Students rise to Mars Ice Challenge

NASA called upon colleges from across the U.S. for contest

BY TAMARA DIETRICH
tdietrich@dailypress.com

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Colorado School of Mines' Caroline Ellis, center, and Angel Abbud-Madrid, right, look over their water extraction device during the Mars Ice Challenge event at NASA Langley Research Center on Wednesday.

It was the team from Colorado that got first mud.

"They haven't got any water in the container yet," Patrick Troutman observed Wednesday morning in the hangar at NASA Langley Research Center in Hampton. "But water oozed up out of their hole and got into the Martian soil and turned it to mud. It's like brownie mix."

If this were a mere race, then, the Colorado School of Mines in Golden would have won the day.

But this was a Mars Ice Challenge — an engineering competition among college teams from across the country to come up with novel yet feasible ways to extract water from Martian soil.

So eight team finalists labored away at their stations with drills, augers and one excavator, all fixed over large commercial fishing coolers to demonstrate they could get through half a meter of clay to reach the half-meter of prized ice buried beneath.

Justin Kilb of Calgary, Canada, was a member of the Colorado team.

"In a nutshell, we're using an auger, called a dry cuttings removal system," Kilb said. To keep clay from riding up the auger to the surface along with the ice, the team enclosed it in a tight metal casing.

The design challenge is part of RASC-AL, or Revolutionary Aerospace Systems Concepts-Academic Linkage. RASC-AL is a partnership between NASA and the National Institute of Aerospace in Hampton. Its goal is to engage the top minds at engineering schools to innovate on concepts for human space exploration.

The puzzle of Martian ice stretches back to the Viking landers of the 1970s, said Troutman, human exploration systems analysis lead at NASA Langley. It was Langley that led the effort to place the first working spacecraft on the surface of the red planet.

"Little did we know at that time that we landed in a region that was fairly water-rich," said Troutman. "But Viking didn't have the tools to measure that."

Then, a decade ago, detailed images from a reconnaissance orbiter showed what looked like "dry" glacier floes on the Martian surface, while a radar instrument penetrated the first foot or so of regolith and found pure water.

"And it's a lot of water," Troutman said. "If you melted all this underground ice they found — some places where it's 800 meters deep — it would cover the entire surface of Mars one meter deep.

"Now, my whole career has been exploration, and I was always a 'go to the moon because it's easier' type guy. This changed my thinking. Because now what Mars has over the moon is oceans of water that we can tap. And if you talk about the whole purpose of why we go explore, my perspective is it's to establish a second biosphere to eventually send humanity out so we have a spare Earth, or in case something bad happens on Earth. Mars could be that place.

"You can sustain thousands, if not millions, of people with the amount of water that's there. So, there's all this water, but it's buried. How do we get to it? And that's where the Mars Ice Challenge comes in."

In fact, it's a double challenge for students.

Because of freezing temperatures and low atmospheric pressure, "water" on Mars is either a solid or a vapor, much like dry ice here on Earth.

And because water behaves so differently on Mars, students were tasked not only with designing a rig that works on this planet, but also with explaining how they would adapt it to conditions on Mars.

The team from the University of Tennessee in Knoxville, for example, developed an excavator to fling dirt away to get at the buried ice. Then a heating device would liquify the ice so a hose could suck it up.

But on Mars, said team member Caleb Peck, the idea would be to use the natural environment to their advantage. Their concept is to put an airtight cylinder over the exposed ice and, after it sublimates and turns to vapor, use a condenser to bring the vapor to a liquid state.

"So it takes little energy to move it around the three phases because of where the atmospheric conditions are on Mars," said Peck.

Student teams began forming last summer, then spent several months working up concept papers to present to NASA. Finalists were chosen in December and funded at about $12,000 each to develop prototypes.

Other finalists are Alfred University in New York, North Carolina State University in Raleigh, the University of Pennsylvania in Philadelphia, the University of Texas at Austin, and two teams from West Virginia University in Morgantown.

"The whole concept for RASC-AL is to engage universities as partners in the journey for space exploration and scientific discovery," said Shelley Spears, director of education and outreach at NIA and RASC-AL's program director.

"It's meant to be a win-win in that students are going to be able to work on something that is real. A relevant and authentic challenge facing space exploration. And then it's also for NASA — for them to gain new perspectives and tap fresh minds and think of things in a very new way."

For Kilb, a petroleum engineering major, the mere possibility of contributing in some way to a workable extraterrestrial water extraction system is a heady concept.

"That would be unquestionably one of the coolest academic pursuits," said Kilb. "To say something that you worked on, NASA has sent it to another planet."

He'd even love to be sent along with it as a NASA astronaut. But that dream has already been dashed.

"I'm 6-foot-4," Kilb said. "And I don't think they like to send people too tall — it's a lot of extra space. (But) it would still be great, whether you go there or you stay here, to try to contribute to such a wild endeavor."

Peck, a budding aerospace engineer, said he's always considered working for NASA.

"Because, heck, it's NASA. It's been here forever," he said. "They were talking earlier about becoming a multiplanetary species, and just helping with that would be incredible."

NASA hopes to get humans to the Martian system sometime in the 2030s. To accomplish that, it's been developing the Orion crew capsule, the Space Launch System of massive rockets and crew habitats, both for the journey and for living on the planet.

"We're talking about extending humanity to another planetary surface," said Troutman. "Our life sharing their life — if there is such. Our life sharing their water.

"Yeah, we had Apollo. We went to the moon (and) that demonstrated transportation technology, things like that. But this is about living someplace else, not just going there to explore. This is for the long term."

According to NASA, judges will select a winner Thursday evening, followed by an awards ceremony at the Crowne Plaza Hampton Marina Hotel.

Dietrich can be reached by phone at 757-247-7892.