



SILICON VALLEY

P O D C A S T

1
00:00:00,000 --> 00:00:02,380
Gary Jordan: Houston, We Have a Podcast.

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00:00:02,380 --> 00:00:07,300
Welcome to the official podcast of the NASA
Johnson Space Center, episode 20, Special Delivery

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00:00:07,300 --> 00:00:11,700
I'm Gary Jordan, and I'll be your cohost today,
along with Matt Buffington, director of public

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00:00:11,700 --> 00:00:16,240
affairs at NASA's Ames Research Center in
California, and the host of NASA in Silicon

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00:00:16,240 --> 00:00:17,140
Valley Podcast.

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00:00:17,140 --> 00:00:17,680
Matt, what's up?

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00:00:17,680 --> 00:00:20,591
Matthew Buffington: Hey Gary, we're doing
great, so glad we could team up on this.

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00:00:20,591 --> 00:00:27,250
This is also concurrently episode 69 for the
NASA in Silicon Valley Podcast.

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00:00:27,250 --> 00:00:30,730
There's a ton of overlap between our listeners,
so I'm really glad we were able to make this

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00:00:30,730 --> 00:00:31,730
happen.

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00:00:31,730 --> 00:00:32,730
Gary Jordan: Yeah, me too.

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00:00:32,730 --> 00:00:36,750
Today is a very special episode, because we're teaming up with NASA in Silicon Valley Podcast

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00:00:36,750 --> 00:00:40,809
to talk about some of the things we can find in a cargo vehicle when it's shipped to space,

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00:00:40,809 --> 00:00:45,200
which is perfect because SpaceX will be sending its Dragon Cargo Vehicle to the International

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00:00:45,200 --> 00:00:46,510
Space Station here soon.

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00:00:46,510 --> 00:00:48,120
So, who do we have from Ames, Matt?

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00:00:48,120 --> 00:00:51,460
Matthew Buffington: Over here we're bringing in Dennis Leveson-Gower.

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00:00:51,460 --> 00:00:57,030
He's a project scientist here over at Ames, and has tons of experience working on cargo,

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00:00:57,030 --> 00:01:00,680
working on payloads, and sending them on up to the space station.

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00:01:00,680 --> 00:01:01,770
How about over there in Houston?

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00:01:01,770 --> 00:01:03,590
Gary Jordan: We'll have Shane Kimbrough.

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00:01:03,590 --> 00:01:07,459
He's a NASA astronaut who recently spent about six months on the space station and landed

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00:01:07,459 --> 00:01:08,479
earlier this year.

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00:01:08,479 --> 00:01:12,179
We've actually had him on the podcast to talk
about his landing experience back in episode

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00:01:12,179 --> 00:01:13,179
three.

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00:01:13,179 --> 00:01:19,039
But while he was up there, he had quite a
few cargo vehicles visit the station.

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00:01:19,039 --> 00:01:23,619
He had the SpaceX Dragon, Orbital ATK Cygnus,
Japanese HTV, and the Russian Progress all

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00:01:23,619 --> 00:01:25,840
within his six-month stay aboard the station.

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00:01:25,840 --> 00:01:29,679
So, it's fair to say he knows what cargo on
station is all about.

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00:01:29,679 --> 00:01:32,679
He performed hundreds of experiments with
the science that was delivered on some of

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00:01:32,679 --> 00:01:36,459
those vehicles, and even got some fresh food,
so I'm excited to ask him about that experience.

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00:01:36,459 --> 00:01:37,740
Matthew Buffington: Awesome.

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00:01:37,740 --> 00:01:42,340
I'm really excited to get the different perspective

on both the science, on the space station,

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00:01:42,340 --> 00:01:45,939

so we can see the astronaut's point of view,
and the people who actually design those experiments.

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00:01:45,939 --> 00:01:48,380

Gary Jordan: Yeah, this is going to be a good
episode.

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00:01:48,380 --> 00:01:51,749

So, with no further delay, let's go light
speed and jump right ahead to our talk with

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00:01:51,820 --> 00:01:55,660

Shane Kimbrough and Dennis Leveson-Gower. Enjoy.

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00:02:07,120 --> 00:02:10,400

Okay, all right, it looks like we're all connected,
ready to go.

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00:02:10,400 --> 00:02:13,140

How about this, Houston We Have a Podcast
and NASA Silicon Valley combined?

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00:02:13,140 --> 00:02:14,720

Matthew Buffington: Yeah, this is going to
be sweet.

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00:02:14,720 --> 00:02:16,200

Gary Jordan: Sweet, I know, I'm pumped.

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00:02:16,200 --> 00:02:19,840

And we're doing this remotely, so here in
Houston, I'm in the studio with NASA astronaut

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00:02:19,840 --> 00:02:22,290

and no stranger to Houston We Have a Podcast,
Shane Kimbrough.

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00:02:22,290 --> 00:02:23,290

Shane, thanks for being here.

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00:02:23,290 --> 00:02:24,290

Shane Kimbrough: Hey, great to be here.

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00:02:24,290 --> 00:02:27,340

Gary Jordan: Cool, and how about over at Ames,
Matt, who do you have?

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00:02:27,340 --> 00:02:31,459

Matthew Buffington: I'm sitting over here
with my buddy Dennis Leveson-Gower.

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00:02:31,459 --> 00:02:35,239

We actually go way back from SpaceX 8, was
it Dennis?

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00:02:35,239 --> 00:02:36,780

Dennis Leveson-Gower: That's right.

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00:02:36,780 --> 00:02:40,379

Matthew Buffington: I always remember it because
it was the first time SpaceX had launched

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00:02:40,379 --> 00:02:42,980

a rocket and landed it on a barge.

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00:02:42,980 --> 00:02:48,220

And Dennis was nice enough as I drove him
back and forth from his office to do press

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00:02:48,220 --> 00:02:49,459

interviews and stuff.

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00:02:49,459 --> 00:02:50,900

Gary Jordan: Nice enough indeed.

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00:02:50,900 --> 00:02:52,120

Matthew Buffington: Exactly.

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00:02:52,120 --> 00:02:56,720

I always like to start our podcast with the question of, how did you

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00:02:56,720 --> 00:03:00,219

get to NASA, how did you end up in Silicon Valley.

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00:03:00,219 --> 00:03:03,640

I definitely want to hear about that from Shane as well, but let's start off with Dennis.

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00:03:03,640 --> 00:03:05,859

So tell us about, how did you end up at NASA?

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00:03:05,859 --> 00:03:09,530

Dennis Leveson-Gower: I really ended up here by accident.

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00:03:09,530 --> 00:03:16,390

I was set to be a professor, discover things, have graduate students.

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00:03:16,390 --> 00:03:19,390

I did a Ph.D. in biochemistry.

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00:03:19,390 --> 00:03:24,959

Then I went to Stanford for a post-doctoral fellow doing bone marrow transplantation,

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00:03:24,959 --> 00:03:27,430

graft vs. host disease, immunology.

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00:03:27,430 --> 00:03:30,650

And slowly over the years, I thought, I'm going to go to industry.

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00:03:30,650 --> 00:03:33,530
I'm not going to do the academic track anymore.

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00:03:33,530 --> 00:03:35,830
It was a slow evolution.

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00:03:35,830 --> 00:03:41,040
So I was out there, had my resume posted on
job sites and stuff, looking around.

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00:03:41,040 --> 00:03:47,530
Just got an email saying, are you interested
in a position at NASA Ames?

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00:03:47,530 --> 00:03:49,520
And I'm like, this is spam.

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00:03:49,520 --> 00:03:52,889
I don't know anything about rockets, I'm not
an engineer.

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00:03:52,889 --> 00:03:55,249
I'm a biologist.

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00:03:55,249 --> 00:03:57,540
So, talked to my wife.

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00:03:57,540 --> 00:04:01,049
She's like, you have to apply, it's NASA.

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00:04:01,049 --> 00:04:05,529
So I thought, all right, at least I can go
and see the base and look around, because

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00:04:05,529 --> 00:04:10,109
I saw it on the side of the highway, so I
knew there was some NASA thing here.

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00:04:10,109 --> 00:04:14,469

And yeah, it was when I talked to the hiring manager, she really convinced me this was

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00:04:14,469 --> 00:04:16,299

a really cool opportunity.

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00:04:16,299 --> 00:04:22,590

Got me into a different head space of not just doing basic research, but doing applied

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00:04:22,590 --> 00:04:29,919

research, and working with a whole different cadre of engineers and operations and safety.

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00:04:29,919 --> 00:04:34,930

And I don't know, it just really appealed to me, so I took a chance and took the job.

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00:04:34,930 --> 00:04:36,289

Matthew Buffington: That's pretty awesome.

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00:04:36,289 --> 00:04:41,240

I always say, when people think of NASA, they think of rockets and telescopes.

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00:04:41,240 --> 00:04:43,390

Biology is a huge part of that.

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00:04:43,390 --> 00:04:46,729

Speaking of biology, sometimes we have humans up in space.

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00:04:46,729 --> 00:04:49,530

Gary Jordan: Excellent segue.

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00:04:49,530 --> 00:04:53,039

All right, Shane, how about you?

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00:04:53,039 --> 00:04:54,810

How did you become an astronaut?

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00:04:54,810 --> 00:04:59,160

Shane Kimbrough: I came -- there's several obviously avenues to be an astronaut.

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00:04:59,160 --> 00:05:00,250

I came through the military.

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00:05:00,250 --> 00:05:05,220

I was an Army officer, Apache pilot my whole Army career.

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00:05:05,220 --> 00:05:10,080

I took a little detour toward the end of I would say my conventional Army career when

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00:05:10,080 --> 00:05:15,610

I went to graduate school at Georgia Tech, and then I went to teach math at West Point

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00:05:15,610 --> 00:05:16,940

for a few years.

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00:05:16,940 --> 00:05:20,680

And then from there, I was called to come work down at Johnson Space Center for a few

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00:05:20,680 --> 00:05:21,680

years.

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00:05:21,680 --> 00:05:24,860

I had applied to be an astronaut that year, didn't get selected.

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00:05:24,860 --> 00:05:29,389

But the good news was, I was I guess somewhat in the highly qualified category, so the Army

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00:05:29,389 --> 00:05:33,620
detachment down here asked me to come down
here and work for a few years.

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00:05:33,620 --> 00:05:36,810
And that was to really get ready for the 2002
astronaut selection.

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00:05:36,810 --> 00:05:39,590
Guess what, that selection never happened.

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00:05:39,590 --> 00:05:46,980
So, we went through the whole thing, interviews
and everything, and it never happened.

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00:05:46,980 --> 00:05:49,930
Congress decided they didn't need a class
that year.

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00:05:49,930 --> 00:05:54,400
So, we hung around for another couple years,
which in a way was somewhat rolling the dice

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00:05:54,400 --> 00:05:56,060
on my Army career.

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00:05:56,060 --> 00:06:01,669
But my wife and I felt it was where we wanted
to be and what we wanted to do, so stuck around,

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00:06:01,669 --> 00:06:04,030
and was lucky enough to get selected in 2004.

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00:06:04,030 --> 00:06:05,850
Gary Jordan: Lucky and persistent enough.

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00:06:05,850 --> 00:06:08,060
Shane Kimbrough: Yeah, persistence is a big
trait, I think.

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00:06:08,060 --> 00:06:09,990

It was my fourth time to apply.

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00:06:09,990 --> 00:06:13,060

Matthew Buffington: I was going to say, isn't that normal for astronauts?

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00:06:13,060 --> 00:06:17,010

Because we had Steve Smith a while back on our podcast, and I think he had applied three

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00:06:17,010 --> 00:06:18,010

or four times as well.

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00:06:18,010 --> 00:06:21,349

Shane Kimbrough: Yeah, I think at least it used to be the norm.

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00:06:21,349 --> 00:06:25,729

A lot of times these days, at least in the last couple classes, we've had a lot of first-timers.

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00:06:25,729 --> 00:06:32,069

But yeah, for folks a little older like myself, I think three or four times is pretty normal.

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00:06:32,069 --> 00:06:37,320

Gary Jordan: I remember talking with the 2017 class, and a couple of them applied multiple

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00:06:37,320 --> 00:06:38,320

times.

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00:06:38,320 --> 00:06:40,780

I know for sure Raja Chari did, but you're right, a couple of them are first-timers.

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00:06:40,780 --> 00:06:44,620

But then you've got folks like Clay Anderson,
who applied like, what, eight or nine times

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00:06:44,620 --> 00:06:45,620
or something?

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00:06:45,620 --> 00:06:46,620
So yeah, right.

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00:06:46,620 --> 00:06:47,620
Shane Kimbrough: Persistence.

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00:06:47,620 --> 00:06:50,830
Gary Jordan: Exactly, persistence, and it
works out too.

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00:06:50,830 --> 00:06:55,509
This is perfect, to combine forces for the
podcast today -- Houston We Have a Podcast

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00:06:55,509 --> 00:07:01,699
and NASA in Silicon Valley -- because today's
topic is cargo, and cargo going to the International

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00:07:01,699 --> 00:07:02,930
Space Station.

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00:07:02,930 --> 00:07:06,060
And Shane, I feel like you're the perfect
person to have on the podcast today, because

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00:07:06,060 --> 00:07:08,970
you've seen your fair share of cargo vehicles
on your last mission, right?

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00:07:08,970 --> 00:07:13,419
Shane Kimbrough: Yeah, we saw everything,
and we saw Cygnus twice.

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00:07:13,419 --> 00:07:15,659

We had a lot of vehicles coming and going.

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00:07:15,659 --> 00:07:21,139

And really cargo, when you think about it, it's the way we handle the logistics problem

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00:07:21,139 --> 00:07:22,629

on the space station.

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00:07:22,629 --> 00:07:27,319

It's a big logistics problem, if you think about it, to get equipment and clothes and

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00:07:27,319 --> 00:07:31,290

food and experiments to that orbiting laboratory.

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00:07:31,290 --> 00:07:32,460

So, how do we do that?

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00:07:32,460 --> 00:07:33,889

We used to do it with the space shuttle.

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00:07:33,889 --> 00:07:36,720

It was nice and easy, it could haul a bunch of stuff.

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00:07:36,720 --> 00:07:39,949

Now, we can't do that, so we have these cargo vehicles you're talking about.

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00:07:39,949 --> 00:07:43,810

Gary Jordan: That's right, because on your way to the space station, you can bring stuff,

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00:07:43,810 --> 00:07:46,099

but now you need stuff delivered.

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00:07:46,099 --> 00:07:48,280

It's a huge complex.

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00:07:48,280 --> 00:07:52,940

It's the size of a five-bedroom house, it needs stuff -- food, supplies, all that kind

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00:07:52,940 --> 00:07:53,940

of things.

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00:07:53,940 --> 00:07:56,150

Matthew Buffington: That's one of the funny things as we were coming in, especially as

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00:07:56,150 --> 00:08:00,860

we're getting closer for the SpaceX 13 launch coming into it.

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00:08:00,860 --> 00:08:05,849

We see there's the both sides -- there's the people up at the space station working on

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00:08:05,849 --> 00:08:10,520

receiving the cargo or even science experiments, but also on the flipside of, how do you get

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00:08:10,520 --> 00:08:11,520

that stuff prepared?

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00:08:11,520 --> 00:08:12,879

That is a feat in and of itself.

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00:08:12,879 --> 00:08:14,210

Gary Jordan: That's true.

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00:08:14,210 --> 00:08:19,860

So Dennis, what do you have to do to prepare stuff to go on cargo missions?

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00:08:19,860 --> 00:08:25,400

Dennis Leveson-Gower: That's a big question, because I mean, it really starts one to two

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00:08:25,400 --> 00:08:31,610

years ahead of the launch, if you think about it, or more, because after you have an experiment

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00:08:31,610 --> 00:08:37,190

defined, you've got to prepare exactly what the science requirements are, then you've

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00:08:37,190 --> 00:08:40,900

got to start making a plan, then you've got to start assessing what the hardware needs

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00:08:40,900 --> 00:08:45,420

are, and the kits' needs are, then you have to design those, then they have to get through

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00:08:45,420 --> 00:08:49,730

safety, you have to plan operations, you have to plan how everything's going to be labelled.

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00:08:49,730 --> 00:08:54,960

And then, usually I think somewhere between three and six months before a launch is when

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00:08:54,960 --> 00:09:02,950

we're going to actually have things prepared, off-gassed, tested, H-fit, label committee,

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00:09:02,950 --> 00:09:06,590

all those things, and do the early load.

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00:09:06,590 --> 00:09:11,930

And then we start preparing the late load chemicals and perishables that have to be

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00:09:11,930 --> 00:09:13,610

loaded 25 hours before launch.

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00:09:13,610 --> 00:09:18,090

And we do that out at Kennedy Space Center for SpaceX launch, anyways.

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00:09:18,090 --> 00:09:24,140

So, there's a whole experiment development cycle that happens, and that's just for one

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00:09:24,140 --> 00:09:25,140

payload.

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00:09:25,140 --> 00:09:30,210

And if we have five or six payloads from Ames coming out, that's a lot of work from a lot

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00:09:30,210 --> 00:09:33,000

of people to send a box of something.

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00:09:33,000 --> 00:09:37,460

Matthew Buffington: It takes a village for it, gathering all that stuff up.

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00:09:37,460 --> 00:09:43,200

But I'm always curious on your guys' side, Shane, for you guys, when you receive this

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00:09:43,200 --> 00:09:47,180

cargo, how exactly does that happen, or how does that work?

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00:09:47,180 --> 00:09:50,840

Like, you're unpacking a trunk from a trip?

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00:09:50,840 --> 00:09:55,580

Shane Kimbrough: No, we're always excited to open up the hatch and get new stuff.

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00:09:55,580 --> 00:09:58,840

It's kind of like Christmas every time we get one of these vehicles up there.

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00:09:58,840 --> 00:10:04,800

But the way we go about unpacking is very organized, and it has to be that way.

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00:10:04,800 --> 00:10:08,960

We have a great team on the ground that gets us ready and prepared with all kind of documents,

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00:10:08,960 --> 00:10:13,800

and keeps us organized with charts and things on how they want it to be unpacked.

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00:10:13,800 --> 00:10:16,140

And so, we follow that religiously.

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00:10:16,140 --> 00:10:19,970

We'll have somebody in the crew is going to be called the loadmaster, and that person's

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00:10:19,970 --> 00:10:22,330

responsible for that vehicle.

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00:10:22,330 --> 00:10:26,141

If we just start pulling things out and stowing things where we want to stow them, that's

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00:10:26,141 --> 00:10:29,320

not the way it's going to be, because we'll never find that stuff.

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00:10:29,320 --> 00:10:33,170

We really have to be disciplined, and put things where they're supposed to go.

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00:10:33,170 --> 00:10:37,250

A lot of times, that means we'll take one bag out, and the bag will have 100 different

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00:10:37,250 --> 00:10:38,250

items in it.

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00:10:38,250 --> 00:10:40,160

And we have to go put those 100 things somewhere.

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00:10:40,160 --> 00:10:43,260

So, it's not as easy as pulling a bag out and stuffing it somewhere.

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00:10:43,260 --> 00:10:45,080

Sometimes it is, but most of the time it's not.

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00:10:45,080 --> 00:10:49,690

So, we've really got to make sure we're all helping each other out.

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00:10:49,690 --> 00:10:54,510

And it's always better to, as I've found with all these cargo ops, to do it as a team versus

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00:10:54,510 --> 00:10:56,670

doing it individually.

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00:10:56,670 --> 00:11:00,780

You're much more efficient, and you can have one person reading the book, keeping control

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00:11:00,780 --> 00:11:03,880

of everything, and the other couple people running things around.

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00:11:03,880 --> 00:11:06,170

And that really worked well for us.

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00:11:06,170 --> 00:11:10,580

Gary Jordan: So, everything has an order and

a destination, right?

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00:11:10,580 --> 00:11:16,100

You've got to unload this first, and put it in this location, and it's all scheduled that

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00:11:16,100 --> 00:11:17,100

way.

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00:11:17,100 --> 00:11:18,990

How long does it take you to unload completely?

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00:11:18,990 --> 00:11:23,820

Shane Kimbrough: I think we actually set some records for unloading vehicles the quickest,

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00:11:23,820 --> 00:11:25,070

which is a good thing I guess.

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00:11:25,070 --> 00:11:29,610

But, we really -- and we did it by working together as a team.

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00:11:29,610 --> 00:11:30,610

And that's the only way.

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00:11:30,610 --> 00:11:33,441

Thomas [Pesquet] and Peggy [Whitson] and I would knock out a vehicle, no kidding, in

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00:11:33,441 --> 00:11:35,300

a day and a half or two.

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00:11:35,300 --> 00:11:36,560

But, that's pretty unusual.

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00:11:36,560 --> 00:11:40,900

That was kind of if it happened to show up just before a weekend, we used the weekend

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00:11:40,900 --> 00:11:44,080

to do it, so it was a freebie.

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00:11:44,080 --> 00:11:47,270

Where if they had it just playing out during a normal week, it would take a week to two

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00:11:47,270 --> 00:11:49,050

weeks sometimes depending on the vehicle to get it unloaded.

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00:11:49,050 --> 00:11:51,080

Gary Jordan: That's right, because you've got to fit it with everything else you're

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00:11:51,080 --> 00:11:52,080

doing.

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00:11:52,080 --> 00:11:53,080

Wow, amazing.

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00:11:53,080 --> 00:11:57,850

Matthew Buffington: Yeah, and a lot of that, I'd imagine it's already complicated enough,

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00:11:57,850 --> 00:12:02,090

and I'm sure it's crazy complicated even just within NASA, but then you start throwing in

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00:12:02,090 --> 00:12:04,320

all these private companies and different groups.

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00:12:04,320 --> 00:12:07,720

Is everybody, how do you keep -- maybe you guys could talk about, how do you keep everybody

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00:12:07,720 --> 00:12:10,210

on the same page on how things get prepared.

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00:12:10,210 --> 00:12:13,040

Because Dennis, you're preparing this stuff for these companies, but then . . .

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00:12:13,040 --> 00:12:18,020

Dennis Leveson-Gower: I think they all go through NASA.

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00:12:18,020 --> 00:12:24,820

You'll have private hardware developers, but the manifest is controlled through NASA, and

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00:12:24,820 --> 00:12:28,050

the crew procedures are controlled through NASA.

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00:12:28,050 --> 00:12:33,950

Shane, correct me if I'm wrong, but at some certain point has to be layered into the controlled

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00:12:33,950 --> 00:12:39,010

process of NASA, even if it's like -- so, you could think of it as NASA buying things

224

00:12:39,010 --> 00:12:43,980

from different vendors, but they'll manage how it goes up, or they'll manage it through

225

00:12:43,980 --> 00:12:46,380

SpaceX how it goes up.

226

00:12:46,380 --> 00:12:47,910

Shane Kimbrough: Totally agree.

227

00:12:47,910 --> 00:12:51,890

We saw differences, of course, because the vehicles are all different inside, so the

228

00:12:51,890 --> 00:12:57,750

way they, location coding is all different,
and where things might be on one is different

229

00:12:57,750 --> 00:12:59,170

than another.

230

00:12:59,170 --> 00:13:02,430

That's the only difference, but bottom line
is, you're going to get a bag, you're going

231

00:13:02,430 --> 00:13:06,040

to take it somewhere, you're going to take
it apart, and take those things somewhere.

232

00:13:06,040 --> 00:13:09,370

And if we keep it pretty simple like that,
it made it easier on the crew.

233

00:13:09,370 --> 00:13:10,370

Gary Jordan: Definitely.

234

00:13:10,370 --> 00:13:11,950

You're the pro mover when it comes to cargo
missions.

235

00:13:11,950 --> 00:13:15,110

Shane Kimbrough: I'm going to get a reputation
here.

236

00:13:15,110 --> 00:13:21,040

Gary Jordan: So what are some of the main
differences, then, in terms of, Dennis, on

237

00:13:21,040 --> 00:13:25,480

your end, for qualifications, and we can start
with that -- what's the difference to get

238

00:13:25,480 --> 00:13:26,660

it on that vehicle?

239

00:13:26,660 --> 00:13:31,720

But then Shane, for unpacking it, some of those little tiny things?

240

00:13:31,720 --> 00:13:35,080

Dennis Leveson-Gower: The biggest thing for us is always safety.

241

00:13:35,080 --> 00:13:40,690

We go to great lengths to try to have chemicals that will not interfere with the life support

242

00:13:40,690 --> 00:13:45,550

system, that won't be toxic to the crew if they're spilled.

243

00:13:45,550 --> 00:13:50,330

Everything that has a tox level will have certain levels of containers and containment

244

00:13:50,330 --> 00:13:54,350

that have to be layered onto how it's packaged and how it's stored.

245

00:13:54,350 --> 00:13:56,570

Then, we have human factors.

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00:13:56,570 --> 00:14:02,790

We have to make sure that the 5 percent Japanese female and the 5 percent American male can

247

00:14:02,790 --> 00:14:06,920

handle the things.

248

00:14:06,920 --> 00:14:12,170

And then, even right before it's loaded, there's an expert that comes in with gloves on and

249

00:14:12,170 --> 00:14:16,180

feels everything, to make sure there's no sharp edges on anything, and that it's not

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00:14:16,180 --> 00:14:20,010

going to hurt anybody when they start pulling them out of the packages.

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00:14:20,010 --> 00:14:21,590

That's what I've seen on my end, big picture.

252

00:14:21,590 --> 00:14:26,600

Shane Kimbrough: I'd say from our end, it's very similar, like I mentioned before.

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00:14:26,600 --> 00:14:28,330

But there are some things.

254

00:14:28,330 --> 00:14:31,830

Every vehicle that gets there, there's some critical items that need to come off first.

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00:14:31,830 --> 00:14:35,180

And we're well aware of what those are, based on the ground team prepping us for that.

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00:14:35,180 --> 00:14:40,760

And most of the time, those are delicate experiments or things like that that have to come off,

257

00:14:40,760 --> 00:14:42,860

or are time-sensitive.

258

00:14:42,860 --> 00:14:47,010

We'll obviously hit those first, and then after that we'll follow the script that the

259

00:14:47,010 --> 00:14:50,380

ground lays out for us, so that we're all

on the same sheet of music, and everybody

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00:14:50,380 --> 00:14:52,450

knows what's going on.

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00:14:52,450 --> 00:14:56,000

Even if we're doing it in our spare time,
where the ground control team might not be

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00:14:56,000 --> 00:15:01,490

following, we can update them with, hey, we
did sections two, three, and four, whatever

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00:15:01,490 --> 00:15:05,390

it was, and they'll be caught back up with
us when they get back on console.

264

00:15:05,390 --> 00:15:08,420

Gary Jordan: Yeah, like if you're doing it
on a weekend or something.

265

00:15:08,420 --> 00:15:09,420

Sweet.

266

00:15:09,420 --> 00:15:13,810

So, what's an example of time-critical, since
you unpacked so many vehicles, what's an example

267

00:15:13,810 --> 00:15:15,660

of a time-critical experiment you had to unpack?

268

00:15:15,660 --> 00:15:19,130

Shane Kimbrough: We had some rodents onboard,
so that was one thing we had to get off.

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00:15:19,130 --> 00:15:22,200

Those are always time-critical, just to get
them setup in their habitations on the space

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00:15:22,200 --> 00:15:23,640
station.

271
00:15:23,640 --> 00:15:24,640
That's one.

272
00:15:24,640 --> 00:15:29,230
I think some that just showed up today actually
on the space station were things like pizza

273
00:15:29,230 --> 00:15:32,000
and ice cream.

274
00:15:32,000 --> 00:15:36,910
If you get things like that, those are time-critical,
because you need to eat those quickly.

275
00:15:36,910 --> 00:15:40,580
Anyway, there's plenty of different, a wide
range there I gave you from rodents to ice

276
00:15:40,580 --> 00:15:41,580
cream.

277
00:15:41,580 --> 00:15:44,870
Matthew Buffington: And I have to chime in
on that, because this isn't just the sad,

278
00:15:44,870 --> 00:15:46,980
dehydrated stuff you buy at the museum.

279
00:15:46,980 --> 00:15:48,590
This is a legit pizza.

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00:15:48,590 --> 00:15:50,390
Shane Kimbrough: This is the real deal, apparently.

281
00:15:50,390 --> 00:15:54,190
It's the first time I've heard of a pizza

delivery going to the space station, so whatever

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00:15:54,190 --> 00:15:55,500

company got that is going . . .

283

00:15:55,500 --> 00:15:57,080

Matthew Buffington: 30 minutes or less.

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00:15:57,080 --> 00:16:00,140

Dennis Leveson-Gower: It's not going to be the best pizza, but it'll probably taste good

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00:16:00,140 --> 00:16:01,140

to you guys.

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00:16:01,140 --> 00:16:03,070

Shane Kimbrough: Ice cream's legit, though.

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00:16:03,070 --> 00:16:07,220

Of course, we didn't have any when I was there, but shortly after I left, they got some, and

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00:16:07,220 --> 00:16:08,220

they're getting some today.

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00:16:08,220 --> 00:16:10,200

Gary Jordan: They waited until right after you left?

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00:16:10,200 --> 00:16:11,200

Oh, man.

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00:16:11,200 --> 00:16:12,200

Shane Kimbrough: Apparently so.

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00:16:12,200 --> 00:16:18,330

Dennis Leveson-Gower: After SpaceX 8 launched, all the guys on the ground at KSC had all

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00:16:18,330 --> 00:16:19,940

these Klondike bars filling the freezer.

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00:16:19,940 --> 00:16:21,370

And I'm like, where did these come from?

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00:16:21,370 --> 00:16:26,930

And they go, the CMC team, the cargo team, when they were packing all the cold stowage,

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00:16:26,930 --> 00:16:32,580

if there's any empty areas in the freezers, they start stuffing ice cream bars in there,

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00:16:32,580 --> 00:16:33,920

as a surprise for the crew.

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00:16:33,920 --> 00:16:37,890

So, we have extra boxes of Klondike bars.

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00:16:37,890 --> 00:16:42,240

Shane Kimbrough: Always a welcome treat.

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00:16:42,240 --> 00:16:46,290

Matthew Buffington: But, when you're unpacking during this, are you in constant contact with

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00:16:46,290 --> 00:16:50,390

the ground, and they're walking you through it, or it's just a mix of sometimes you are,

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00:16:50,390 --> 00:16:54,960

sometimes you guys get your to-do list and you make it happen and update them later on?

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00:16:54,960 --> 00:16:58,571

Shane Kimbrough: Yeah, we have a couple meetings beforehand, of course, before the vehicle

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00:16:58,571 --> 00:17:02,820

gets there, and there's a whole choreography they want us to do, and the order they want

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00:17:02,820 --> 00:17:03,820

us to do it in.

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00:17:03,820 --> 00:17:08,760

And so, we're disciplined and follow that to the T. A lot of times we'd have questions,

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00:17:08,760 --> 00:17:12,600

or something wouldn't be where it was supposed to be, and that's where we'd call down real

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00:17:12,600 --> 00:17:17,430

quickly and touch base with whoever was on console for that, so that we weren't getting

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00:17:17,430 --> 00:17:20,880

out of their choreography, even if something wasn't there.

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00:17:20,880 --> 00:17:23,260

But they were always there if we needed them.

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00:17:23,260 --> 00:17:28,960

Usually, we would just tag up at the end of a day, end of a cargo day, and make sure to

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00:17:28,960 --> 00:17:32,590

tell them exactly what we did so they were up to speed on everything.

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00:17:32,590 --> 00:17:35,399

Gary Jordan: I don't know if you got any Klondike bars.

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00:17:35,399 --> 00:17:38,490

Was there any missions that gave you some nice treats?

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00:17:38,490 --> 00:17:43,379

Shane Kimbrough: I think almost every vehicle had care packages from our families onboard.

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00:17:43,379 --> 00:17:46,340

Those are always a surprise, so that was kind of cool.

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00:17:46,340 --> 00:17:51,470

We didn't get any ice cream, but we got a lot of fresh fruit, and that was kind of cool.

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00:17:51,470 --> 00:17:55,149

That's another thing I think they hold onto, and if there's any extra space they'll cram

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00:17:55,149 --> 00:17:56,179

them in there.

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00:17:56,179 --> 00:18:00,800

But, some apples and oranges and things like that were really delicious after not having

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00:18:00,800 --> 00:18:01,800

them for quite a while.

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00:18:01,800 --> 00:18:06,460

Gary Jordan: I was going to say, definitely a treat compared to -- it's fresh, it's literally

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00:18:06,460 --> 00:18:07,460

fresh.

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00:18:07,460 --> 00:18:09,040

Shane Kimbrough: We ate those really quickly.

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00:18:09,040 --> 00:18:11,930

Gary Jordan: You kind of have to.

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00:18:11,930 --> 00:18:14,779

Shane Kimbrough: Yeah, don't want them to go bad.

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00:18:14,779 --> 00:18:19,019

Matthew Buffington: I'm wondering, if you get into the coordination that's needed, and

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00:18:19,019 --> 00:18:24,830

even thinking on the side when, we have researchers, scientists who are creating science experiments,

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00:18:24,830 --> 00:18:28,290

it's hard enough doing it in a lab on your own.

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00:18:28,290 --> 00:18:33,559

And so, when people are -- I'm wondering, Dennis, from your perspective as people design

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00:18:33,559 --> 00:18:39,759

and put these experiments together, but then Dennis -- or, Shane, on your side, actually

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00:18:39,759 --> 00:18:41,450

conducting these things.

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00:18:41,450 --> 00:18:47,360

Talk a little about that, what goes into making an experiment for someone else to do, and

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00:18:47,360 --> 00:18:49,620

your instructions on how to do it?

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00:18:49,620 --> 00:18:52,149

It seems very complicated.

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00:18:52,149 --> 00:18:55,620

I'm looking at you, Dennis.

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00:18:55,620 --> 00:19:01,679

Dennis Leveson-Gower: Okay, what I'll receive is basically a grant proposal that had a very

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00:19:01,679 --> 00:19:06,000

high science score from a panel of reviewers.

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00:19:06,000 --> 00:19:10,779

And then I'll start looking at it and saying, can we actually do this in space?

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00:19:10,779 --> 00:19:13,190

Because, crew time is very precious.

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00:19:13,190 --> 00:19:16,330

You cannot do things as quickly in space as you can on the ground.

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00:19:16,330 --> 00:19:21,440

We add a 1.4 margin of how long it would take us on earth, at a minimum.

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00:19:21,440 --> 00:19:25,950

It's all got to be done in a self-contained glove box volume.

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00:19:25,950 --> 00:19:33,570

And, I start working to make little tweaks and adjustments -- like I said, can we replace

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00:19:33,570 --> 00:19:36,380

this chemical with a nontoxic one?

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00:19:36,380 --> 00:19:38,620

Can we simplify this procedure?

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00:19:38,620 --> 00:19:40,320

What's the tolerance of the timeline?

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00:19:40,320 --> 00:19:46,110

Because, if they have to do an EVA, we can't have a time-critical part of our experiment

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00:19:46,110 --> 00:19:48,080

at the same time they've got to be outside the station.

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00:19:48,080 --> 00:19:53,909

So, we start looking at every single factor, and it takes month to organize that.

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00:19:53,909 --> 00:19:58,450

But then, eventually we get that down into a set of crew procedures, just like written,

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00:19:58,450 --> 00:20:03,429

step-by-step, everything to do, and it should be simple as possible, even though these astronauts

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00:20:03,429 --> 00:20:05,440

are super well trained and super smart.

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00:20:05,440 --> 00:20:07,570

We make these super simple documents to send them.

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00:20:07,570 --> 00:20:09,980

It's kind of funny.

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00:20:09,980 --> 00:20:15,220

And then the training happens at JSC, where an experienced scientist will go and work

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00:20:15,220 --> 00:20:20,920

with the astronauts, and make a fighter pilot

into a biologist.

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00:20:20,920 --> 00:20:21,970

And then we send everything up.

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00:20:21,970 --> 00:20:27,610

And then on my end, we're sitting in a control room watching a live video of the astronauts.

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00:20:27,610 --> 00:20:29,360

It's very cool.

361

00:20:29,360 --> 00:20:31,240

And, talking to them.

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00:20:31,240 --> 00:20:37,400

And usually, there's one designated person with the best speaking voice talking, and

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00:20:37,400 --> 00:20:43,049

then there's five people in the room behind them with total chaos, yelling it's storage

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00:20:43,049 --> 00:20:49,970

locker 5B, 6-Alpha, and they go, storage locker 5-6-B-Alpha.

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00:20:49,970 --> 00:20:54,980

And then, we just are in their ear, pretty much, walking them through what we need them

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00:20:54,980 --> 00:20:55,980

to do.

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00:20:55,980 --> 00:21:00,260

I know there's simpler payloads, where I think Shane would say you just follow written instruction,

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00:21:00,260 --> 00:21:03,700

but for some of the more complicated things,
we're actually talking to them, walking them

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00:21:03,700 --> 00:21:04,700

through it.

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00:21:04,700 --> 00:21:08,080

Shane Kimbrough: Yeah, it's very helpful to
have Dennis and his team there talking to

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00:21:08,080 --> 00:21:09,610

us.

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00:21:09,610 --> 00:21:14,360

These scientists in general have spent many
years creating whatever the experiment is.

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00:21:14,360 --> 00:21:18,799

The last thing we want to do is mess it up,
or mess up any of their data.

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00:21:18,799 --> 00:21:24,960

So, we want to be very careful in all that
whole process Dennis explained about getting

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00:21:24,960 --> 00:21:28,809

the experiment approved and then what he's
got to do to get it in a crew procedure.

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00:21:28,809 --> 00:21:31,059

That takes a lot of people a lot of time.

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00:21:31,059 --> 00:21:34,049

And so, by the time it gets to us, it's pretty
well refined.

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00:21:34,049 --> 00:21:40,059

It's not perfect, because I haven't seen that
procedure, and I might read something differently

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00:21:40,059 --> 00:21:41,059

than Dennis would read it.

380

00:21:41,059 --> 00:21:46,260

So, it is so nice to have them on the horn,
so to speak, right there talking to us in

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00:21:46,260 --> 00:21:50,830

case we have any questions, so we don't mess
up any of the experiment or any of the data.

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00:21:50,830 --> 00:21:52,169

Gary Jordan: That's true.

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00:21:52,169 --> 00:21:57,340

And then off of Dennis' point of making them
as simple as possible, a lot of it has to

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00:21:57,340 --> 00:22:02,910

do with the fact that, you're right, these
scientists spend so much time getting these

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00:22:02,910 --> 00:22:06,630

procedures ready for this experiment, but
that's not the only one you're doing.

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00:22:06,630 --> 00:22:09,210

You are doing quite a few experiments.

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00:22:09,210 --> 00:22:12,400

Shane Kimbrough: Very true, and in general,
we're not trained on all these.

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00:22:12,400 --> 00:22:15,970

We're trained generically on experiments.

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00:22:15,970 --> 00:22:20,059

Like Dennis alluded to, making a pilot a biologist
for a day.

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00:22:20,059 --> 00:22:25,549

I was lucky enough to have Peggy there, who is a biologist, so she could help me understand

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00:22:25,549 --> 00:22:29,820

something that normally I wouldn't understand, because it's not in my background.

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00:22:29,820 --> 00:22:37,620

But Dennis and his team can get some really complicated experiment into a procedure that's

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00:22:37,620 --> 00:22:39,620

simple, like he said, so that even I can understand it.

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00:22:39,620 --> 00:22:40,620

That's pretty good.

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00:22:40,620 --> 00:22:45,250

Gary Jordan: So, what else do you have to train for, besides the scientific experiments?

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00:22:45,250 --> 00:22:49,970

Because Dennis also talked about, you have to train for EVAs, and on this last mission

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00:22:49,970 --> 00:22:54,590

you did four, so that's quite a big chunk of time that takes away from science.

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00:22:54,590 --> 00:22:57,100

And then you've got to train for unloading cargo vehicles.

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00:22:57,100 --> 00:22:58,399

What else are you training for?

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00:22:58,399 --> 00:22:59,649

Shane Kimbrough: Those are the big ones.

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00:22:59,649 --> 00:23:03,399

Of course, the cargo vehicles when they come up, we actually use the robotic arm to grab

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00:23:03,399 --> 00:23:04,630

them, to capture them.

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00:23:04,630 --> 00:23:11,620

So, a lot of our training is with the robotics team to make sure we do that operation successfully.

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00:23:11,620 --> 00:23:15,700

Grabbing something that's going 17,500 miles an hour is not trivial.

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00:23:15,700 --> 00:23:21,110

But, with our training, we always train of course for the worst-case scenarios, and the

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00:23:21,110 --> 00:23:24,980

vehicles, at least when I was there, behaved very well.

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00:23:24,980 --> 00:23:30,249

It seemed like it was simple, even though the stress is pretty high, the gains are up,

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00:23:30,249 --> 00:23:34,110

because it's a real vehicle and you want to make sure we grab this thing and get it onboard.

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00:23:34,110 --> 00:23:37,700

So, that's another piece of our training we do.

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00:23:37,700 --> 00:23:38,700

What else?

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00:23:38,700 --> 00:23:40,500

Those are the big-ticket items.

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00:23:40,500 --> 00:23:46,369

Operationally, EVAs, like you talked about, robotics, when we're capturing these vehicles,

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00:23:46,369 --> 00:23:48,880

and most of the other time we're doing experiments.

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00:23:48,880 --> 00:23:52,159

That makes up most of our days onboard the space station.

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00:23:52,159 --> 00:23:53,159

Gary Jordan: Yeah.

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00:23:53,159 --> 00:23:58,070

Was it different to use the robotic arm to capture the different vehicles, or did it

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00:23:58,070 --> 00:23:59,139

translate pretty well?

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00:23:59,139 --> 00:24:02,450

Shane Kimbrough: There are differences certainly with every vehicle.

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00:24:02,450 --> 00:24:09,320

So, we had Cygnus, we had SpaceX, we had HTV from Japan, and we had a Russian vehicle,

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00:24:09,320 --> 00:24:13,549

but that one docks automatically, so we didn't have to reach out with the robotic arm to

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00:24:13,549 --> 00:24:14,549

grab that one.

422

00:24:14,549 --> 00:24:18,789

But, there are several differences, and the cues you use are different for every vehicle.

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00:24:18,789 --> 00:24:23,149

Again, we get spun up by our training team a week or two prior to each vehicle showing

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00:24:23,149 --> 00:24:28,279

up, so we remember you're looking here, not here, based on whatever the vehicle was, and

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00:24:28,279 --> 00:24:31,020

using certain cues to help get the vehicle onboard.

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00:24:31,020 --> 00:24:34,700

Matthew Buffington: I'd imagine no matter how much you train on that, and I'm sure there's

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00:24:34,700 --> 00:24:40,879

simulations and different things of remoting the giant robotic arm, I imagine once you're

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00:24:40,879 --> 00:24:44,300

doing that for the first time, it's got to be nerve-wracking, because you're like, this

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00:24:44,300 --> 00:24:47,220

is a very expensive toy, I don't want to mess this up.

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00:24:47,220 --> 00:24:49,289

Shane Kimbrough: Yeah, it was on the first time.

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00:24:49,289 --> 00:24:53,860

And again, we got several opportunities, so I won't say it became less important, but

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00:24:53,860 --> 00:24:55,451

you got more comfortable with it.

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00:24:55,451 --> 00:24:57,539

But, it is a big deal.

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00:24:57,539 --> 00:25:03,419

And I really wanted Tomas, the French astronaut
I was flying with, to get a lot of experiment.

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00:25:03,419 --> 00:25:08,309

So, when we were together, I grabbed the first
one, and after that I let him grab all the

436

00:25:08,309 --> 00:25:10,679

other ones, to get his experience level up.

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00:25:10,679 --> 00:25:15,820

And he'll go fly again here in a few years,
hopefully, and be able to use all that experience

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00:25:15,820 --> 00:25:18,620

to help his crewmates out when he's onboard.

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00:25:18,620 --> 00:25:20,539

Gary Jordan: Definitely.

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00:25:20,539 --> 00:25:24,230

When you're training to capture these things,
like Matt was saying, when you're in the real

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00:25:24,230 --> 00:25:28,080

thing, it's a little bit different, but the
training, I've seen it before.

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00:25:28,080 --> 00:25:29,629

It's pretty detailed.

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00:25:29,629 --> 00:25:34,850

There's a projection of, it's like a, I don't know, describe the training.

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00:25:34,850 --> 00:25:38,360

Shane Kimbrough: We have this, we call it a dome facility, because that's what it is,

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00:25:38,360 --> 00:25:40,610

and the graphics are just fantastic.

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00:25:40,610 --> 00:25:44,720

And it gives you the sense of speed in which things are coming together, and the rates that

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00:25:44,720 --> 00:25:46,740

you're coming are very good.

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00:25:46,740 --> 00:25:49,480

But, it's just not the real thing.

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00:25:49,480 --> 00:25:50,789

It's like our pool.

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00:25:50,789 --> 00:25:55,100

Our pool is amazing to train for space walks, but it's not the real thing.

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00:25:55,100 --> 00:25:56,700

There are differences.

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00:25:56,700 --> 00:26:00,140

And until you get up there -- and now, we're in the Kupla, we're flying almost all of

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00:26:00,140 --> 00:26:05,119

these out of the Kupla, which maybe think about you're upside down flying it, so spatially

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00:26:05,119 --> 00:26:08,950

you've got to get your head around where are the arms moving even though you're upside

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00:26:08,950 --> 00:26:10,809

down, those kind of things.

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00:26:10,809 --> 00:26:14,610

It's not super simple until you actually get up there and do it a few times, and then it

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00:26:14,610 --> 00:26:16,919

becomes a little bit easier on the mind.

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00:26:16,919 --> 00:26:20,749

Gary Jordan: I can see why they would put you through the training for it, because there's

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00:26:20,749 --> 00:26:26,090

a lot to think about, just being upside down, using the controls, controlling something

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00:26:26,090 --> 00:26:28,590

from a Cupola, but then the arm's over here, I guess.

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00:26:28,590 --> 00:26:29,590

Shane Kimbrough: Right.

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00:26:29,590 --> 00:26:31,299

So, it's not necessarily right out your window.

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00:26:31,299 --> 00:26:35,760

It is in this case when you're in the Kupla, but you could fly it from the lab as well,

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00:26:35,760 --> 00:26:37,929

and you wouldn't have any windows and you'd just be using cameras.

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00:26:37,929 --> 00:26:38,929

That's what we used to do.

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00:26:38,929 --> 00:26:40,960

That's what we did on my first flight.

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00:26:40,960 --> 00:26:43,679

So, things have gotten a lot better in that regard.

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00:26:43,679 --> 00:26:49,510

Gary Jordan: I'm sure they write these procedures to be as easy as possible, so Dennis, what

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00:26:49,510 --> 00:26:53,629

are some of the techniques you do whenever you're writing these scientific procedures

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00:26:53,629 --> 00:26:56,940

for the astronauts to make it as easy as possible for them?

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00:26:56,940 --> 00:27:02,760

Dennis Leveson-Gower: Yeah, I mean, we try to boil it down to step-by-step, but also

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00:27:02,760 --> 00:27:08,889

add in some rationale for why you're doing it a certain way, so they don't have to memorize

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00:27:08,889 --> 00:27:14,320

the exact step, but they can know what the end goal is and why they're doing it, so they

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00:27:14,320 --> 00:27:19,149

know I should make sure I keep this cold, or I should make sure I handle this gently.

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00:27:19,149 --> 00:27:20,399

And then hopefully, that helps.

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00:27:20,399 --> 00:27:26,039

But I find that most of the time, it boils down to, we have the procedure, but then they

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00:27:26,039 --> 00:27:29,100

say, tell me what to do next, and we're just talking to them.

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00:27:29,100 --> 00:27:33,990

Shane Kimbrough: Especially when we're in the glove box.

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00:27:33,990 --> 00:27:35,909

We're immobile when we're in there.

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00:27:35,909 --> 00:27:37,750

We can't move around and do things.

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00:27:37,750 --> 00:27:39,999

Dennis Leveson-Gower: Yeah, and how do you read something when you're doing that?

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00:27:39,999 --> 00:27:42,200

Shane Kimbrough: Yeah, so it's very helpful to have you guys onboard.

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00:27:42,200 --> 00:27:46,350

Matthew Buffington: And for me, going back, one thing that occurred to me as you're dealing

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00:27:46,350 --> 00:27:52,600

with some, if it's a sensitive science experiment or the precious pizza cargo, I wonder, when

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00:27:52,600 --> 00:27:56,499

you're packing, obviously there's a little bit of Tetris, where you're trying to place

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00:27:56,499 --> 00:27:59,289

things into the cargo to be very efficient.

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00:27:59,289 --> 00:28:02,889

But it's also, launches are quite intense.

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00:28:02,889 --> 00:28:10,999

So I'd imagine, Dennis, I'd imagine things have to be durable enough to survive such

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00:28:10,999 --> 00:28:16,940

a crazy, extreme, launching, and then it's floating in space, and then the big robotic

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00:28:16,940 --> 00:28:19,989

arm that Shane's operating is grabbing it.

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00:28:19,989 --> 00:28:24,700

But then also, on the flipside, Shane, I'd imagine for you, being a human experiencing

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00:28:24,700 --> 00:28:26,179

that sensation as well.

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00:28:26,179 --> 00:28:29,529

But what goes into keeping things safe and packed in?

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00:28:29,529 --> 00:28:35,200

Dennis Leveson-Gower: Yeah, for especially things like the rodent habitat, we strap it

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00:28:35,200 --> 00:28:37,890

to a table and we vibrate the heck out of it.

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00:28:37,890 --> 00:28:45,500

It goes through launch impact testing, it

gets put through temperatures, it goes through

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00:28:45,500 --> 00:28:48,450

pressurization, depressurization.

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00:28:48,450 --> 00:28:52,809

Anything like that goes through rigorous testing to make sure it stands up to things.

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00:28:52,809 --> 00:28:56,239

And then, it's usually packed in some foam, into a locker.

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00:28:56,239 --> 00:29:03,059

Then, it's put on a scale so that you can find the center of gravity of that hardware,

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00:29:03,059 --> 00:29:04,730

and also the weight and dimensions.

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00:29:04,730 --> 00:29:09,789

And then from that, some eggheads do some math, and some robots load it into the capsule

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00:29:09,789 --> 00:29:11,690

the right way so it's all balanced.

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00:29:11,690 --> 00:29:14,380

I don't understand all that part.

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00:29:14,380 --> 00:29:18,549

But, we just make sure that we've tested everything, whatever.

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00:29:18,549 --> 00:29:20,779

And I mean, it's pretty excessive.

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00:29:20,779 --> 00:29:25,440

Whatever could possibly go wrong, we test,

worst-case, and then we treat it as gently

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00:29:25,440 --> 00:29:26,759

as possible.

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00:29:26,759 --> 00:29:31,120

And yeah, then wrap it up and ship it up.

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00:29:31,120 --> 00:29:35,279

Matthew Buffington: And how is that, Shane,
from your perspective being the human inside

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00:29:35,279 --> 00:29:39,809

said rocket, vibrating and going through those
intense pressures?

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00:29:39,809 --> 00:29:44,260

Shane Kimbrough: On the Soyuz, which is what
I just flew on, I was very surprised on the

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00:29:44,260 --> 00:29:45,999

launch how smooth it was.

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00:29:45,999 --> 00:29:51,630

I had an experience on the space shuttle before,
and it was rocking and rolling and shaking

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00:29:51,630 --> 00:29:54,960

around like you'd imagine, and you see in
the movies.

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00:29:54,960 --> 00:29:57,059

But the Soyuz was super smooth.

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00:29:57,059 --> 00:30:01,909

We pulled about 3Gs going uphill, but the
ride itself was very smooth.

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00:30:01,909 --> 00:30:02,909

I was very impressed.

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00:30:02,909 --> 00:30:08,440

Matthew Buffington: So, not only designing the experiments and getting them up, but you'd

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00:30:08,440 --> 00:30:12,990

mentioned before, Dennis, that it could take years in this process.

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00:30:12,990 --> 00:30:18,009

I'd imagine there's several experiments and ideas that never get into Shane's hands.

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00:30:18,009 --> 00:30:22,519

Or, great ideas that just, either it's funding or different things.

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00:30:22,519 --> 00:30:25,690

It's a competitive process, and everybody wants their cool science experiment to go

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00:30:25,690 --> 00:30:26,690

up.

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00:30:26,690 --> 00:30:31,039

Dennis Leveson-Gower: Yeah, no, we have a queue of investigators going out to 2022.

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00:30:31,039 --> 00:30:37,110

We're trying to get them flown off as fast as possible, but we're limited by launch vehicles

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00:30:37,110 --> 00:30:38,279

and crew time.

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00:30:38,279 --> 00:30:42,980

Crew time is becoming less of a concern, because we're getting an extra crew member up there.

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00:30:42,980 --> 00:30:47,470

But now it's launch vehicles, and you can only launch so many experiments at a time.

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00:30:47,470 --> 00:30:52,179

But, there's a whole list of reserve experiments, of people that have put their heart and soul

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00:30:52,179 --> 00:30:56,360

into something, and they just need 15 minutes of crew time, and they're just hoping their

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00:30:56,360 --> 00:30:57,590

experiment can get done.

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00:30:57,590 --> 00:30:59,700

Matthew Buffington: This is stuff that's already up there?

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00:30:59,700 --> 00:31:03,029

Dennis Leveson-Gower: I think they have over 100 experiments at a time on the ISS.

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00:31:03,029 --> 00:31:08,769

Shane Kimbrough: Yeah, I think we ended up doing 273, I was told, over the six months.

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00:31:08,769 --> 00:31:12,200

But yeah, at any one time, there can be over 100 onboard, that's about right.

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00:31:12,200 --> 00:31:16,100

Dennis Leveson-Gower: And I remember someone saying, Peggy's going to get every one of

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00:31:16,100 --> 00:31:17,320

those done.

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00:31:17,320 --> 00:31:19,619

She's going to work through the backlog.

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00:31:19,619 --> 00:31:20,669

Matthew Buffington: Singlehandedly.

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00:31:20,669 --> 00:31:25,169

Shane Kimbrough: We took out all the task list and all the things that were backlogged,

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00:31:25,169 --> 00:31:26,169

for sure.

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00:31:26,169 --> 00:31:27,419

So, it was nice.

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00:31:27,419 --> 00:31:31,489

Dennis Leveson-Gower: Yeah, a lot of people over here appreciate it when you guys give

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00:31:31,489 --> 00:31:34,669

up some of your free time and bang one of those experiments out.

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00:31:34,669 --> 00:31:35,779

Shane Kimbrough: Glad to do it.

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00:31:35,779 --> 00:31:36,779

Gary Jordan: That's true.

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00:31:36,779 --> 00:31:42,619

What else, besides if you were to take the weekend to unpack a cargo vehicle, what else

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00:31:42,619 --> 00:31:43,809

are you doing on the weekends?

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00:31:43,809 --> 00:31:47,440

Shane Kimbrough: Weekends, generally on Saturday mornings, it's spent cleaning.

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00:31:47,440 --> 00:31:52,389

So, it's like your house, about once a week you need to probably do a little cleaning.

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00:31:52,389 --> 00:31:57,489

So, we spend all Saturday morning vacuuming the whole station, wiping things down, and

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00:31:57,489 --> 00:32:01,520

just getting everything back in shape after usually a busy week.

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00:32:01,520 --> 00:32:04,820

And then, Saturday afternoons are generally off, and Sundays are generally off.

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00:32:04,820 --> 00:32:09,940

So, I'm a big sports fan, so I was usually watching games, whether it was football or

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00:32:09,940 --> 00:32:13,460

World Series or anything going on.

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00:32:13,460 --> 00:32:15,600

Tomas got us into watching rugby.

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00:32:15,600 --> 00:32:19,260

So, that was big in Europe at the time.

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00:32:19,260 --> 00:32:21,080

So, we got to watch some of those matches.

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00:32:21,080 --> 00:32:25,639

So, we do that as a crew sometimes, or sometimes individually you'd watch those things.

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00:32:25,639 --> 00:32:30,749

And you certainly can catch up on emails or

watch movies or call home or any of those

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00:32:30,749 --> 00:32:31,749

things as well.

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00:32:31,749 --> 00:32:35,299

Or, you can just look out the window, which was always spectacular, something you can't

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00:32:35,299 --> 00:32:36,299

do here on earth.

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00:32:36,299 --> 00:32:40,379

So, I tried to do that more often, because I can always talk to people or email people

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00:32:40,379 --> 00:32:44,730

when I'm on earth, but I can't always look out the Kupla window for a rev around the

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00:32:44,730 --> 00:32:46,299

earth in 90 minutes.

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00:32:46,299 --> 00:32:47,389

That was pretty cool.

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00:32:47,389 --> 00:32:49,940

Matthew Buffington: I'm curious, how is that setup?

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00:32:49,940 --> 00:32:53,269

You don't have a normal weekend like you would.

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00:32:53,269 --> 00:32:56,799

It's not like you're commuting home and spending the weekend with your family.

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00:32:56,799 --> 00:33:00,220

You're sitting there floating in space, so

there's never really a day off.

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00:33:00,220 --> 00:33:01,649

You're always on.

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00:33:01,649 --> 00:33:03,029

Shane Kimbrough: Correct.

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00:33:03,029 --> 00:33:07,100

So I had to, when I was the commander, I made it clear to my crew that we were going to

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00:33:07,100 --> 00:33:12,882

work from DBC to DBC, which is the morning conference with mission control all the way

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00:33:12,882 --> 00:33:16,950

to the evening conference with mission control, but we weren't going to work outside of that.

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00:33:16,950 --> 00:33:23,409

And there were a few exceptions on the weekends where we'd say, there's this one cargo vehicle,

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00:33:23,409 --> 00:33:24,919

for example, we want to unload.

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00:33:24,919 --> 00:33:26,900

Let's do two hours, and that's it.

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00:33:26,900 --> 00:33:28,030

We're going to work two hours together.

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00:33:28,030 --> 00:33:32,690

If you've got three people, that equates to about six hours of work.

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00:33:32,690 --> 00:33:34,470

And we can do a lot in two hours.

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00:33:34,470 --> 00:33:38,830

But I would make sure we weren't working all weekend, because as the commander, I've got

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00:33:38,830 --> 00:33:44,049

to make sure the crew is not exhausted, for one, so they can hit the next week's activities

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00:33:44,049 --> 00:33:45,429

when Monday starts.

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00:33:45,429 --> 00:33:50,899

But also, we've got to always be ready for that really bad day, an emergency onboard

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00:33:50,899 --> 00:33:53,989

the space station, where that's in the middle of the night or during the day.

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00:33:53,989 --> 00:33:56,210

The crew's got to be fresh enough to handle that.

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00:33:56,210 --> 00:34:00,279

So, I'm always thinking about that as I'm working the crew and the crew's being worked

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00:34:00,279 --> 00:34:01,309

by the ground.

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00:34:01,309 --> 00:34:06,130

And sometimes, we have to modify what they want us to do in order to keep our reserves,

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00:34:06,130 --> 00:34:08,240

so to speak, to be able to handle an emergency.

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00:34:08,240 --> 00:34:09,240

Gary Jordan: That's right.

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00:34:09,240 --> 00:34:14,180

So, as a commander, how much jurisdiction do you have on time, because I know they schedule

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00:34:14,180 --> 00:34:19,620

a lot of things for you, but then what power do you have as a commander?

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00:34:19,620 --> 00:34:20,620

Shane Kimbrough: Big picture, we'll talk.

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00:34:20,620 --> 00:34:25,100

I'll talk with the lead flight director usually before the week, or maybe even two weeks out.

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00:34:25,100 --> 00:34:28,880

We'll talk about the big picture, how things are going to flow, and what they want to get

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00:34:28,880 --> 00:34:29,880

done.

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00:34:29,880 --> 00:34:31,740

And then, the details just kind of flush out.

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00:34:31,740 --> 00:34:35,600

I don't really have too much influence on that.

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00:34:35,600 --> 00:34:39,710

I'll let the flight director know, here's what I want to focus on.

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00:34:39,710 --> 00:34:43,180

Make sure we get maybe a day here or there because we worked last weekend, and those

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00:34:43,180 --> 00:34:45,540

kind of things, because that happens a lot.

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00:34:45,540 --> 00:34:51,990

And then in general, if something's coming up real-time, day-of, maybe an experiment

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00:34:51,990 --> 00:34:55,610

or something is running twice as long as it was expected -- that happens.

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00:34:55,610 --> 00:34:57,820

And we'll just adjust real-time.

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00:34:57,820 --> 00:35:02,120

Maybe I'll take the activity that Peggy was supposed to do next, if she's buried in this

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00:35:02,120 --> 00:35:03,250

experiment, or vice versa.

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00:35:03,250 --> 00:35:06,440

We'll help each other out to get all the things done.

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00:35:06,440 --> 00:35:08,480

And you do that almost daily.

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00:35:08,480 --> 00:35:12,470

You get done with something early, you go help somebody else if you can, or else you

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00:35:12,470 --> 00:35:15,840

take something else off their timeline by knocking out something down the road for them.

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00:35:15,840 --> 00:35:18,230

Gary Jordan: Sounds like you guys were really tightknit.

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00:35:18,230 --> 00:35:21,770

You guys needed to be a really tight team to get all this stuff done.

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00:35:21,770 --> 00:35:26,180

Shane Kimbrough: Totally agree, and I was super fortunate to have Peggy and Tomas onboard

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00:35:26,180 --> 00:35:29,600

for about 90 percent of my time onboard.

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00:35:29,600 --> 00:35:34,070

I was with Kate [Rubins] and Takuya [Onishi] for only a week or so, unfortunately for me,

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00:35:34,070 --> 00:35:35,760

because they were superstars as well.

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00:35:35,760 --> 00:35:38,030

But, they left shortly after we got there.

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00:35:38,030 --> 00:35:42,200

So really, my whole mission was with Peggy and Tomas on the US side.

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00:35:42,200 --> 00:35:44,000

And we did really work well together.

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00:35:44,000 --> 00:35:49,810

We thought the same, our work ethic was the same, and we just loved helping each other

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00:35:49,810 --> 00:35:52,020

out and loved being around each other, which doesn't always happen.

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00:35:52,020 --> 00:35:53,560

So, I was very fortunate.

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00:35:53,560 --> 00:35:55,420

Gary Jordan: Very true.

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00:35:55,420 --> 00:36:00,290

That makes me -- getting back on track to the cargo stuff, I was actually thinking about,

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00:36:00,290 --> 00:36:05,720

we were talking a lot about when cargo comes up, how to get it, how to unpack it, but then,

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00:36:05,720 --> 00:36:10,810

there's a packing story, and they're different for each vehicle, because some of them just

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00:36:10,810 --> 00:36:15,240

burn up, some of them have experiments running before they burn up, and then some of them

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00:36:15,240 --> 00:36:16,240

actually come back.

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00:36:16,240 --> 00:36:17,310

What are some of the differences there?

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00:36:17,310 --> 00:36:18,540

Shane Kimbrough: Yeah, so we had all those.

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00:36:18,540 --> 00:36:22,860

The only one that comes back to earth, as you're probably aware, is SpaceX.

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00:36:22,860 --> 00:36:28,480

So, anything that's real critical experiment-wise, or even maybe broken equipment that engineers

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00:36:28,480 --> 00:36:31,600

want to get their hands on to figure out what happened to it, those kind of things we'll

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00:36:31,600 --> 00:36:34,850

put into SpaceX, so they can come back to the ground.

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00:36:34,850 --> 00:36:39,550

A lot of that has to do with experiments we did on our bodies -- blood draws and those

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00:36:39,550 --> 00:36:43,280

kind of things need to come back, as well as rodent research things will come back on

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00:36:43,280 --> 00:36:47,580

SpaceX, because the scientists need to recover them and look at the data and get all that

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00:36:47,580 --> 00:36:48,580

stuff.

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00:36:48,580 --> 00:36:49,580

That's one thing.

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00:36:49,580 --> 00:36:52,110

All the other vehicles in general burn up, like you mentioned.

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00:36:52,110 --> 00:36:56,020

So to me, I think of it, that's how we manage our trash.

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00:36:56,020 --> 00:36:58,980

That's how we manage trash on the space station.

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00:36:58,980 --> 00:37:02,590

We crate tons of trash, believe it or not, up there, whether it's food trash or clothes

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00:37:02,590 --> 00:37:05,980

trash or experiment trash or waste, human waste.

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00:37:05,980 --> 00:37:08,360

All that stuff needs to get off at some point.

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00:37:08,360 --> 00:37:13,510

And the way we do that is to use these cargo vehicles that are not coming back to earth.

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00:37:13,510 --> 00:37:15,650

And we can't just cram things in there, like you might think.

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00:37:15,650 --> 00:37:17,320

It's a very organized way.

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00:37:17,320 --> 00:37:22,540

And again, we'll get a plan from the ground team and mission control that lays out how

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00:37:22,540 --> 00:37:24,050

they want us to pack it.

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00:37:24,050 --> 00:37:28,870

And a lot of times there are experiments onboard that will happen once it leaves the space

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00:37:28,870 --> 00:37:32,010

station before it gets burned up, like you mentioned.

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00:37:32,010 --> 00:37:35,870

So, we've got to make sure certain aisle ways are clear, and the airflow is going to be

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00:37:35,870 --> 00:37:37,760

correct, so that those experiments can happen correctly.

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00:37:37,760 --> 00:37:39,500

Gary Jordan: I see.

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00:37:39,500 --> 00:37:47,190

So, it's kind of like a supply chain, really, because there needs to be new stuff sent up

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00:37:47,190 --> 00:37:52,400

to the International Space Station, and then you need to take some of the old stuff out.

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00:37:52,400 --> 00:37:54,620

That's the cycle that keeps the ISS going.

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00:37:54,620 --> 00:37:55,940

Shane Kimbrough: Correct.

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00:37:55,940 --> 00:37:59,260

And launch delays and things don't happen, and these launches aren't always happening

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00:37:59,260 --> 00:38:00,260

on time.

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00:38:00,260 --> 00:38:04,870

So, sometimes your trash backlog gets pretty high on the space station.

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00:38:04,870 --> 00:38:09,010

That's not a -- there are some odors and things that go along with that.

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00:38:09,010 --> 00:38:14,940

So, we always like to have vehicles coming frequently, so we can manage our trash, of

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00:38:14,940 --> 00:38:17,060

course along with doing great experiments as well.

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00:38:17,060 --> 00:38:20,460

Gary Jordan: But you guys have plenty of food and all that kind of stuff, right?

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00:38:20,460 --> 00:38:23,740

So, even if something gets delayed, you'll be set for a while, for at least a lot of

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00:38:23,740 --> 00:38:24,740

things.

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00:38:24,740 --> 00:38:25,740

Shane Kimbrough: Yeah.

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00:38:25,740 --> 00:38:26,740

I think they have about a six-month reserve onboard.

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00:38:26,740 --> 00:38:30,710

So, we can handle a lot of delays, I guess.

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00:38:30,710 --> 00:38:35,170

Gary Jordan: Dennis, on your end, when it comes to these experiments coming back to

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00:38:35,170 --> 00:38:39,430

earth, and especially on SpaceX, the ones you actually can get your hands on and don't

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00:38:39,430 --> 00:38:42,140

burn up, what are some of the things you're looking at for those?

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00:38:42,140 --> 00:38:45,970

Dennis Leveson-Gower: Looking at getting it back as quickly as possible is usually our

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00:38:45,970 --> 00:38:52,610

priority, especially with rodent experiments,
cell science experiments.

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00:38:52,610 --> 00:38:58,320

You're trying to study the effects of microgravity
on these organisms, and the minute you start

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00:38:58,320 --> 00:39:01,770

getting back into the earth's atmosphere,
you're going to start to experience gravity

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00:39:01,770 --> 00:39:03,760

and see molecular changes.

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00:39:03,760 --> 00:39:06,950

So, the clock is ticking to try to get the
samples back.

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00:39:06,950 --> 00:39:12,240

So in the future, hopefully return vehicles
can land on solid ground, and we get the samples

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00:39:12,240 --> 00:39:13,480

back even faster.

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00:39:13,480 --> 00:39:19,640

Right now, it's taking about a day or two
on a boat in the ocean.

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00:39:19,640 --> 00:39:26,320

But yeah, the priority's obviously for animal
experiments, we want all of them alive and

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00:39:26,320 --> 00:39:27,320

happy.

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00:39:27,320 --> 00:39:29,280

And so far, we've done it twice and they have
been.

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00:39:29,280 --> 00:39:31,710

JAXA has also done it twice.

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00:39:31,710 --> 00:39:34,750

All the mice did really well on return.

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00:39:34,750 --> 00:39:41,230

And, yeah, intact samples kept at the right
stowage temperatures and everything, then

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00:39:41,230 --> 00:39:42,230

we're happy.

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00:39:42,230 --> 00:39:48,040

Matthew Buffington: On a similar note, and
this is a slight pivot, but I love the little

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00:39:48,040 --> 00:39:50,460

catchphrase of working off the earth for the
earth.

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00:39:50,460 --> 00:39:58,640

We've talked a lot about how it all happens,
from an idea, an experiment, it's created,

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00:39:58,640 --> 00:40:01,520

it's packed, it's sent up, then you actually
conduct it.

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00:40:01,520 --> 00:40:09,300

But, I'd love to pick your brain, Dennis and
also Shane, of the why.

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00:40:09,300 --> 00:40:13,970

Why is doing experiments in microgravity important?

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00:40:13,970 --> 00:40:17,710

Clearly NASA and the international community
is spending a lot of money to put this thing

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00:40:17,710 --> 00:40:18,710

up here.

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00:40:18,710 --> 00:40:23,250

And, what can we get out of that that you just can't do on the ground?

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00:40:23,250 --> 00:40:29,310

Dennis Leveson-Gower: Yeah, there's a lot that we can't do on the ground.

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00:40:29,310 --> 00:40:34,191

My bias is that we want to go to Mars, and we want to explore space, and we want to make

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00:40:34,191 --> 00:40:40,620

Star Trek real, so we should be figuring out what happens to our bodies, what happens to

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00:40:40,620 --> 00:40:47,560

physical processes on a cellular level, really understand the biology and what changes when

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00:40:47,560 --> 00:40:49,920

the vector of gravity is removed.

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00:40:49,920 --> 00:40:57,790

Of course, there is objectives to benefit the earth, as you say, and one prime example

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00:40:57,790 --> 00:41:04,610

is, you can't have forced bedrest of research animals, but if they're in space, all the

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00:41:04,610 --> 00:41:09,430

gravity load is off, and it will mimic conditions where people have extended bedrest or unloading

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00:41:09,430 --> 00:41:11,230
on their muscles.

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00:41:11,230 --> 00:41:18,020
You also, microgravity seems to have an accelerated aging effect, so you can look at age-related

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00:41:18,020 --> 00:41:19,390
factors.

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00:41:19,390 --> 00:41:24,620
You have fluid shifts, and basically high blood pressure in your brain, and that starts

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00:41:24,620 --> 00:41:28,340
affecting the astronauts' vision and things like that, and we want to understand how that

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00:41:28,340 --> 00:41:29,340
works.

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00:41:29,340 --> 00:41:34,840
So, you have a lot of, like, growing 3D tissues in the lab.

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00:41:34,840 --> 00:41:38,950
To be able to do those kind of things, you may be able to do them better in space, and

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00:41:38,950 --> 00:41:41,370
understand the processes better in space.

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00:41:41,370 --> 00:41:48,450
And I think it directly translates into, benefits the earth.

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00:41:48,450 --> 00:41:53,260
Sometimes, you have to connect the dots a little bit to see how that space research

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00:41:53,260 --> 00:41:58,270

affects the ground, but if you look at every experiment we've done, it always has spin-off

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00:41:58,270 --> 00:41:59,270

benefits.

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00:41:59,270 --> 00:42:00,410

Shane Kimbrough: Tough to add much to that.

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00:42:00,410 --> 00:42:02,070

It's very true.

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00:42:02,070 --> 00:42:05,840

The way I look at it is, everything we do up there is either for future exploration,

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00:42:05,840 --> 00:42:10,140

like Dennis mentioned, or it's to help humanity in general.

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00:42:10,140 --> 00:42:13,380

If we're not doing that, I think we're really missing the boat.

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00:42:13,380 --> 00:42:17,780

But everything we touch up there and I've been involved with has met one of those two criteria

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00:42:17,780 --> 00:42:23,600

One example I like to think of is, we have this machine up there that makes water.

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00:42:23,610 --> 00:42:28,680

It takes every bit of liquid onboard the space station, from urine to sweat to condensation

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00:42:28,680 --> 00:42:33,620

to anything, and it goes into this machine

and it makes water that's extremely pure that

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00:42:33,620 --> 00:42:38,080

we use for our food and our drinks the next day, so to speak.

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00:42:38,080 --> 00:42:39,790

It's a great technology for us to have.

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00:42:39,790 --> 00:42:43,510

It's not something we have to have for the space station, but we will have to have something

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00:42:43,510 --> 00:42:47,520

like that for Mars, or the moon, or wherever we're going to go deep space.

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00:42:47,520 --> 00:42:51,020

So, we're working on that now for future exploration.

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00:42:51,020 --> 00:42:55,830

A side benefit of this whole thing is, we actually use that technology on earth as well.

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00:42:55,830 --> 00:42:59,440

There's third-world countries that don't have clean water supplies, and the same technology

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00:42:59,440 --> 00:43:01,880

is helping them get clean water.

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00:43:01,880 --> 00:43:06,790

That's really a cool thing when you're helping future exploration and you're helping humanity.

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00:43:06,790 --> 00:43:09,130

Gary Jordan: Yeah, especially with, that's just one example, right?

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00:43:09,130 --> 00:43:12,390

That's one thing on the station that's helping in both directions.

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00:43:12,390 --> 00:43:15,430

Matt, I think that's a really good place to end the podcast.

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00:43:15,430 --> 00:43:17,500

Matthew Buffington: I think that's perfect, dude.

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00:43:17,500 --> 00:43:23,670

Gary Jordan: I think that's fantastic, because it kind of sums up why do we do all the science,

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00:43:23,670 --> 00:43:27,260

and why the science goes up and down to the International Space Station.

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00:43:27,260 --> 00:43:30,820

Guys, thanks so much for coming on the show, both to Shane and Dennis for coming on Houston

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00:43:30,820 --> 00:43:34,900

We Have a Podcast and NASA in Silicon Valley, the first time we're doing this together.

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00:43:34,900 --> 00:43:36,670

Matt, I really hope we can do this again.

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00:43:36,670 --> 00:43:41,290

Matthew Buffington: With our powers combined, it works out.

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00:43:41,290 --> 00:43:42,850

Thanks a lot for helping pull this together.

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00:43:42,850 --> 00:43:43,850

This has been a lot of fun.

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00:43:43,850 --> 00:43:45,020

Gary Jordan: Yeah, absolutely.

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00:43:45,020 --> 00:43:45,660

Thanks, guys.

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00:43:45,660 --> 00:43:46,520

Shane Kimbrough: It was great, thanks everybody.

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00:43:46,520 --> 00:43:47,460

Dennis Leveson-Gower: Thanks for having me.