Science in Orbit—Mary Ellen Weber

Mary Ellen Weber works with a syringe related to the Bioreactor Development System (BDS) aboard STS-70 in July 1995. NASA Image 95-HC-486.

Imagine, as a scientist, having the opportunity to study an environment that literally exists nowhere on Earth, and then imagine actually being one of the test subjects. The human body has evolved over millions of years under the force of gravity. Every system in your body—how your fingernails grow, how you digest food, how you circulate blood—has evolved to use gravity.

The reason your heart is not in the middle of your body, but in the upper part of your body, is because of gravity. We take ourselves as test subjects into space in an environment where there is no gravity, and we get to observe what happens. All the sensors that tell your body how much water you should have are in your neck, and, when all that fluid shifts up to your neck, your body thinks you have too much water. In space, astronauts function with about 30 percent less water than they do here on the ground. That's just one of the amazing changes that takes place in the human body. As an astronaut, you get to see this happen to your body, to see your body struggle with it, and then, in just a matter of days, you get to see your body adapt and live and flourish in this whole new environment.

This was an opportunity that I could not even imagine initially. I could dream about it when I was in college getting a chemical engineering degree and then later getting a doctorate degree in chemistry.

I had a dream to go in space and to be able to experience this and be able to make these kinds of studies and observations. But I only hoped; I didn't think it would actually happen. When it did, back in 1992, it was certainly a dream come true. When I finally had the opportunity to fly in space in 1995 for the first time, it was just the most incredible thing I have ever experienced.

Now most people ask me, they say, "Well, what is your specialty as an astronaut?" Well, the science astronauts, the mission specialist astronauts, don't actually have a specialty. We do our science vicariously through the other principal investigators that work year after year, dedicating themselves to designing experiments, to asking the critical questions that the astronauts can then answer when they're up in space.

One of these experiments that I got to fly with back in 1995 was the bioreactor. This is an incredible experiment and incredible equipment. What it allows you to do is grow not just cells, not just a layer of cells in a petri dish, but to grow human tissue outside the human body. I had the opportunity to fly with the first bioreactor of this new generation in 1995 and watch colon cancer tissue—not cells, but tissue—grow before my eyes.

Charlie Walker discussed the challenges of commercializing technology. Since his firsthand experience, I have been able to work with a venture capital firm which has decided to invest in this technology. There is a market need out there that can compensate for the high cost and the limited access of space, and we believe we have a winner here.

It is just an amazing opportunity, as an astronaut, to be a part of both flying the experiments in space and of helping commercial companies identify the opportunities that space brings. This company is trying to make a liver-assist device. Right now if you have liver failure, you have two choices: you either get a transplant or you die. There is nothing else out there right now. But with the bioreactor that can grow tissues that function like the tissues in our body, we believe we can make a device that can save millions of lives. At the

heart of it, one of the key elements of that is space.

Another feature of space is that it is a very quiescent environment, which allows us to obtain structures of proteins and design new drugs. This is not a pipedream. This is something that is happening and has been going on for a decade. There's a new flu medication coming out that is targeted to a very specific flu enzyme that keeps any flu virus from attacking your body, and, because we know the protein structure, we're able to design this drug with very limited side effects.

This is what is possible when you have a whole new environment. These are the possibilities of science and space. We have just begun to tap into this with weeklong flights or two-week flights, and we are only beginning to chip away at some of these questions. With the Space Station now, 365 days out of the year we have an opportunity to enter into a whole new era of space science—not just understanding space, but seeing how human bodies, proteins, and tissues react and grow in space.

I am so proud to be a part of this space program, so proud to be a part of something bigger than all of us. For thousands of years, people looked up at the sky and tried to imagine what was out there, what were those points of light? They made up stories about astrological figures. They just couldn't imagine it all. We are so fortunate in these past forty years to be alive at the time when we are just beginning to get the answers. It's not only amazing to be an astronaut, it's an amazing time to be alive. With the sacrifices and the commitments of so many people in this country, we will indeed propel our civilization into this next era of space exploration.