Martians: Guardians of Green Eating

A sustainable, ethical diet of mainly vegetables, insects, and lab-grown meat, preserves life on both Mars and Earth.

Maturity
Growing trend
Technical feasibility unclear

STEEPV
Technological
Environmental

By Danielle Lim

Description

Mars does not have the necessary resources to support a human diet. Propelled by the progress in space travel and depleting resources on Earth, scientists have made advancements in self-sustaining agriculture and food sources. The most cost-effective, feasible, and long-term food solutions are low-calorie vegetables, insects, and lab-grown meat. They are not resource-intensive and require closed-ecosystems. People on Earth will benefit from spillover effects of these innovations amid a growing climate crisis. Key features draw from a vegetarian diet, learning from Indigenous methods, and minimizing waste. A plant-based diet also provides soothing psychological and health benefits. Both Earthlings and Martians will survive in their respective harsh environment.

Signals

• The environmental constraints on Mars spur new sustainable and ethical ways of producing food (Choi, 2019), including NASA's Vegetable Production System (Hirsch, 2013).
• Crops can be cultivated in LED-lit tunnels, hydroponics, aeroponics, and green-houses. The most appropriate crops are low-calorie vegetables, wheat, corn, soybeans, peanuts, and sweet potatoes (Choi, 2019).
• Plants and insects have shown to survive space travel. In 1972, spiders in space were able to spin webs, showing their ability to adapt to the environment (Baker, 2019).
• In 2019, Aleph Farms developed lab-grown meat in space for the first time through bioprinting (Gohd, 2019).
• Lab-grown meats, eggs, and dairy costs are dropping rapidly. In two years, the cost of a cultured meat burger patty dropped from $325,000 to $11 (Choi, 2019).
• A typical omnivore's diet requires three acres of land and a vegan's diet requires one-sixth of an acre (Bland, 2012).
• The space plants act as medicine, oxygen providers, building resources, a source of entertainment and relaxation, as well bioprinting foods allows a range of culturally diverse foods (Oluwafemi et al., 2018).
• Few animals have survived space travel and they are unlikely to be able adjust to a Martian life with toxic soil, radiation and low gravity (Dorminey, 2019).
• There are major concerns about the ethics of sending animals into space (Cofield, 2016).

Related Trends

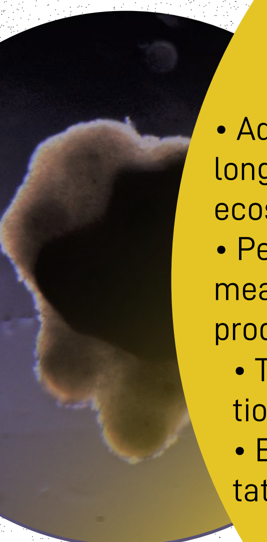
- Mass commercialization of sustainable tech
- Dining and recreation in space impacts future lifestyles
- Gardens are a central feature of space colony planning
- Development of Mars as "Planet B"

Counter Trends

- The discovery of other life forms as food sources
- Importing food from Earth becomes necessary
- Transporting animals into space is successful, primarily small animals (Baker, 2019). Livestock may have to evolve for life in space.

Implications

- Crop scalabilty and resiliency tests need to be established to gain more support.
- Society looks to incorporate more learnings from Indigenous communities in harsh climates, like the Arctic (Brown, 2020).
- More appreciation of food and becoming less wasteful may be evolving cultural characteristics and values.



10-20 years from now

- Advancements in food technology make human colonies and longer space travel successful. We better understand our own ecosystem.
- People move away from a meat-based diet. Farms and meat-processing industries die out (less land use for food production).
- The transition may be difficult until there is widespread distribution. There may be cultural loss/evolution and gaps in accessibility.
- Each region may have their own closed-loop system. Food importation and transportation may be reduced.
- Recipes, traditional meals, and home economics evolve to use new ingredients.

Images:

Opposite: The Voorhes. (2018). [Picture of gloved hand holding lettuce] [Photograph/Mixed Media]. Popular Science. https://www.popsci.com/nasa-growing-food-in-space/

Left: 3D Printing Solutions. (2019). [An image of small-scale muscle tissue made using bovine cell spheroids] [Photograph]. Space.com. https://www.space.com/meat-grown-in-space-station-bioprinter-first.html

Right: (2013). [Image of NASA's Nicole Dufour (left) performing prelaunch testing on lettuce sprouts, under LED grow lights] [Photograph]. The Modern Farmer. https://modernfarmer.com/2013/09/starship-salad-bar/

References:

Baker, S. (2019, June 29). *A dog sent to die and tortoises that flew around the moon*. Business Insider. https://www.businessinsider.com/animals-nasa-russia-space-agencies-sent-to-space-2019-6

Bland, A. (2012, August 1). *Is the Livestock Industry Destroying the Planet?* Smithsonian Magazine. https://www.smithsonianmag.com/travel/is-the-livestock-industry-destroying-the-planet-11308007/

Brown, B. (2020, August 11). Greenhouse in Arctic Canada could teach scientists how to grow food in outer space. *Eye on the Arctic*. https://www.rcinet.ca/eye-on-the-arctic/2020/08/11/greenhouse-in-arctic-canada-could-teach-scientists-how-to-grow-food-in-outer-space/

Choi, C. Q. (2019, September 18). *How to Feed a Mars Colony of 1 Million People*. Space.Com. https://www.space.com/how-feed-one-million-mars-colonists.html

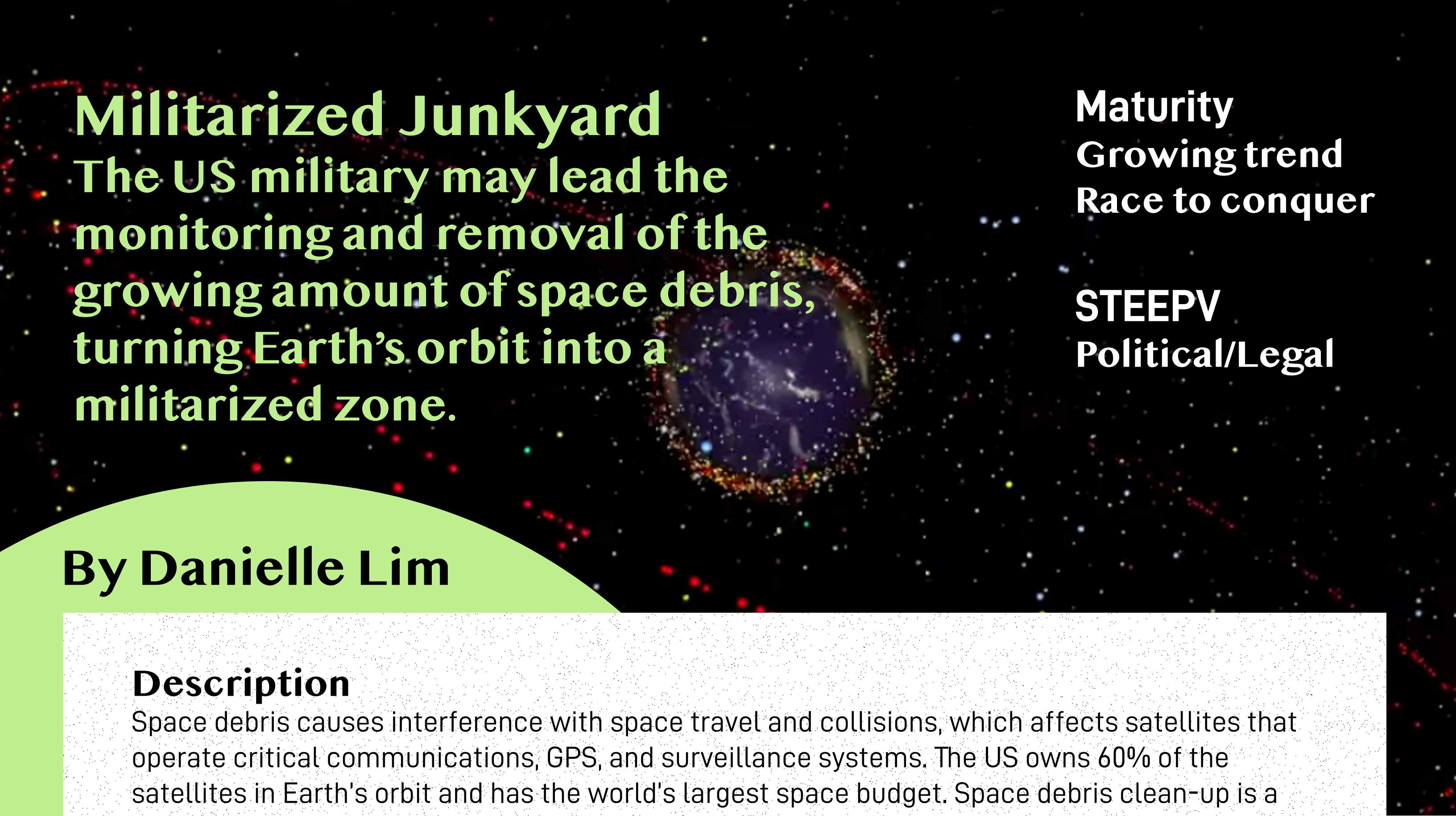
Cofield, C. (2016, August 25). *Why Do We Send Animals to Space?* Space.Com. https://www.space.com/33823-why-do-we-send-animals-to-space.html

Dorminey, B. (2019, November 7). *The Case Against Sending Animals Into Space*. Forbes. https://www.forbes.com/sites/brucedorminey/2019/11/07/the-case-against-sending-animals-into-space/

Gohd, C. (2019, October 8). *Meat Grown in Space for the First Time Ever*. Space.Com. https://www.space.com/meat-grown-in-space-station-bioprinter-first.html

Hirsh, J. (2013, September 10). Space Farming: The Final Frontier. *Modern Farmer.* https://modernfarmer.com/2013/09/starship-salad-bar/

Oluwafemi, F. A., De La Torre, A., Afolayan, E. M., Olalekan-Ajayi, B. M., Dhital, B., Mora-Almanza, J. G., Potrivitu, G., Creech, J., & Rivolta, A. (2018). Space Food and Nutrition in a Long Term Manned Mission. *Advances in Astronautics Science and Technology*, 1(1), 1–21. https://doi.org/10.1007/s42423-018-0016-2



Militarized Junkyard

The US military may lead the monitoring and removal of the growing amount of space debris, turning Earth's orbit into a militarized zone.

Maturity
Growing trend
Race to conquer

STEEPV
Political/Legal

By Danielle Lim

Description

Space debris causes interference with space travel and collisions, which affects satellites that operate critical communications, GPS, and surveillance systems. The US owns 60% of the satellites in Earth's orbit and has the world's largest space budget. Space debris clean-up is a necessity, but anti-satellite activity is a national security threat. Technology, such as nets, robotic arms, and lasers, that can extract debris can also remove private or government property. The US military has a direct stake and bears the most risk regarding monitoring and protecting objects in orbit. Agreements are not international, coordinated, nor enforceable. As more valuable assets enter space, the risk of destruction increases, prompting offensive and defensive measures.

Signals

• The Kessler Syndrome, acknowledged in 1978, creates a chain of collisions. As space debris collides, more debris is created. This limits the number of satellites able to be put into orbit, threatens existing satellites, and obstructs space travel ("NASA's Space Debris Problem," 2018).
• Some nations have their own space policies, such as US' Orbital Debris Mitigation Standards adopted in 2001. In 2007, the Inter-Agency Space Debris Coordination Committee provided space debris recommendations, but they are completely voluntary (Kwong, 2020). The Outer Space Treaty in 1967 between the US and the USSR includes liability repercussions, however damage attribution is impossible ("How humans trashed space," 2020).
• In 2019, the US observed a Russian missile thought to be an anti-satellite weapon capable of warfare (Macias, 2019).
• In 2007, the Chinese military destroyed one of their own weather satellites to test anti-satellite technology. (Kwong, 2020).
• There is currently no viable solution to clean space debris. Because of the Kessler Syndrome space shuttles have a 1-in-250 chance of collision (Tallis, 2015).
• The ESA's Clearspace mission will be the first attempt to retrieve space debris in 2025. This single mission costs $130 million USD (Kwong, 2020).
• Science and military go hand in hand, such as chemical warfare and using the Hubble telescope for surveillance (Klimas, 2018).
• Some experts say the Cold War never ended. Although powers have shifted, past diplomatic relations and distrust persist today ("Did the Cold War ever really end?" 2019).

Related Trends

- Commercialization and privatization of space technologies
- Space travel will need account for interference
- Environmental impacts of space debris
- New governance systems emerge

Counter Trends

- Global collaboration is successful and open-tech platforms are available
- Further commercialization introduces more satellites, perpetuating the space debris crisis
- Other major nations surpass the US in space warfare
- The UN expands the Outer Space Treaty and space governance

Implications

- Nations need to cooperate and communicate transparently, however coming to agreement will be a long, acrimonious process. This may grow into a major issue for public policy and the UN.
- China, Russia, India, and the EU become more defensive and space war contingency plans may be created.
- The US Space Force grows and increases their recruitment efforts.
- Trust in governments may decrease. Space exploration may polarize political platforms and citizens.

10-20 years from now

- Earth's operational and communications systems face frequent damage. Outages and alternative communications systems may become common.
- Space travel may be inhibited due to growing space debris and military control. Governments may enforce companies to perform their own clean up, attain permits, or pay fines, creating a barrier to entry.
- More private companies drive down the price of clean up technology, stimulating the economy, and competing for highly priced government contracts.

Images:
Opposite: European Space Agency. (2019). [Screenshot of earth's orbit] [Illustration]. ESA. https://www.npr.org/2020/01/10/795246131/space-junk-how-cluttered-is-the-final-frontier
Left: ShipSash. [Russian MiG-31 jet carrying an anti-satellite weapon] [Photograph]. CNBC. https://www.cnbc.com/2019/04/11/top-us-military-officer-responsible-for-space-warns-junk-is-urgent-danger.html
Right: Clearspace. (2020). [Rendering of Clearspace technology] [Illustration]. The Guardian. https://www.youtube.com/watch?v=oMTOo-3p-T4

References:
Did the Cold War ever really end? (2019, February 1). HistoryExtra. https://www.historyextra.com/period/cold-war-did-cold-war-us-russia-relations-ever-really-end-soviet-union-america-tensions-nuclear-weapons/

How humans trashed space (and how to fix the problem). (2020, April 1). https://www.youtube.com/watch?v=oMTOo-3p-T4
Klimas, J. (2018, September 7). Neil deGrasse Tyson: Space Force mission should include asteroid defense, orbital clean up. POLITICO. https://politi.co/2CtgqgH

Kwong, E. (2020, January 13). *Space Junk: How Cluttered Is The Final Frontier?: Short Wave*. NPR. https://www.npr.org/2020/01/10/795246131/space-junk-how-cluttered-is-the-final-frontier

Macias, A. (2019, April 11). *Top US military officer responsible for space warns of an urgent danger: Junk*. CNBC. https://www.cnbc.com/2019/04/11/top-us-military-officer-responsible-for-space-warns-junk-is-urgent-danger.html

NASA's Space Debris Problem. (And how to solve it). (2018, November 19). https://www.youtube.com/watch?v=Ctvzf_p0qUA
Pekkanen, S. (2018, November 13). Why space debris cleanup might be a national security threat. The Conversation. http://theconversation.com/why-space-debris-cleanup-might-be-a-national-security-threat-105816

Tallis, J. (2015). Remediating space debris: Legal and technical barriers. *Strategic Studies Quarterly,* 9(1), 86–100. The Nuclear Non-Proliferation Treaty (NPT), 1968. (n.d.). Office of the Historian. Retrieved January 27, 2021, from https://history.state.gov/milestones/1961-1968/npt