Personal Needs of Future Space Settlers

Authors: Gordon Arthur, Hosain Bahari, Lawrence Downing, Jeff Greason, Bob Krone, Rod Pyle, and David Schrunk.

Editors: Gordon Arthur and Bob Krone

Introduction

This article is a product of the Kepler Space Institute (KSI) graduate class PHI 503, "The Human Centered Paradigm," during the Summer 2020 Semester, Professors Dr. Lawrence Downing and Dr. Bob Krone. Scholars in that class were all members of an Ideas Unlimited[1] group survey method workshop focus group on June 10, 2020. During the short workshop, they each responded to the target "My needs to be a complete person settling in Space." They each contributed to a database of 104 ideas. Additional ideas were added as the course progressed. Those random ideas have been classified for the content of this article.

Environmental Aspects

Fundamental for Space settlers will be an environment that meets comfort standards for physical and mental needs. Earth-like gravity, a breathable atmosphere, abundant surface water, tolerable radiation, and natural beauty will all be necessary for emotional, psychological, and physiological needs.

The ability to visit and explore surrounding environments will be desirable. Very desirable will be the companionship of a small group of generally like-minded people. "An environment my wife might be happy in, which includes all of the above, with a more stringent 'outdoors.'"

Political/Governance/Social/Economic Aspects

My group will need equality in leadership, governance, and justice. That would be a system of lunar government, led by capable and compassionate leadership, that optimally serves the best interests of the population. It should be easily understood with a legal structure based generally on Western democratic ideas, including ethnic, cultural, and gender diversity within the larger group. It should have the investment of resources necessary to support the expansion of the habitat to support one additional person as a "small" fraction of the output on one person's economic activity, so that people can afford the cost of setting up an independent household for children (as an aside, this is the major challenge for free-space habitats).

An exchange subsistence for buying and selling will help the economy. Performing arts will enrich society.

[1] The text for the Ideas Unlimited Method is Bob Krone and Salena Gregory-Krone, *Ideas Unlimited: Capturing Global Brainpower* (Wilmington, DE: Stratton Press, 2019).

Construction

Planning for human Space settlement construction will be a critically important complex task, the details of which will far exceed Earth construction planning. Here are some thoughts from the KSI graduate course on June 10, 2020:

Have the technology and resources available to extend the Biosphere space (which in practice is primarily crop-growing space that is lit and pressurized and has sufficient radiation shielding and environmental control for crops to grow). Create a space with a sense of being outside, which includes long sightlines, the space to walk for perhaps half an hour at a time without being on a treadmill, and growing plants.

Grow the biosphere to the point where there is some wildness permitted—that is, not 100% of the biosphere output is by and for humans, but it can support other life forms whose only value to humans is aesthetic and a possible future source of biodiversity.

Plan access to power—thermal and electric—sufficient to power an economic surplus above and beyond survival, and the ability to expand the sources of that power 'organically' (within the settlement). Have a secure water supply for consumption. Have air, water, and power from renewable local sources.

Design one-g gravity for between 40% and 100% of the habitat. Also, develop an economic and banking system, spacious living quarters with private sleeping areas, simulated day/night cycles, windows or simulated window media, a robust medical support system with free medical care and pharmacies for all residents and travelers, interplanetary internet communications with vast storage capabilities, and capabilities to travel the surface of the planet/Moon.

Comment by David Schrunk[2]

On the application of Ideas Unlimited to space exploration and development, we should consider lunar (and Martian) lava tubes for human settlements. Lava tubes have the following advantages:

- Large size: On the Moon, some lava tubes are 2-3 km wide, 0.6 km high, and 100-150 km long. This is enough room for large populations and development/manufacturing/agriculture/scientific activities. The large internal volumes avoid the psychological stress disadvantages ("cabin fever") of surface/subsurface shelters.
- Roof thickness: The roofs of lunar lava tubes are 20 to 50 or more meters in thickness. They provide absolute protection against all ionizing and UV radiation and micrometeorites.

[2] David G Schrunk, MD, is a KSI faculty member and one of the world's expert lunar researchers. He submitted the following on lunar lava tubes construction. See his book, *The Moon: Resources, Future Development and Settlement*, 2nd ed. (Cham, Switzerland: Springer Praxis Books, 2010).

- Level floor: Lava tubes were formed on, and are parallel to, the lunar surface. They are ideal for agriculture, manufacturing, housing, and transportation (etc.) systems.
- Constant temperature: On the Moon, the inside lava tube temperature is estimated at a constant -20°C. This avoids the temperature extremes at the surface and simplifies all human-related activities.
- Stability: Lava tubes have remained intact for millions of years, and they can be reinforced if necessary.
- Lack of lunar dust: The "space weathering" mechanism that pulverizes the lunar surface to produce lunar dust does not operate inside lava tubes.
- Opportunity for transportation networks: Lava tubes are present in many areas of the Moon. With existing mining technologies, adjacent lava tubes can be connected to create a subway rail network that moves people and supplies safely and at high speeds between widely separated areas on the Moon.
- Possible source of volatiles: The "cold trap" mechanism that accumulates water and other volatiles in the bottom of craters in the polar regions might also be operative (via openings to the surface) in lava tubes—a potentially valuable resource.
- Use of compact "space-rated" nuclear reactors: Compact nuclear reactor technology is now available to provide reliable energy requirements for initial development of lava tubes. Eventually, manufacturing capabilities will grow to the point that solar panels can be constructed from lunar materials so that future energy needs of human settlements will be supplied by solar energy.

Lava tubes are fortuitous ideal "pre-made" structures for human settlements on the Moon. All we need to do is install the utilities….

Personal Needs

This section contains inputs of the Ideas Unlimited focus group for the primary focus of this workshop—capturing ideas for the future needs of the people who travel to Space to establish settlements. In 2021, the only existing "settlement" is the International Space Station (ISS), which is a very small, populated research station. Future space colonies will be entirely different, as the following needs, provided in the first person, will describe.

My health—physical and mental—will be a priority and my hierarchy of needs will need to be addressed within an environment of freedom of thought and expression. I want to have walking/running space; a diversity of dietary selections and health care options, to be able to have both private and community experiences with freedom of choice as to when to be in each mode. This should include control of my leisure time and

the ability to invest in projects of my own choosing. That leisure time should be longer than the time required to meet basic survival needs.

Respectful interaction and communication with colleagues and friends in the settlement will be essential. That should include options for group activities, a diversity of arts and entertainment, and learning programs. Travel to view and explore the exotic atmosphere and unique aspects of the planet will be a special privilege of space settlements. I should like to have a private vehicle. Electronic communications with family, friends and professional communities on Earth will prevent "space fever."

I would like to have a minimum of interference from outside agents and to have a sphere of private life in which I may act as I choose, as long as it does not affect others negatively in the settlement. Access to Earth and space media plus online access to the available knowledge of the Solar System and the universe will fully integrate my family and me into Carl Sagan's "Star Stuff" configuration.

Without partnership and love, the Space experience will become a frustrating burden. Sharing a loving relationship will provide me with the necessary support to be creative, grow with intellectual stimulation, and be professionally successful. I will want to improve my environment and living space, which will require materials, energy, and time over and above the time necessary for survival and professional work. Being able to obtain luxury items from Earth occasionally will satisfy my desire to create a unique home environment.

Professional productivity will be a prime requirement for space settlers—particularly during the early stages, due to the construction tasks and the desire to create resources for export. My skills will need continual improvement and addition. I would like to have some choice of research assignments and to feel confident that if I invent a new technique or machine that is useful to others, this will result in increased access to resources and materials that will facilitate new inventions. I would like both a sense of, and the reality of, ownership of the physical assets I initiate and develop, and the ability to pass them on to others who will benefit from them after I am gone. I want to enjoy a feeling of significance—from managing my own survival and improving my comfort in the settlement, not just discovering how others in the settlement, present and future, can improve things further.

Summary

Comment by Gordon Arthur

When I saw the first iteration of the data, I applied Maslow's Hierarchy of Needs to it.[3] Maslow's categories do not overlap exactly with the categories this paper uses, but I found that six of the categories in this paper at least partially covered physiological needs, four

[3] See A. H. Maslow, "A Theory of Human Motivation," *Psychological Review* 50 (1943): 370-96.

categories covered safety needs, three covered love and belonging needs, two covered esteem needs, and one covered self-actualisation needs. Thus, the needs the group identified seemed a reasonably well-balanced collection.

Comment by Jeff Greason

In looking over the random 104 ideas that generated this article, a theme that emerges to my eyes is one I might term "economic surplus." That is, there is of course concern over reaching the minimum needs for human survival, but there is also a recognition that in the long term, survival is not enough. Just what each person would choose to do with his or her resources that are over and above bare survival of course varies from person to person (that is what makes an economy run, after all—the variety of desires). But that there needs to *be* an economic surplus and a sense of economic growth is a theme I see in much of the responses.

It is well known that, once beyond basic survival, "contentment" is relative, not absolute—it has more to do with the sense of whether your prosperity is increasing or decreasing than it does with the absolute value thereof. I think the question with which only a few workers in the field have grappled (O'Neill very notably among them) is this question of how do you get PAST basic survival, to the point where there is an economic surplus and a balance of trade with the home society. There is no easy answer to this, but in a real sense, it is the key question. If it can be answered, the other details will be worked out—if it cannot, they will not matter much.

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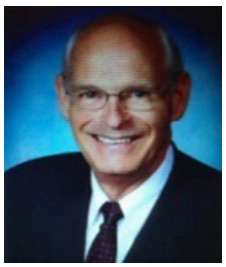
About the Authors and Editors:

Gordon Arthur, PhD is co-founder and Associate Editor of the *Journal of Space Philosophy*. He has degrees in Physics, Philosophy of Religion, and Theology. He is Dean of Space Philosophy and Theory at KSI. He has taught courses in both philosophy and governance at KSI. He has published books in theology and journal articles in both philosophy and theology.

Hosain Bahari is CEO, Canserve Auto Repair Pte. Ltd., He is an entrepreneur, and he has been a business owner since 2009. He was a senior manager of GE Power System (USA) and GE Keppel Energy Services Pte. Ltd. for more than 30 years. He has been a certified Six Sigma practitioner since GE Chairman, Jack Welch initiated the Six Sigma culture in General Electric. He was Shop Manager of Westinghouse Electric (USA) Australasia, Pte. Ltd., and he was a senior officer in Keppel Shipyard Pte. Ltd. in 1975.

He is a PhD candidate (ABD-All But Dissertation) with the University of South Australia. He has an MBA degree from the International Management Centre in Buckingham, UK and the Ngee Ann Technical College, Singapore.



Lawrence Downing, DMin, after his forty years as a minister, university professor, and author specializing in human values, ethics, and moral leadership, joined KSI in its formative years as a faculty member and Director of Space Faith.

Jeff Greason is an entrepreneur and innovator with 22 years' experience in the commercial space industry. He is the CTO of Electric Sky, developing long-range wireless power for propulsion and other purposes, and Chairman of the Tau Zero Foundation, developing advanced propulsion technologies for solar system and interstellar missions. He has been active in the development of commercial space regulation and served on the

Augustine Commission in 2009. Jeff was a cofounder of XCOR Aerospace and served as CEO from 1999 to early 2015. Previously, he was the rocket engine team lead at Rotary Rocket, and an engineering manager in chip technology development at Intel. He holds 25 US Patents. He is also a Governor of the National Space Society.

Bob Krone, PhD, President, KSI, *Journal of Space Philosophy* Editor-in-Chief, Emeritus Professor of Systems Management, University of Southern California (USC), Colonel, USAF (Ret.), PhD in Political Science and Policy Sciences, UCLA (1972, Dissertation, *NATO Nuclear Policymaking)*, authored or co-authored 14 books in Management and Space Sciences, Doctor of Honoris Causa, La Sierra University, 2018.

Rod Pyle is a space author, journalist, and historian who has written 15 books on space history, exploration, and development for major publishers that have been released in ten languages. He has written extensively for NASA and is the editor-in-chief for *Ad Astra* magazine. Rod taught at the University of LaVerne for ten years and holds a BFA from Art Center College of Design and an MA from Stanford University.

David Schrunk, MD, is an aerospace engineer; founder, Quality Laws Institute; KSI faculty member, Author, Moon Development.

Editors' Notes: The graduate courses and programs of KSI began in 2019. Scholars enrolled in all the courses work on original Space research assignments. This is the second one to be published in the *Journal of Space Philosophy*. The first was by Jeff Greason, "Thoughts on Future Space Science and Art," in the Spring 2020 issue of the journal. This article is a unique example of scholars in a 14-week course producing a professional publication by the end of the course. This is one niche feature of KSI academics.

All previous issues, since the founding of the *Journal of Space Philosophy* in 2012, can be viewed, or downloaded, from: www.keplerspaceinstitute.com/jsp. ***Bob Krone and Gordon Arthur.***