More than a hundred thousand people are on a waiting list right now for an organ transplant, and unfortunately that usually a one-to-one process.

You get a organ when somebody else loses an organ.

What if one day you could print your own organ, maybe from your own cells?

Our goal is is that we're going to print a tissue that's more than a centimeter thick.

And you think a centimeter, that's not really that impressive.

Well, that's more than 10 times what we can print on the ground, and we think that microgravity is going to be the key.

This big L is actually the bioprinter, so this is the BFF.

This actually legacy hardware.

This is our ADSEP, or Advanced Space Experiment Processor.

That's where we will put the tissue after it's printed.
Basically, it's the maturation process.

It's what turns a construct into a tissue because we're just putting building blocks down and then can step back and let biology do it biology does.

As smart as we think we are biology will always be smarter.

We're not just bringing back tissue.

We're bringing back tissue that's cardiac tissue and it's going to beat just like a heart.

That is cool as anything.

So what happens if we build the next thing, and the next thing and the next thing eventually yeah, we're going to print a heart.

That's really where we're going.

Biorock is an experiment to study how microbes, bacteria interact with rocks in microgravity and simulated Martian gravity.
And you might think why would we be interested in what microbes do in rocks?

Well microbes on the Earth are used to break down rocks to release economically important elements.

About 60% of the world's copper and gold is today extracted in Biomining.

So the long-term future exploration of the Moon and Mars we might want to use microbes to help us break down rocks to do industry.

That's a very long-term view in the shorter term view microbes break down rocks, turn them into soils.

If we want to transform our lunar and Martian basalt into material that is more useful for agriculture for growing crops rather than having to take things with us we might use bacteria to do that.

And then finally, of course we could use extraterrestrial materials to supply nutrients and life support.
systems.

Why ship nutrients to the moon and Mars with all that mass and energy cost when you can just shovel in some lunar and Martian regolith into your life support system and provide the nutrients from that.

Five to ten percent of fractures will not heal without extra help or intervention by the orthopedic surgeon.

And what they use is a drug called bone morphogenetic protein and this helps to heal the bone.

However, there is a risk of developing cancer with the use of these proteins. So identifying new bone-healing agents is really important and that's what we're testing here.

So you may say well, why do we need to do that in spaceflight?

Why can't we just do it here on Earth?
Animals will walk immediately after you do a bone surgery.

Humans, we don't. We use crutches, we may be bedridden, but in spaceflight the animals can't see that.

Gravity and bone healing is helped when you walk, when you bear weight.

And the drugs that we currently have work through that mechanism the drug we have patented does not, and so we think it will be better for bone healing and spaceflight if we go to Mars and have a fracture or here on Earth for the military personnel, for bad auto accidents and even for people with osteoporosis that have a fracture and it has impaired healing.

This video here is showing the bioculture where the bioreactors will be residing and this has two compartments.

One of them is a warm compartment at 37 degrees that's where the cells will grow and then the second compartment next to it is a cold compartment and that's where all the nutrients.
and the media will be in.

And what happens is that crew member will inject the media at certain time points to feed these cells and then add the fixative at the end.

The cells will come in back to the Earth and on Earth what we're going to do is isolate RNA and DNA and proteins from these cells and do whole genome analysis whole proteome and how metabolome analysis and this will help us understand the whole picture.

We are taking advantage of a groundbreaking discovery that was made almost a decade ago, which is the induced pluripotent stem cell technologies.

So basically what it means is that we are now able to make in a laboratory stem cells starting from a little fill a little drop of blood from any of us or a little tiny piece of skin and we convert these cells into what we call induced pluripotent stem cells.

We use them to generate any cell type that we want.
So in our case that we're studying neurodegenerative diseases, we really want to make the brain cells and study them.

Well have a cell line from a Parkinson's patient and also an age-matched control and these will be making dopaminergic neurons and these are the neurons that are lost in Parkinson's disease.

And we will also have a cell line from a multiple sclerosis patient and these will be made into cortical neurons and microglia will be added to those and also in age-matched control.

So we're interested to see what happens in space.

Can we get more mature maturation of these cells?

Can we make a better model for Parkinson's Disease and multiple sclerosis?

So I think it has a lot of implications for the health of brain cells of astronauts who spend a lot of time in space, and we're also
hoping to learn more about these two diseases

to have new mechanisms and new insights on how we can treat patients.