Humanity's Little Real Estate

(And how we can get more)

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Humanity currently has a small world to live in. The population is surging, crime rates are growing, and tension is increasing between more and more countries. In today's world, truly kind and humane people are rare. Earth's population is surging past seven billion, and quite soon it will reach and pass eight. While Earth's population will continue to rise, Earth will not grow to meet our needs. On that note, Randall Munroe has investigated what would actually happen if the earth expanded. From his research, we discover that this wouldn't really help. Quite the contrary. So, It's clear that we need somewhere else to live. But where can we go?

Most of the planets in our solar system are downright uninhabitable. Mercury is right next to the sun, scorching whatever is there. Venus, like Mercury, has sky-high temperatures due to its atmosphere, which also pours down highly toxic gases and storms. Mars has some potential, due to its Earth-Like gravity, size, and a similar atmosphere. Mars has been investigated by NASA and other astronomy organizations. NASA even sent two rovers there, and they showed us that we could possibly live there. However, there are massive dust storms, and we would need to bring huge amounts of supplies to get there and terraform the planet beyond recognition to meet our huge needs. The gas giants Jupiter, Saturn, Uranus, and Neptune are not an option by any stretch of the imagination. Pluto, besides being tiny (I, like NASA, am not considering Pluto as a planet), is far too cold and has no atmosphere. Also, it wouldn't give us much more room to live in. We might as well colonize Antarctica for more land. From this, it is clear we need to look outside our solar system. But to where? The solution is closer than you might think.

Proxima Centauri, a star about four light-years away from Earth, was discovered in 2013. It would be a very long journey to get there, but from what we have learned about our closest neighbor, it just might be worth it. Proxima Centauri B, a planet orbiting Proxima Centauri, has been found to have potentially life-supporting environments.

However, that still means it is really, *really* far away. But, at the rate our space technology is increasing, we could conceivably send spacecraft with people there in the next few centuries (Assuming we send people on our first mission there. It would seem like a waste to send a spacecraft there [on the centuries-long journey] without anybody on it, just to see if it would work, then design a new spacecraft and take another few centuries to send that one there to pick up the rubble of the old unmanned mission, which could have very likely destroyed crucial life samples there). So, we need to send a manned mission the first time around, or we might be extinct by the time we can send the manned mission there.

However, it's not as simple as just sending a spacecraft with a few dozen people to Proxima Centauri. We have to think about the people on board. These people have to survive both mentally and physically, which is a huge challenge. Humans have the shortest attention span of just about any creature in the universe. Cell phones were originally created to communicate when you couldn't communicate face to face. However, cell phones have become an entertainment staple for mainly teenagers, even some adults. Whenever we get even just the tiniest bit bored, out comes a cell phone and a video game begins to be played. And that is just how it is these days. We likely don't have that luxury on the spacecraft. A good portion of video games these days have multiplayer, and/or require a connection to the internet to be played. Millions and billions of miles away from earth, we definitely don't have the internet. The tiny portion of video games that don't require the internet would become boring very quickly. We could try more old-fashioned games, such as board or card games, but those would be difficult to play aboard a spaceship. Another issue is they add weight to the spacecraft, making the engineers behind the creation of the spacecraft have to factor in about twenty to seventy pounds of games. Why so many? The idea is to keep them entertained, right? But back to surviving the journey.

Mental health aside, there is also the fact that space itself is very, *very* hard to survive. In the zero-gravity environment, our bones' density drops by 1% a month, our muscles suffer atrophy, and the risk of vision problems increases. In our mission to Proxima Centauri, all of these things are very bad. As for gravity, we could try to make a rotating spacecraft that uses centrifugal force to simulate gravity, but that makes another massive challenge to our already annoyed and stressed engineers. It would also require a lot more fuel and parts, making us heavier and harder to stop if we might hit something. We could use the force of the spaceship going forward really fast, but that would make the engineers equally mad, and it would cost much much more for the fuel. Physical health is an even larger challenge than mental health, possibly giving our astronauts something to think about: their deteriorating health. This all seems very bad, right? How are we going to overcome all these challenges? Well, there is a possible solution: cryogenic freezing. Basically freezing a human for a few years, stopping aging and other bodily processes, making them have almost perfect health when they arrive. Just one more thing to tack onto the list of the things the engineers have to figure out. You might think that entering cryogenic freezing, more commonly known as cryosleep, is incredibly hard. In fact, it really isn't. To enter cryosleep, we just need to cool down the astronauts' internal temperature by nine degrees. Astronauts would be given a sedative to calm them and prevent them from shivering, and they would then enter cryosleep. And that would be that. Getting humans cold enough to do this and keeping them that way would pose a challenge, which nitrogen, well known for its very, *very* cold state when liquid, could easily fix. So, Cryogenic freezing is the best solution to Physical and Mental health. But, it's not as if we can just chart a course to Proxima Centauri B, put everyone to bed, and wait a couple of decades. We have never sent manned spacecraft farther than the moon, and last NASA checked, Proxima Centauri is a *long* way from the moon. So, we need someone to be piloting the ship at all times. But with all the astronauts in cryosleep, that presents a problem. But, there is a simple solution: just have a few astronauts awake at a time. They can pilot the spacecraft for a couple of days or possibly weeks, and then we could just rotate to some new ones. We probably shouldn't have the astronauts awake for too long, or we get the boredom and health deterioration problem. So, a couple of days or weeks should do it.

But what about the spacecraft itself? How does it work? What is its design? How is it propelled? All of these questions are very important. After all, to get to Proxima Centauri B, we need a spacecraft. First, let's address the matter of how we will propel ourselves through space. There are many ways of doing this, conventional methods aside. We could use gravity slingshots, laser ablation, the use of antimatter, nuclear pulse-propulsion, or maybe even solar sailing. This is obviously a very long list of methods, so let's narrow it down to find the best option. Let's begin by describing all the propulsion methods.

Gravitational slingshotting isn't a new idea and actually has already been used. The basic idea is as follows: a spacecraft is moving towards a large body, say a planet or a star, and it will get sucked toward the planet by the planet's gravity. The gravitational force pulling the spacecraft toward the body accelerates the spacecraft. Once the spacecraft is too close to the planet or achieved the desired speed, engines will kick in and the spacecraft will break free from the gravitational pull of the body, with considerable speed.

Laser ablation is a somewhat recent discovery. This sounds like a terrifying thing, and to all extent, it is. Randall Munroe investigates what would happen if we fired laser pointers and eventually actual lasers at the moon, and in the process, he gives a good explanation of laser ablation. But back to laser ablation. The basic principle is this: you fire a powerful laser at a large chunk of matter attached to a spacecraft, and the matter flying off of that hunk accelerates the spacecraft.

Antimatter is weird stuff. When antimatter reacts with matter, they annihilate in a flash of energy to rival a nuclear bomb. This burst of energy would propel spacecraft. "Well this is all well and good," one might say, "but where on earth are you going to get enough matter to fuel the ship to get it to Proxima Centauri?". This is a simple question with a simple answer. You don't need that much antimatter. For example, a forty-five-day journey to mars would only require about ten milligrams of antimatter and an equivalent amount of regular matter. So a journey to Proxima Centauri would only require about forty-four M&Ms of antimatter and an equal amount of matter. A journey to Proxima Centauri using antimatter drives would only take about 189.9 days, or about 6.33 months. Don't believe it? Here's the math. The distance to Mars is 167,650,000 miles away, while the distance to Proxima Centauri is 7,232,934,863 miles, or 4.243 light-years. M=10 milligrams of antimatter.

167,650,000 = 1M

7,232,934,836 divided by 167,650,000 = 43.14M

Now you may think of one problem with the 6.33-month journey: what if we run close to a body with an extremely large mass? Time should warp. Well, this is true. If we run into something large enough to warp time, then time will change for us. It may delay the journey or speed it up, relative to earth. But, if we continue at a constant speed and don't encounter something that will change the time of our journey, then it will take 6.33 months. That being said, antimatter is a very promising method. There is one tiny little flaw: antimatter is very expensive to make. But, with new technology, the cost has plummeted. So, antimatter is a very promising solution to get us to Proxima Centauri.

Solar sailing is as weird as it sounds. Think regular sailing, but instead of wind pushing the sail, light pushes the sail. That is an oversimplified description of solar sailing, but in essence, it's true. That's all there is to say about solar sailing.

With all these new spacecraft propulsion methods, which is the best? Let's start by narrowing down the options. So, let's cut the two that are the hardest to pull off: solar sailing and laser ablation. With that, we are left with antimatter and gravitational slingshotting. Since gravitational slingshotting requires thrust, we land on antimatter being the best option.

Finally, Let's talk about our home base on Proxima Centauri B. For this purpose, I have created a 3D model of what our habitat could look like. You can download it here. (Note: you will need a 3D viewer to see this model). Now, I am going to talk a bit about it. It may help for you to have the model open. The large triangular wedge building is, obviously, the living quarters. There will likely be more beds and rooms, all depending on the amount of people we send there. The building that looks like an aircraft hangar and has long tables in it is the aquaponics building. The long tables are the aquaponics. That is also the food prep area and the mess hall. The blue flat rectangular building is an aircraft hangar. We'll probably take planes with us to Proxima Centauri B to survey the planet we're on. The large red building is the heat and fuel building, where fuel or whatever else flammable we find is burned for heat and energy. The blue pipes are for drilling purposes. And finally, the tall tower serves as an air traffic control tower and just a general control area. So we have our habitat.

And there you have it. We have created a feasible plan to get us to Proxima Centauri. We would use cryosleep to get our astronauts safely there, with just a few awake at a time. We would use antimatter engines to get us to Proxima Centauri B in under 190 days. And we have a well usable habitat. So, humans now have accessible real estate just over four light years away. Granted, it won't be easy to get humans there, but in the long run, it just might be worth it.

Work Cited

"'Cryosleep' May Open The Door To Deep Space. Here'S How". *NBC News*, 2017, https://www.nbcnews.com/mach/tech/cryosleep-may-be-key-deep-space-missions-here-s-how-ncna770961. Accessed 10 Feb 2020.

"NASA - New And Improved Antimatter Spaceship For Mars Missions ". *Nasa.Gov*, 2020, https://www.nasa.gov/exploration/home/antimatter_spaceship.html. Accessed 12 Feb 2020.

"Collisions". Big Think, 2020, https://bigthink.com/technology-innovation/interstellar-travel-to-proxima-centauri?rebelltitem=3#rebelltitem3. Accessed 5 Mar 2020.