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Dr. Marshall Porterfield - Purdue University Agricultural & Biological Engineering

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The hard and challenging thing:

Why space travel matters in the 21st century

by Jessica Merzdorf

If you ask Marshall Porterfield, the answers to Earth's biggest problems can be found in space - or at least, in the technology we use to get there.

The steely-eyed researcher in Purdue University's department of agricultural and biological engineering pioneers the boundaries between engineering, computer science and biology to develop life-sustaining technologies for space travel. He creates biosensors, devices that use biological components like cells or enzymes to detect the presence of chemicals and other substances, but also finds ways to use plants to recreate Earth-like conditions on long space missions. Far from considering space exploration a luxury, Porterfield argued at the 2017 Dawn or Doom technology conference that voyaging beyond Mars is essential for humanity's future.

"I don't think we're going to be an earthbound species and persist here on the planet," the National Aeronautics and Space Administration (NASA) researcher and former division director said in an interview after the conference. "We must become a space-going species to protect our viability."

In his Sep. 27 talk, Porterfield described three reasons why humans should explore space: To learn how to survive in hostile environments in case global risks like climate change make Earth inhospitable for human life, to discover technologies that could address those risks, and perhaps most importantly, to fulfill our basic drive to explore.

"Pursuing these grand challenges leads to the betterment of the human condition."

Space: Humanity's 'fallout shelter'

Porterfield believes that many threats to our future on Earth - climate change, deforestation, pollution - stem from overpopulation.

“We have more and more people wanting a standard of living that is driven by fossil fuels,” he explained. As fossil fuel extraction increases to satisfy this demand, greenhouse gas emissions increase too. In 2017, the U.S. Energy Information Administration reported that, while coal consumption has decreased yearly for nearly 10 years, natural gas consumption continues to rise, and fossil fuels still make up about 80 percent of U.S. energy consumption annually. The U.S. Environmental Protection Agency has tracked a steady yearly increase in worldwide greenhouse gas emissions due to fossil fuels since 1900, peaking at more than 9.8 billion metric tons in 2014.

Fossil fuel emissions and pollutants pose immediate risks to human life and the environment, from triggering asthma attacks to leaking toxins into vulnerable habitats. But they also contribute to global climate change. Scientists worldwide are already observing the warmer temperatures, altered growing patterns and increased flooding and drought that signal changes in Earth’s climate.

Porterfield said finding new homes on Mars or the moon could be our “fallout shelter” if the population continues to grow and the risks to life become too great.

“We need to develop the technology to survive in hostile environments,” he said. “We’ll either need it for space, or to save ourselves here on Earth.”

Harnessing the power of plants

Imagine a system that could purify your home’s water, freshen your air, generate electricity, and put food on your table - all for minimal daily cost.

It sounds futuristic, but NASA has researched such systems since the Cold War, Porterfield said. They are called bioregenerative life support systems, or BLSS, and they harness plants’ ability to recycle carbon and water to mimic some of Earth’s life-sustaining features.

Bioregenerative systems were originally envisioned for long-term space travel, but they are also an example of technology that could help us tackle our problems here on Earth, he said.

“Bioregenerative technology could alleviate the footprint of growing cities, especially in terms of water,” he said. “Instead of wastewater treatment plants, what if we all had a biotreatment plant that made our water 90 percent pure and extracted carbon into fuel cells that created electricity? There are many ways we could move from a centralized grid to individuals having

bioregenerative components in their homes. When you localize food production to that level, your carbon footprint decreases."

Porterfield eagerly described similar technology that could address food insecurity, urban sprawl, agricultural efficiency and growing pharmaceutical plants.

"Vertical gardening is on the verge of becoming extremely profitable," he said. "For the next generation of pharmaceuticals, we are going back to plants, and these will be transgenic plants grown in controlled environments. Electric companies could apply their electricity to carbon dioxide recovery technology, which can increase crop activity in these controlled environments and be used to create biofuels."

He paused as the challenges of the current political climate - reduced funding for the space program, revival of the fossil fuel industry, public doubt of climate change - brought him back to reality. "I would think big industry would want to get involved."

Chasing the unknown

To the crowd of students and professionals gathered at the Dawn or Doom conference, Porterfield said the official timeline for the first U.S. mission to Mars is 2030 to 2040.

"In politics," he said, "that means we're not going."

Nevertheless, he continues to invest in creating technology that will get us there if the government's priorities shift again in his favor.

"Interplanetary travel, landing and roving capabilities, habitation - all of these technologies are within our grasp," he said. "We still need biomedical research to see how the human body responds to long-term space travel … we're still learning about the human microbiome in engineered environments."

Because to Porterfield, space travel is ultimately all about humans: the next step in our age-old journey of exploration.

"Science is a process of discovery," he said. "We are where we are today because humans sought new places and new opportunities. Everything about our DNA is hardwired to explore and discover."

He said that, while the space program has already furthered our knowledge and society, it is up to us to press onward - to seek what he called the "unknown unknown".

“The space program changed our national science policy and stimulated education. The main outcome of that education was people who take their science and technology experience out into society and do even more.

“It’s all because of our innate desire to do the hard and challenging thing.”