

i once had a professor asked me why in the world do we spend so much money on space exploration in the face of so many pressing challenges here on earth so good question and a tough one for me should we be building a future life in space i want to argue yes and tell you how i do believe in the beauty of space exploration for the sake of new knowledge because the little that we do know about our universe pales in comparison to what we do not yet know and in some ways it's in my blood my parents are both pilots my dad wasn't even a fighter pilot and my mom was one of the first women to ever fly for the united states air force and fourteen years ago i floated in microgravity like an astronaut for the first time this inspired me to work in aerospace for the rest of my life but space exploration does so much more than just inspire our space program has routinely delivered breakthrough innovations the apollo program gave us the foundation of modern computing the international space station gave us laser eye surgery contributed to that amazing technology and now new technologies are coming online to enable lifesaving biotech in orbit and even deliver energy from space what makes all of this possible in the last fifteen years the cost to get to space has dropped dramatically from over fifty thousand dollars a kilogram in the nasa shuttle era to now under two hundred dollars a kilogram with spacex a starship coming online this is remarkable this is like fedex if you can ship something around the world you can ship it to space but the precursor space station were so much of this amazing work has been taking place the international space station it's getting old it's very cramped and worse it's about to be shut down can be dick mission in twenty thirty twenty thirty one we need new infrastructure and we need it fast and fortunately current in space construction is quite slow difficult and dangerous this is a diagram of all of the pieces of the international space station and they were assembled over fifteen years like this by astronauts doing incredibly courageous and risky maneuvers in bulky spacesuits basically building some of the most advanced technology known to humankind by hand this hand built method doesn't scale even if the cost to go to space dropped even more dramatically tomorrow we only have room for about fourteen humans in orbit period the bottleneck isn't rockets anymore it's real estate and we need a new solution for how to build in orbit and scale up space infrastructure for the public good nine years ago

i started working on this problem could we learn from nature from plants and proteins that self assemble at a small scale and adapt to the grandest scales in space we know that when you're in freefall around planet you had the sensation of zero gravity in that environment forces like magnetism can bring together vast objects with it's so first that mit and now to really institute my team and i have invented a system to do just this it's to grow space structures in orbit using a ton of robotic self assembly the idea behind the method is to allow us to build reconfigurable space stations that are bigger than our biggest rockets based on my mit phd we use electro permanent magnets very special strong magnets that bring the modular tiles together to dock to rendezvous essentially think about space legos with magnets that click click click click into place tessa rain what we call this space habitat is a self assembling structure so we ship the modular parts to their destination wherever they're meant to be and once the tiles are the modules arrive they build themselves so we don't require astronauts or even robotic arms to go out and do slow or risky spacewalks some space diverse here you can see that the tiles were packed flat for the ride to orbit very efficiently we like to joke on the teams that like a glorified pez dispenser because remember the candies from the nineties and from there after the tiles have come together to form one buckyball multiple buckyballs can talk to form a larger space station and the best part is that we have tested this in space twice so here you can see michael lopez i'll agree i'm on orbit inside the international space station helping us test the code and the timing and the pacing for dynamic robotic self assembly in orbit from here we build and fly and test we entered the prototype we simulate the physics to be able to fine tune the construction method and last year we built a human scale mockup of are spaced habitat and we brought it on a road show across the country what we hoped to communicate to the public with these interiors is a life worth living in space or at least worth commuting to once we're in space we can use the really unique environment of the vacuum of microgravity to manufacture things that can't be made on earth in low earth orbit we're working with partners to use the test for a construction technology to assemble large volume high throughput biotech factories it turns out that in microgravity protein crystals grow differently certain types of

tissues grow faster or mature better and we can even do novel drug discovery in a way that we can't do under the conditions of earth's gravity we know that certain key biological samples behave differently and space particularly when they're floating so whether it's exceptional quality organoids for testing all kinds of drugs or cancer drugs or artificial retinas that would cure retinal degeneration these therapies will be made in space stabilized and brought back down to earth a little bit further out between earth and the sun we're working to see if we can help startup energy companies self assemble thousands of solar panels in orbit above the atmosphere now what this would allow us to do is capture raw unfiltered sunlight and beam it anywhere on earth even at night as like a flashlight from space and it would fundamentally solve these storage problems for solar power allowing us to deliver abundant green energy to the surface of the earth these are some of the most responsible ways that we could use space technology in service of earth my team and i have been working on an idea passionately known for decades in science fiction as off roading not of rolling the humans but off roading the heavy industry we could let earth recover as a garden planet for generations to come and use space infrastructure to do that offer all day and this future there's a lot closer than you may think while space travel definitely feels rarefied and in many ways it's certainly still is i bring dozens of people with me every year into microgravity on parabolic flights this is how nasa trains astronauts factually notice the vomit comet it's more fun than it sounds and this is how we are training the new space generation we're building architecture to welcome more people to orbit whether it's for a long weekend to see the planet from space for the first time or maybe for a career scientist to commute for a decade to work on a major breakthrough rockets like starship enable us to dream really big to be able to get enough mass of test articles and enough people into orbit to be able to fundamentally scale up space infrastructure for the public good we know that the business case for space is here governments are investing in space based solar power companies are investing and zero bio biotech and in the next ten years we believe that we will be able to deploy our first module really self assembling space how to up and contribute to a trillion dollar space economy and one of the best things we could do with this infrastructure is

harness it for the profound benefit of life on earth because fundamentally space exploration isn't about escaping earth in nineteen sixty eight bill anders took this iconic photograph now lovingly referred to as earthrise and he famously remarked we came all this way to explore the moon and the most important thing is we discovered the earth bills comment it reminds us that space exploration it's about building an aspiration of future for humanity wherever we are on earth in orbit around earth or beyond access to space is cheap enough now and available enough we need to update our conception of the possible we invest now in space infrastructure if we invest now in space architecture new paradise for how we can build infrastructure and space we can profoundly expand humanities horizons while still protecting the heritage of are priceless planet we don't have to pick one or the other someday we will live on mars someday we will travel outside of the confines of our solar system but until then let's put space to work for earth