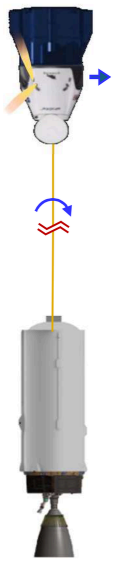
3 Steps to Settle Space

BY JOE CARROLL

Settling space requires supporting full human life cycles. The easiest and safest place to do that is in equatorial low Earth orbit (ELEO), using artificial gravity (AG). These 3 steps can get us there:

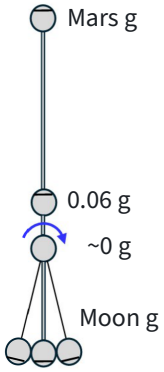
Step 1: Crew spin tests in AG, in orbit.



For a fixed AG gravity level, faster spins allow smaller and cheaper stations. But we don't know what spin rates we can adapt to in AG, because we can't do relevant spin tests on the ground. We use rotating rooms, with the felt gravity nearly parallel to the spin axis. The spin effects stay the same if we turn around. So we quickly adapt. But in AG, felt gravity is at a right angle to the spin axis. This causes different effects. And each time we turn around, the effects we feel reverse direction. This makes it ***far*** harder to adapt. Sizing affordable but usable AG designs requires finding human responses to various AG spin rates and radii ***in orbit.***

Any crewed space vehicle can do useful spin tests, perhaps in the first hours of trips to the ISS. A flat spin can give the sensations and outside views that crews will have near the spin axis of an AG facility. Keeping a spent stage attached allows larger radii and g levels. Docking with Haven 1 or 2 allows a few meters more. But tests at Moon, Mars, or higher g require spinning tether tests like that done by Gemini 11—but with several times its 30m tether and 0.15 rpm spin, and a compatible docking interface. Such tests may be costly, but will let us size realistic AG stations and even settlements.

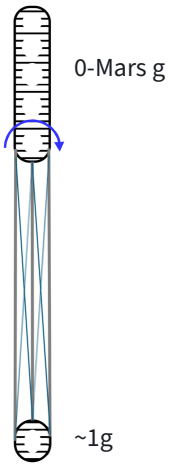
Step 2: A commercial low-g space station.



Once we know how well we adapt to AG, we can size AG facilities for crews, and even for tourists. Unlike real gravity, AG allows easy access to many gravity levels. (This is worth exploiting!) The layout on the right uses very long pressurized tunnels and elevators to connect its modules. It can test human health and refine g-countermeasures for the Moon and Mars at low cost and risk, and even do relevant multi-generation tests of various crops and small animals.

It can also host low-g processes and test the appeal of low-g tourism and retirement. Frequent traffic can speed low-g process development and servicing. Launch can be timed for docking in the first orbit, as Gemini 11 did. Reliably short trips allow simpler capsules and closer seating: think buses, not RVs. This can greatly reduce seat prices.

Step 3: Habitats at ELEO, and include ~1g.



LEO inclinations <10° see low enough radiation to allow many-year stays. And those <1° also allow quick trips up and down on ***any*** orbit. With low radiation, enough active time in 1g, and quick trips to Earth, some staff may start families. Some tourists, retirees, and others may also stay.

The layout at right offers 0-Mars & ~1g in a slow spin, with local open spaces, at <1% the volume of a cylinder slowly rotating on its axis. This greatly shrinks mass and cost.

Supplying habitats at ELEO requires equatorial spaceports. All supplies can be delivered at lower cost and risk than delivering 1/10 as much to a distant settlement. Residents can develop automated farming and recycling to further reduce costs. Growing communities based on tested markets seems like the safest, easiest, and earliest way to begin settling beyond Earth.

Joe Carroll is Special Adviser to the Space Studies Institute.

To learn more, see **ssi.org/spin** or contact **joe.carroll@ssi.org**