Vintage clothing soars in popularity

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# Mars touchdown

## Perseverance rover begins its mission

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After nearly half a year barreling through deep interplanetary space, the Mars 2020 spacecraft entered the thin Martian atmosphere on Feb.18 in preparation for the final and most critical part of its mission: Entry, descent and landing (EDL). Traveling at a high speed of 12,500 miles per hour and reaching a temperature of 2,370 degrees Fahrenheit, the EDL process took about seven minutes beginning with a heat shield followed by a supersonic parachute to slow the descent. Within 7,000 ft of the surface, the spacecraft began its rocket-powered descent which eventually lowered the rover called Perseverance onto the Martian surface using cables.

EDL, aka the "Seven Minutes of Terror" to the engineering team, is only the first part of the mission. The scientific goals of Perseverance prepare for eventual manned missions to Mars and involve testing a carbon dioxide to oxygen converter, storing Mars 2020 samples for future analysis and demonstrating that flying is possible on Mars with a small helicopter called Ingenuity,

The Devil's Advocate was able to speak about Perseverance with Emily Bohannon, a System Testbed engineer for the Mars 2020 mission at NASA's Jet Propulsion Laboratory. Bohannon's job consisted of working in the testbed testing different procedures and also working on flight parameters. Bohannon joined Mission Operations after landing, working in the Data Management and Transmission team.

Talking before the Perseverance's safe landing, Bohannon stressed the importance and nervousness of the day.

"The most difficult part of the mission is entry, descent and landing just because there are, in terms of engineering, so many things that can go wrong that will cause us to crash and everything needs to work basically perfectly," Bohannon said. "It's gonna be really hectic. I'm gonna be freaking out the whole time, but we've done countless tests and the fact that we're doing this for a second time after Curiosity means we have lessons learned and we've improved upon things. So, I'm nervous because how can you not be nervous, but I'm confident in our technological advancements, processes and testing. I feel we're going to be on Mars in one piece."

Perseverance is the most technologically advanced rover ever sent to Mars and will conduct a variety of tests including the Mars Oxygen ISRU Experiment (MOXIE) which will produce a small amount of pure oxygen from atmospheric carbon dioxide. Bohannon explained more about MOXIE.

"MOXIE is one of the biggest experiments because the more you bring to Mars, the heavier your vehicle is going to be and the heavier your vehicle is going to be, the harder it is to launch, the harder it is to land and it's just really expensive," Bohannon said. "So if you can reduce the amount of stuff you need to bring like an oxygen supply then that seriously increases the possibility of getting to Mars."

Another important part of the rover will be the soil samples it takes from the landing site at Jezero Crater, which is believed to have once been a water lake. If Perseverance finds something interesting like chemical signatures of ancient life in the soil, it will store the sample to be subsequently brought back to earth through future missions. Bohannon explained the potential future of the samples.

"I believe the European Space Agency will do the Earth Return Orbiter to Mars that will chill around in orbit and drop something on Mars," Bohannon said. "Then I think the Jet Propulsion Laboratory will make the little rover that will go pick up the samples, come back and get on the little rocket which will go back to the Earth Return Orbiter and then the orbiter goes home. The reason why [bringing back samples] is so big is because you know we have crazy smart science instruments on Perseverance, but you can only do so much on a rover. It's nothing compared to being able to take something and put it in our labs that are bigger than a car so that'll be really interesting. You could do really good tests with that on earth if you can get it back. That's like a scientist's dream."

The last main scientific expedition that will take place aside from blasting rocks with lasers on Mars will be Ingenuity's first flight. The flights will be purely a technological demonstration lasting less than 90 seconds each for up to five flights but will also provide vital information for the future about aerial travel in the thin Martian atmosphere.

"We have never had a rotorcraft on another planet and we want to see if we can do it in the extremely thin Martian atmosphere which is like one percent of Earth's," Bohannon said. "Flying on Mars isn't something that we normally thought we'd be able to do but [Ingenuity's team] did testing in special vacuums where it simulated the Martian atmosphere and the Martian gravity, and they got it on as a late-ish edition to Mars 2020. Once we land, we have several days where we're not moving anywhere, just doing different checkouts making sure, based on the cameras and everything, that we're in a good spot. Then once we transition from our cruise flight software to our surface flight software, we're ready to drive [Perseverance] and deploy the helicopter using pyrotechnic bolts that will explode under the rover which is crazy. The helicopter will then drop on the ground and the rover will drive away so we're not on top of it anymore and then helicopter operations aren't going to fly right away since they have to do their checkouts but after that, they'll go up."

Perseverance is a mission that can be thought of as one of the first stepping stones to Mars for humanity. Its goals are largely oriented towards testing and gathering information for manned missions in the not so distant future. For young engineers like Bohannon and students alike interested in outer space, the Mars 2020 mission provides excitement that will continue for decades to come.

"My parents or my grandpa would talk about watching people land on the moon for the first time, and I've always felt like everything already happened for the first time for me," Bohannon said. "But then you have things like the possibility of sending a person to another planet and you know putting a helicopter on Mars and we're gonna hear sounds from Mars for the first time we have microphones. That's another new thing we have microphones on the vehicle. So that's a lot of like new things that have never happened before so it kind of it gives our generation that same feeling that our parents had where we get to see something happen for the first time and they're like wow I never thought I would see this in my lifetime."