COMMENTARY Sandra Magnus and Jack Burns

The elusive 'why' of space exploration

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For those of us in the space sector, we rarely spend time asking "why go to space." The answer is so obvious, so much a part of our DNA, that we don't need to spend time articulating, or even discussing amongst ourselves the "why."

Unfortunately, as a community, we take the "why" so much for granted that when we reach out to connect with those outside of our space tribe — such as our national leadership (whether that is Congress or the administration), or our colleagues from other economic spheres, or to the public — we stumble to deliver a coherent narrative to explain the importance of human expansion into space.

Instead, we dive straight into the gory details of the "how" and describe with passion and excruciating detail all the hardware we need and are building to achieve our endeavors. We talk about rockets, space stations, space vehicles, habitats, fueling depots, resource extraction equipment, life support, and so on. And then we don't understand why our audiences are not as excited or inspired about the concept of humans venturing, permanently, beyond our planet's boundaries. Failing to inspire the same excitement in our listeners, we inevitably change conversational tactics to highlight the practical, expounding on the economic benefits society reaps when we push the limits of what humans and technology can do. Sometimes we receive a flicker of interest in this argument, sometimes not.

It is time to shift the conversation a bit — to be more unapologetically inspirational and aspirational from the get-go and only then follow with the practical, positive outcomes.

Humans are meant to explore; it is the core of who and what we are as a species. We explore to gain knowledge and satisfy our curiosity, to expand our boundaries, whether those are intellectual, geographical, economic, or spiritual. We have, over thousands of years, explored and spread our presence across the planet. It is time to move off the Earth and continue that dynamic throughout the solar system. Space is the next frontier. The "why" is that simple; it is enough to capture anyone's imagination.

Next, we must the consider the "what." If we are to expand across the solar system, what should we be doing? Should we focus on the age-old, fundamental questions that speak to our origin and place in the cosmos? (for example, where do we come from and are there others like us in the galaxy?) These are truly monumental questions that should be addressed by the American space program in partnership with international and commercial partners. Adopting a fundamental question — the importance of human expansion, for its own sake as well as the ongoing search for our place and life in the universe — as the motivation for space exploration is key to a sustainable space program. These questions drive investigations of multiple destinations over many decades, the development of advanced technologies, and opportunities for commercial exploitations of space-based resources.

The search for how life began on Earth is addressed on our planet and our nearby companion, the moon, which formed following a collision (or collisions) of a Mars-sized body with the proto-Earth around 4.5 billion years ago. Nearly 700 million years later, the outer planets in the solar system underwent a major repositioning and resulted in a large influx of asteroids raining down upon the Earth and moon. About this same time, the first single-celled life began on Earth. Is this a coincidence or was this "late, heavy bombardment" the genesis of life of Earth? All evidence of these impacts has been erased by our planet's active atmosphere and geology. But on the moon, the history of

this bombardment is preserved as a "witness plate." Within the South Pole-Aitken Basin, in particular, there is primordial material on or near the surface that can be excavated during the first exploration of the moon's far side with robots and humans.

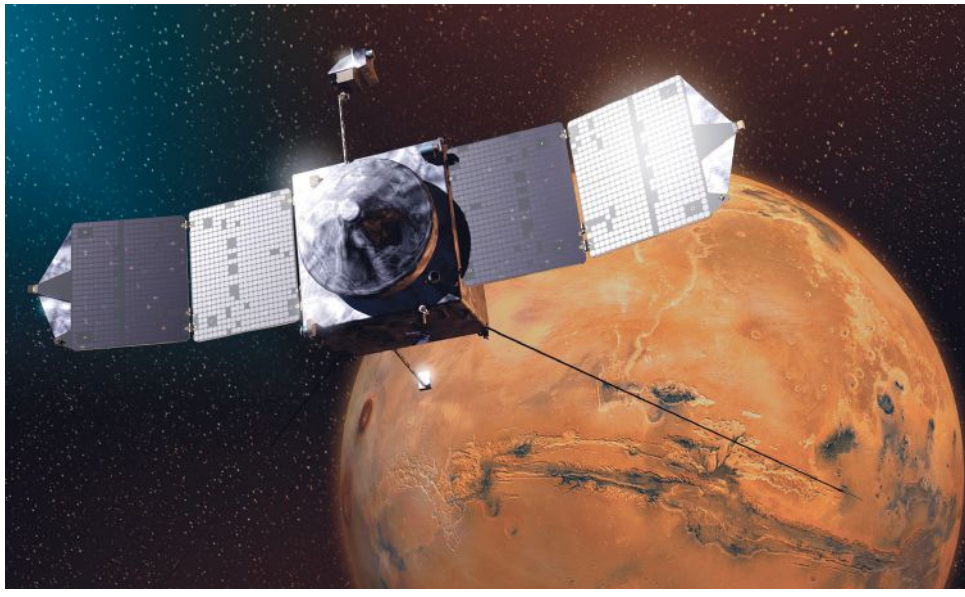
For nearly a century, writers have speculated that Mars is a possible location where life may have formed independently. NASA's Maven and Curiosity missions indicate that large bodies of water once existed on Mars billions of years ago and that conditions for life may have existed. Finding evidence of microbial life with different DNA/RNA constructions would lead to breakthroughs in our understanding of how life formed and might also point to advances in biomedicine. This solar system destination might address our creation in quite novel ways.

Going further outward in a sustainable space exploration program to address these fundamental questions are the "water worlds" around Jupiter and Saturn. Moons like Europa and Enceladus appear to have oceans of water below layers of ice that are probably tens of kilometers thick. Could life, even macroscopic life, exist in briny seas that are analogous to Earth's primordial oceans heated by tidal forces from these moons' gas giant planets? Beyond the solar system lies newly discovered exoplanets. Who knows what we will find on these unexplored bodies — life forms like us, or different?

Finally the "how" needs to be addressed. It is here where the conversation can turn to the practical. The "how" should address not only the equipment and methodologies that will be utilized but also the desired outcomes. Ideally, a well-designed and executed, inspirational, sustained space program will:

- Drive advances in science and technology
- Expand opportunity for everyone, everywhere in space
- Enhance and expand knowledge, education, innovation and economic vitality
- Advance the understanding of Earth and develop technologies to improve the quality of life on our home planet

The "how" is important. In order to achieve these outcomes we must look strategically at the complete picture, knowing the "why" and "what" in order to examine and identify the appropriate roles for all of the various entities that want to engage in the enterprise. There is room for everyone — all countries, government and private actors of all sizes, and individuals. We must do this together. We will do this together. **SN**



Sophisticated measurements made by a suite of instruments on the Mars Atmosphere and Volatile Evolution, or MAVEN, spacecraft revealed the ups and downs of hydrogen escape – and therefore water loss.

NASA ARTIST'S CONCEPT

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