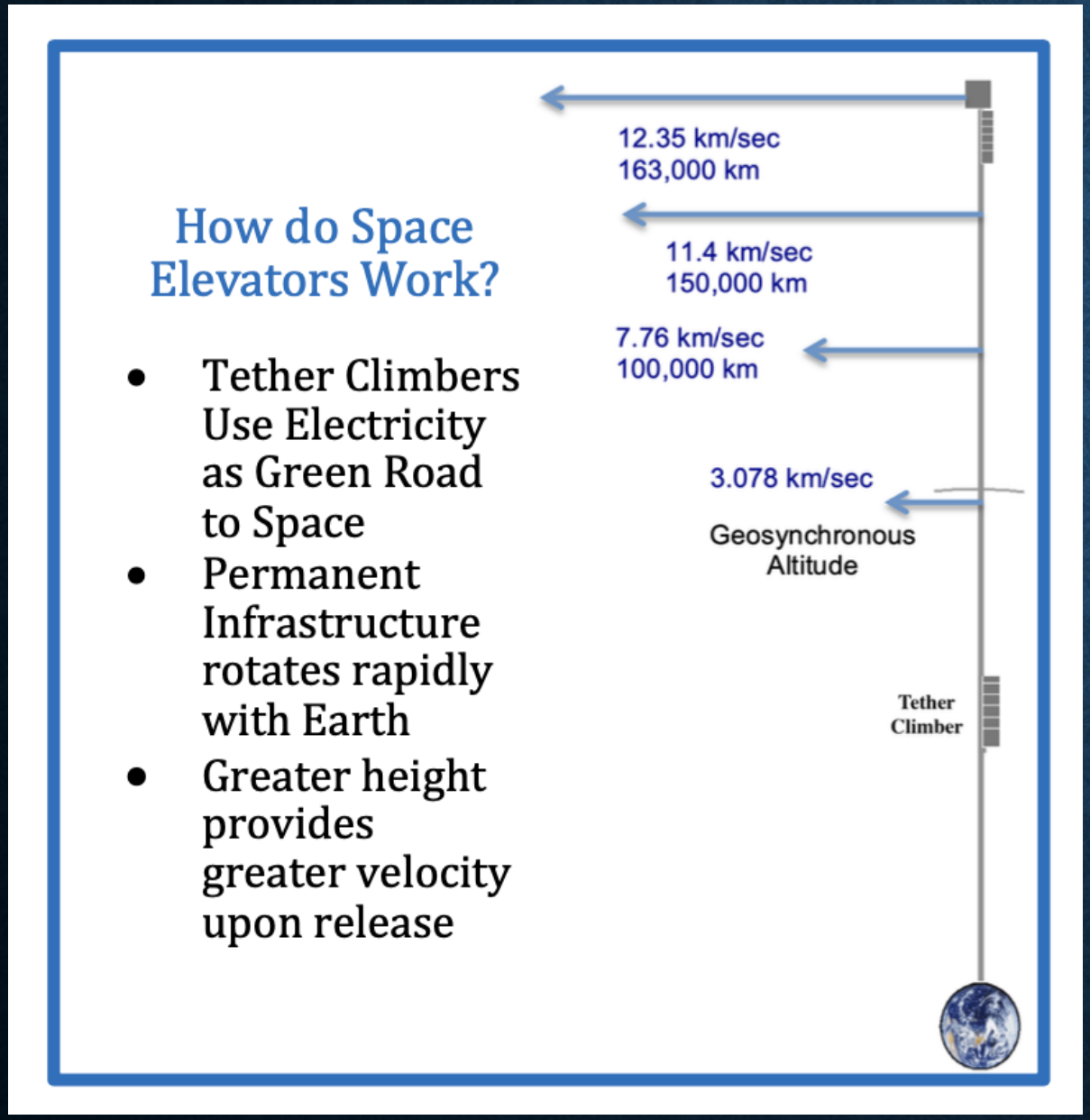
- Challenge 1: Protection against radiation
- Challenge 2: Low gravitation and adverse health impact
- Challenge 3: Cold temperatures
- Challenge 4: Lack of atmospheric pressure (blood boils)
- Challenge 5: Breathable air with adequate carbon dioxide for plants
- Challenge 6: Magnetic Field to retain atmosphere and prevent it from being stripped away by solar wind & CMEs
- Challenge 7: No soil /organic life on Mars or the Moon.
- Challenge 8: Finding volatiles or materials on the Moon or Mars that could be mined and processed to create non-toxic gases for atmosphere

EARTH IS A GOLDILOCKS PLANET

- Earth is a Goldilocks planet not just because it is in the right temperature zone due to its distance from the Sun. It has all of the missing elements addressed previous slide.
- Earth's is life sustaining in all these six ways. When you look at Mars versus the Moon one sees that each has advantages and disadvantages.
- Mars has more frozen water, stronger gravity, and has more chemicals available to support life in terms of advantages, but it is much, much, much farther away.
- Moon is on about a quarter of million miles away. Mars is typically hundreds of time further away. Lunar communications has only minor time delay, and the economics of resupply is hundreds of time more cost effective and timely. The amount of atmospheric gases needed to terra-form the Moon is much, much less. Transport to the Moon much less costly and faster.

MAGNETIC FIELD IS CRITICAL MISSING ELEMENT

- It is possible to create an atmosphere on both the Moon and Mars with a plasma generation system. The economic and technical challenges seem less for the Moon simply because the Moon is smaller and closer at hand. However, the Moon's lesser mass and gravitational field means the retaining atmosphere once generated will be harder.
- For strategic reasons the creation of a sustainable Moon presence might make the economic case to create a lunar magnetic field system.
- Other supporting efforts to establishing a viable atmosphere and other needed elements such as water, organic soil, and mechanism to generate needed life support systems would be easier for the Moon. If we could create a reliable space elevator to this activity, the economics would be significantly improved.



THIS ILLUSTRATION OF A SPACE ELEVATOR SHOWS A WAY TO LIFT MASS AT LOW COST BUT ALSO HOW TO LAUNCH TO THE MOON OR MARS AT 7.76 KM/SEC BY SIMPLE RELEASE FROM THE TETHER.

Chart courtesy of Peter Swan.
Chapter 7 Living in Space

POSSIBLE OTHER TASKS FOR A SPACE ELEVATOR

Reference Mission	Major Benefit from Space Elevators	Years to completion by space elevators
Space Solar Power	750,000 metric tons (MT)s to Destination	4.42 years
Mars Settlement	1,000,000 Metric tons (MTs) to Mars surface	5.88 years
Moon Village	500,000 Metric tons (MTs) to surface of Moon	2.94 years
Earth Sun Shades	20,000,000 Metric tons (MTs) to Sun-Earth L-1	117.64 years
Orbiting Rotating Human Habitat	10,500,000 Metric tons (MTs) at the Lunar L-5 location	61.76 years

Chart courtesy of Peter Swan. Chapter 7 Living in Space

GREAT AMOUNT OF ADDITIONAL RESEARCH NEEDED

- **Biosphere sustainable “closed loop” recycling to support growing crops in space, achieving 90% plus water plus similar levels of efficiency in recycling of nutrients, and human waste. (Think about Matt Dillion in the Martian)**
- **Transport of a significant amount of water, rich organic soil, creation of green house growing farms to produce nutrients and oxygen at domed transitional facilities. There is a need to “grow” most of the atmosphere.**
- **Creation of housing, transport space ports, and other support facilities that would need to be continuously inhabited for decades as the lunar surface would be brought to life.**
- **Artemis exploration needs to research materials that could be processed to produce gases that could support organic life on the Moon**

PART OF AN EVOLVING TERRAFORMING ENTERPRISE ON THE MOON?

A TERRAFORMING EFFORT IS MORE THAN SPACE ELEVATORS, MAGNETIC FIELDS AND BIOSPHERE TECHNOLOGY

- Even if the technology could be developed would there still be the need to invest hundreds of billions of dollars and decades of concerted effort to Terraform the Moon?
- Would there be an international agreement to proceed to do this? Could this be accomplished through UN processes like in a UN COPUOS Working Group? Or something more like a consortium of nations and aerospace companies akin to the "Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes" but with binding terms?
- Thomas Jefferson under the Louisiana Purchase acquired 828,000 sq miles of land for $15 million in 1803. This would be equivalent to $42 billion dollars in 2026 dollars. The Moon's surface is 18 times larger. If it were possible to terraform the Moon for say $100 billion to $200 billion, it would be still be a huge bargain on the Louisiana Purchase scale.

"THE FUTURE OF LIVING IN SPACE" – OUT IN THE FALL 2026

- This book provides useful background research and development information on all aspects of living in space. This book explores issues of microgravity and radiation impacts on human health in deep space, biosphere "closed loop" recycling of water, nutrients, human waste in deep space-and space farming, advanced space transport such and nuclear fusion ion propulsion and space elevators, greater dependency and use of smart robots, simulated gravity on rotation space stations and colonies, challenges of terraforming of Mars, key issues of space law and policy for deep space and space safety for the Moon, Mars and More.
- Estimated cost $40 with expected publishing date in Fall 2026. Joseph Pelton, editor, contributors: Thais Russomano, M.D. Dr. Susan Jewell, MD. Et al, Eric Dahlgren et al, Peter Swan et al, Gary Barnhard, Frank White, Adriano Autino, Werner Grandl, Sibshakar Palit et al, Dr. James Green, Dr. Michael Kezirian et al, Dr. Upasana Dasgupta,