Statement of

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Thank you, Chairman Cruz, Senators Nelson and Markey, and all the members of the space subcommittee and full committee for the opportunity to testify today. Putting humans on Mars has been a lifelong passion for me and the focus of my research career, so I am delighted to be here with you today.

In the past 40 years, we've learned an impressive amount about our sister planet, Mars. Thanks to NASA's scientific robotic missions, from Viking through Curiosity, we have more information about Mars than about any other planet, excluding our own. These missions have beamed back images of Mars' majestic and alien landscape and discovered liquid water beneath its surface. They've provided evidence that in ancient times there was surface water and an atmosphere rich enough to support life.

Just last month, researchers pouring over data from our Curiosity Rover identified complex, organic molecules in Martian sediment. Were they produced biologically, as similar compounds are here on Earth, and hence signs that Mars once bore life? 3.5 B years ago, Earth and Mars–sister planets, both likely had life. What went so terribly wrong on Mars? The answers, our scientific discoveries, tell us about life here on Earth and throughout the Solar System.

Scientific spacecraft and rovers will continue to make great discoveries and might someday answer the three enduring questions of exploration: 1) Are we alone? 2) Are there other habitable planets? 3) Is there life elsewhere, and what type? Landing women and men on Mars will accelerate discovery by many orders of magnitude. The first human missions to Mars will surpass the past 50 years of Mars robotic exploration. On just one human mission, we'll travel more than the 75 km cumulatively traveled on Mars by NASA's rovers.

Nothing inspires a nation—and future generations of innovators, my students, our students, who I call the 'Mars Generation'—more than human spaceflight! Putting humans on Mars has been my dream for as long as I can remember, inspired by Apollo 11 as a young girl in Montana witnessing Michael Collins, Neil Armstrong and Buzz Aldrin being the first to land on the Moon. Apollo taught me to dream, to reach for the stars, and that anything was possible. I believe—I know—that we can make the leap, putting humans on Mars in the 2030s.

But dreams and willpower are not sufficient. We already have some of the brightest scientists, engineers, and technologists bringing their inventiveness and persistence to the 'Boots on Mars' mission. We've had bipartisan support from Congressional leadership and across administrations. We need to build on those foundations with a clear strategy and commitments to significant long-term funding.

Prioritizing among NASA's many important missions is never easy, and you all in Congress have to make tough choices if we are to succeed. We spend $4 billion annually for Low Earth Orbit missions. They do important – critical— work. I know first-hand, my patented gravity loading countermeasure suit, flew on the ISS as a technology demonstration on astronauts in 2015 and 2017. But from an exploration point of view, and the desire to push humanity beyond what we think is possible, we've been stuck in LEO for far too long. We need to re-think the funding portfolio and timely investments to succeed in getting humans back to the Moon and onward to Mars.

Strategically, getting boots on Mars means figuring out the optimal roles for NASA, for private, commercial space ventures and for our international partners. Within NASA, we need to better integrate the Science, Space Technology, and Human Exploration portfolios. I recommend a synergistic Mars Program Office across all three with the necessary budget. No one nation can get to Mars alone, nor should we, on the timescale I envision. The benefits of the journey are for all of humanity – human exploration demonstrates the best of global cooperation.

My view of the best pathway to Mars breaks the strategy into three phases. Historically, we had Mercury, Gemini and Apollo. Currently, Phase I is the human exploration we are doing now, in LEO, on the International Space Station. Phase II is to get back to the Moon and deep space, demonstrating the technologies we need to sustain astronauts beyond LEO, namely, heavy lift launch capability, solar electric propulsion, deep space and surface habitats, and life support and mobility systems. We will fly to Earth-Moon orbit and land on the Moon. We need to evaluate the feasibility, cost, schedule, and investment portfolio, then make a decision and stay the course.

Phase III is self-sufficient travel to Mars. Explorers will be months away from home, we need to be completely autonomous without instant communications with Earth. We will rely on our technology investments in the 2020s in advanced propulsion, smart habitats, advanced human-machine autonomy, and novel radiation protection for this completely self-supporting journey to realize seamless interoperability between humans and our machines for scientific exploration. Why send humans to Mars many ask? When we're searching for life in the Universe, past or present, we look for liquid water that is critical to the evolution and sustenance of life. We have data from our Mars robotic rovers and orbiters that tell us that water was stable for as much as a billion years on Mars' surface, but that was about 3 billion years ago. This is the same time period that life evolved here on Earth in the oceans, formed from the building blocks of life – amino acids – that have been delivered all over the solar system by comets and asteroids. Astrobiologists tell us that the conditions on Mars were so similar to those on Earth that it's the most likely, closest place beyond Earth to have harbored – and might still harbor – life.

It will take focused research and technology development to implement Phase II and Phase III, to assure that we can lead human Mars exploration missions. At MIT, my students and I are working on some of these challenges. We investigate astronaut performance in low gravity environments and engineer solutions, like advanced second skin spacesuits and habitats that provide autonomy, sensing and self-repair. My technology demonstrated on ISS, could be furthered on the moon to provide greater astronaut mobility, ultimately, it will be technology realized during Mars exploration. Like many NASA investments, my research also has applications here on Earth, such as assisting people with locomotion and musculoskeletal disorders via soft exoskeletons.

In our lab and others across the country, the technology needed to get to Mars is under development. But most of it is still at a low Technology Readiness Level, or TRL. That's why it's crucial that we integrate Science and Space Technology as central parts of a NASA's Mars strategy.

Increase funding, keep it stable and develop a NASA portfolio that greatly furthers synergies among science, technology, and human exploration. This comprehensive, phased plan with the right coalition, will send us beyond low earth orbit, to the moon, and put humanity on Mars in the 2030s.