Address to House Committee on Science, Space, and Technology

Mr. Chairman, members of the committee, thank you for inviting me to this hearing.

Unlike the other people you've heard today, I am not a space expert. I'm just an enthusiast, and I know that. But I do spend a lot of time thinking about the future of manned spaceflight and the challenges that come with it. And, to me, one issue stands out as the largest problem facing long-term space habitation.

The human body is simply not suited to living for long periods in zero-g. Until this issue is solved, we have no hope of landing humans on the surface of Mars, nor can we create permanent residences in space.

Astronauts who spend months in zero-g suffer bone loss and muscle degradation. Once they return to earth, they have to be carried out of their capsule by ground crew. It takes days, sometimes weeks for them to re-adapt to gravity because their muscles are simply too weak to stand. Imagine, then, a crew of astronauts setting foot on the surface of Mars after eight months in space to get there. They would be unable to move, let alone execute their mission. This is not an option.

And that's not even the worst part. Weightlessness also causes degradation of the eyes. And, unlike the bone and muscle loss which the body will repair once it returns to gravity, the eye damage is permanent and irreversible.

Astronauts aboard the International Space Station have to spend two hours per day exercising just to stay remotely healthy. This means that we dedicate one eighth of all waking-person-hours in space to counteracting the effects of zero-g habitation. That time could be better spent on experiments, station upkeep, or simply rest for the crew.

Instead of concentrating on ameliorating the effects of zero-g, we should concentrate on inventing artificial gravity. And this is not some magical technology straight out of science fiction. We already know how to do it. You just need to spin the space station to provide centripetal force. This conjures up images of huge wheel-in-space constructions that we simply can't afford to build. But centripetal gravity can be accomplished much more cheaply and easily than the flashy futuristic visions you've see in films.

For our next space station, we should have the crew compartment connected to a counterweight by a long cable and set the entire system rotating. This creates the centrifuge, which will generate constant outward force for the crew. Inside the crew compartment, it would be virtually identical to the gravity we experience on Earth. All physiological problems of zero-g would be solved.

Some would argue that one of the main purposes of a space station is to do experiments in zero-g. This is easily accommodated. We could have a node in the center. That would provide an area of zero-g for whatever experiments require it. The astronauts would work in there as needed, but spend most of their time in the crew node where their bodies get the gravity they need to remain healthy.

While the concept is simple, the engineering is very complex. If you were standing in that crew compartment, the downward force on your head would be less than the downward force on your feet. Because your head is closer to the center of the centrifuge than your feet are. NASA conducted experiments on the ground with centrifuges in the 1960s. They found that humans get significant vertigo and dizziness from this effect if the rotation rate is faster than 2 revolutions per minute. I will spare you the math, but this means the cable connecting the two nodes would have to be 450 meters long, which is over a quarter mile.

I have no delusions that such a station would be easy to accomplish. Not only would it be the most massive space station ever built, but it would also have to stand up to the forces that its own artificial gravity creates. Plus, a rotating station would need very advanced control systems to keep its solar panels and thermal radiators properly aligned.

It would be a huge engineering challenge to design and implement this station. But huge engineering challenges are what NASA is all about. I have no doubt they could rise to the occasion.

Once this station were built, it’s rotation rate could be adjusted to provide whatever gravity we wanted. We could test the long-term health effects of lunar gravity. Or Martian gravity. Or we could leave it at Earth gravity to ensure crew health.

And when the time comes for a human mission to Mars, the artificial gravity technology proven by this station will be employed in the vehicle that transports the astronauts there, ensuring that they are fully healthy and capable when they first set foot on the red planet.

Thank you.