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00:00:01,500 --> 00:00:06,070

>> Pat Ryan: The Automated Transfer Vehicle has just arrived at the International Space Station.

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00:00:06,070 --> 00:00:10,800

It's going to provide a lot of fresh fruit and gifts from home for the crew members,

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00:00:10,800 --> 00:00:16,120

new clothes, personal supplies but there's also a good bit of science material that is going

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00:00:16,120 --> 00:00:19,640

to boost the station's research capability and that's been delivered to.

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00:00:19,640 --> 00:00:24,730

This morning we're going to learn more about the science that's coming out of the ATV

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00:00:24,730 --> 00:00:30,240

with Camille Alleyne who is International Space Station Assistant Program Scientist.

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00:00:30,240 --> 00:00:32,420

Camille, what's on board the ATV-3?

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00:00:32,420 --> 00:00:35,140

Is this an especially large delivery?

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00:00:35,140 --> 00:00:37,130

>> Camille Alleyne: It's not an especially large delivery

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00:00:37,130 --> 00:00:44,090

but there are quite a few sampled-research samples that will be launched to support some

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00:00:44,090 --> 00:00:47,200

of the investigations that are going on during this increment.

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00:00:47,200 --> 00:00:51,170

>> Pat Ryan: There are material there for a couple of experiments that have nano

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00:00:51,170 --> 00:00:52,980

in the title which sounds kind of cool.

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00:00:52,980 --> 00:00:54,850

Tell me about what those are.

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00:00:54,850 --> 00:00:57,430

>> Camille Alleyne: Well, the first one is called NanoStep and that's all

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00:00:57,430 --> 00:01:00,350

about protein crystal growth and what they've launched,

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00:01:00,350 --> 00:01:06,270

protein crystals specifically called lysozymes which are large amounts farmed

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00:01:06,270 --> 00:01:10,290

in egg white or in our tears or our saliva.

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00:01:10,290 --> 00:01:14,240

So they've launched those protein crystals and what investigators are trying

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00:01:14,240 --> 00:01:21,140

to study is the mechanisms for which they grow perfectly under microgravity.

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00:01:21,140 --> 00:01:23,440

And this is a Japanese led investigation.

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00:01:23,440 --> 00:01:30,160

And so protein crystal growth, sometimes when we have launched them and we've launched

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00:01:30,160 --> 00:01:32,770

about 400 of these protein crystals.

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00:01:32,770 --> 00:01:39,090

Some have grown perfectly and the perfection of the crystal is reflected in its size

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00:01:39,090 --> 00:01:44,590

and its purity and so they've seen some growing perfectly and some haven't grown at all.

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00:01:44,590 --> 00:01:49,930

So researchers are trying to fundamentally understand what is the precise mechanism

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00:01:49,930 --> 00:01:53,240

for the growth of the perfection in the protein crystals.

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00:01:53,240 --> 00:01:56,690

>> Pat Ryan: Is there value in getting perfect crystals or does that teach us something else?

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00:01:56,690 --> 00:01:57,950

>> Camille Alleyne: Yes, absolutely.

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00:01:57,950 --> 00:02:02,890

It is critical -- protein crystal growth is critical in the development

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00:02:02,890 --> 00:02:09,430

of protein structures and that's fundamental to our understanding of life at the molecular level

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00:02:09,430 --> 00:02:14,050

and also the development

of molecular biotechnology.

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00:02:14,050 --> 00:02:15,330

>> Pat Ryan: That's nanosteps.

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00:02:15,330 --> 00:02:16,020

There's also --

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00:02:16,020 --> 00:02:16,770

>> Camille Alleyne: That's nanosteps.

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00:02:16,770 --> 00:02:20,820

>> Pat Ryan: I counted 12 different investigations under the NanoRacks.

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00:02:20,820 --> 00:02:24,350

What's new in the NanoRacks section here?

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00:02:24,350 --> 00:02:28,900

>> Camille Alleyne: So NanoRacks is a multipurpose research facility that's onboard

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00:02:28,900 --> 00:02:32,600

the space station and it's commercially developed and it's managed

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00:02:32,600 --> 00:02:35,900

under the [inaudible] of the US National Laboratory.

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00:02:35,900 --> 00:02:38,780

And so they investigate the samples that are going up.

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00:02:38,780 --> 00:02:44,110

It's actually seven investigations that will be housed in the NanoRacks facility

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00:02:44,110 --> 00:02:49,350

and these are sometimes investigations  
that are led by researchers

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00:02:49,350 --> 00:02:51,890

and sometimes they are student  
developed experiments.

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00:02:51,890 --> 00:02:57,580

So these seven are actually student  
developed experiments and they involve one,

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00:02:57,580 --> 00:03:02,940

looking at the effects of microgravity on  
concrete mixing and the students will be looking

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00:03:02,940 --> 00:03:06,530

at mixing two types of concrete mixtures.

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00:03:06,530 --> 00:03:13,500

One by stirring and one by vibrations  
and they would compare those mixtures

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00:03:13,500 --> 00:03:16,430

to concrete mixtures on the ground.

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00:03:16,430 --> 00:03:19,670

The second is looking at  
the effect of microgravity

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00:03:19,670 --> 00:03:25,990

on an antibiotic resistance e. coli  
bacteria and then there's one that's looking

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00:03:25,990 --> 00:03:31,110

at a remote controlled robotics, its  
mechanism and its mechanical devices.

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00:03:31,110 --> 00:03:34,790

Some very interesting student  
developed experiments and [inaudible].

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00:03:34,790 --> 00:03:36,070

>> Pat Ryan: Students of which age?

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00:03:36,070 --> 00:03:37,140

>> Camille Alleyne: High school.

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00:03:37,140 --> 00:03:37,550

>> Pat Ryan: High school.

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00:03:37,550 --> 00:03:39,940

>> Camille Alleyne: And from California high schools.

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00:03:39,940 --> 00:03:40,910

>> Pat Ryan: My goodness.

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00:03:40,910 --> 00:03:43,040

Now there's hardware for something else called energy

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00:03:43,040 --> 00:03:46,020

and that's one I haven't heard very much about.

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00:03:46,020 --> 00:03:47,320

What's that?

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00:03:47,320 --> 00:03:49,660

>> Camille Alleyne: Energy's an [inaudible] led investigation

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00:03:49,660 --> 00:03:54,850

and what the researchers are looking at is the metabolic rate of the crew members

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00:03:54,850 --> 00:03:59,500

and the total energy balance after long duration space flight.

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00:03:59,500 --> 00:04:04,530  
What they found is that crew members come back with a negative energy balance meaning

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00:04:04,530 --> 00:04:08,980  
that their caloric intake is insufficient for the amount of energy

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00:04:08,980 --> 00:04:11,320  
that they need to live and work in space.

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00:04:11,320 --> 00:04:16,260  
So ultimately researchers are trying to derive an equation for the amount

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00:04:16,260 --> 00:04:22,060  
of energy that's required during long duration space flight.

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00:04:22,060 --> 00:04:24,670  
>> Pat Ryan: They not eating enough or do they not eat enough of the right things?

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00:04:24,670 --> 00:04:27,490  
>> Camille Alleyne: They don't eat enough for the amount of energy

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00:04:27,490 --> 00:04:31,300  
and so it's predicting how much work needs to be done and how much calories need

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00:04:31,300 --> 00:04:35,740  
to be intake in order to complete that work.

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00:04:35,740 --> 00:04:40,130  
There's so much we're discovering about how the human body adapts

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00:04:40,130 --> 00:04:44,500

to microgravity and long duration space flight.

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00:04:44,500 --> 00:04:50,370

And so researchers are becoming more and more interested in using nutrition

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00:04:50,370 --> 00:04:54,630

as a counter measure for those adverse effects that we see.

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00:04:54,630 --> 00:04:56,880

And so one of the effects that we see

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00:04:56,880 --> 00:05:02,190

when there's a negative energy balance is a significant loss in body mass.

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00:05:02,190 --> 00:05:07,900

There's also a loss in mental and physical power, muscle atrophy, bone density loss

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00:05:07,900 --> 00:05:10,110

and cardiovascular deconditioning.

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00:05:10,110 --> 00:05:11,830

So it's significant.

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00:05:11,830 --> 00:05:14,740

>> Pat Ryan: There's -- there are a lot of different experiments that have to do

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00:05:14,740 --> 00:05:16,990

with finding out how the body's going to be impacted.

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00:05:16,990 --> 00:05:17,350

>> Camille Alleyne: Yes.

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00:05:17,350 --> 00:05:19,420

>> Pat Ryan: One is relatively new, it's called sprint

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00:05:19,420 --> 00:05:22,790

and you've got some new supplies going up for the sprint experiment.

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00:05:22,790 --> 00:05:26,130

>> Camille Alleyne: Yes, we have some resupply kits going up for the sprint experiment

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00:05:26,130 --> 00:05:29,020

and I say sprint is all about exercise.

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00:05:29,020 --> 00:05:35,020

And so it involves high intensity, low volume exercise regimen.

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00:05:35,020 --> 00:05:39,570

Currently astronauts and crew members are required to do about two

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00:05:39,570 --> 00:05:41,710

and a half hours a day of exercise.

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00:05:41,710 --> 00:05:44,310

So some of the crew members who are going to be involved

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00:05:44,310 --> 00:05:50,080

in this investigation would not exercise as frequently but when they do exercise,

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00:05:50,080 --> 00:05:52,560

it's going to be with greater intensity.

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00:05:52,560 --> 00:05:57,860

And so the exercise regime includes integrated resistance using a device

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00:05:57,860 --> 00:06:03,040  
on board called an irade [phonetic] which  
is an advanced resistance exercise device.

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00:06:03,040 --> 00:06:09,470  
And they will also get their cardiovascular  
conditioning from the treadmill,

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00:06:09,470 --> 00:06:11,910  
the kober [phonetic], the [inaudible] treadmill.

100  
00:06:11,910 --> 00:06:15,510  
>> Pat Ryan: And they have  
other exercise equipment on too.

101  
00:06:15,510 --> 00:06:16,730  
>> Camille Alleyne: They do.

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00:06:16,730 --> 00:06:20,320  
>> Pat Ryan: But the sprint is  
different because it's a harder workout.

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00:06:20,320 --> 00:06:22,580  
>> Camille Alleyne: Exactly,  
more intense workout

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00:06:22,580 --> 00:06:28,240  
and so like the nutrition researchers are  
hoping that the exercise could be used

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00:06:28,240 --> 00:06:33,220  
as a counter measure for some of -- decreasing  
some of the losses they see in the muscle

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00:06:33,220 --> 00:06:35,840  
and the bone and the cardiovascular  
deconditioning.

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00:06:35,840 --> 00:06:38,880

>> Pat Ryan: Edwardo Amaldy [phonetic]  
had some new hardware and supplies

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00:06:38,880 --> 00:06:42,320

for another variation of the ALTEA experiment.

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00:06:42,320 --> 00:06:42,440

>> Camille Alleyne: Yes.

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00:06:42,440 --> 00:06:45,940

>> Pat Ryan: Anomalous Long  
Term Effects in Astronauts,

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00:06:45,940 --> 00:06:47,600

tell me about what's the new one's called.

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00:06:47,600 --> 00:06:52,380

>> Camille Alleyne: It's called ALTEA shield  
and it's led by the Italian space agency

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00:06:52,380 --> 00:06:55,360

and that's a technology investigation  
that's going

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00:06:55,360 --> 00:07:02,250

to monitor the cosmic radiation  
inside the US [inaudible] laboratory.

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00:07:02,250 --> 00:07:10,280

Ultimately researchers are trying to see that  
-- study the interactions between cosmic rays

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00:07:10,280 --> 00:07:17,220

and brain functions and we know that radiation,  
space radiation is one of the greatest risks

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00:07:17,220 --> 00:07:21,260

to astronauts flying beyond --  
traveling beyond [inaudible] orbit.

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00:07:21,260 --> 00:07:28,540

So it's important to study what that environment is like so ALTEA shield is another installment

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00:07:28,540 --> 00:07:34,200

in the ALTEA investigations that's trying to characterize the cosmic radiation environment

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00:07:34,200 --> 00:07:38,650

within the vehicle and ultimately, we'll be able to develop technologies

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00:07:38,650 --> 00:07:43,430

that could protect the astronauts from that kind of space radiation.

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00:07:43,430 --> 00:07:46,790

>> Pat Ryan: Now I'm really interested in another piece of research

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00:07:46,790 --> 00:07:49,440

that was delivered here that isn't going to survive.

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00:07:49,440 --> 00:07:51,280

It doesn't have anything to do with the space station.

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00:07:51,280 --> 00:07:51,460

>> Camille Alleyne: [Laughter] Yes.

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00:07:51,460 --> 00:07:55,630

>> Pat Ryan: It's called REBER and it will support ATV while it goes

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00:07:55,630 --> 00:07:56,760

to its own destruction.

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00:07:56,760 --> 00:07:57,040

Tell --

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00:07:57,040 --> 00:07:57,510

>> Camille Alleyne: Right.

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00:07:57,510 --> 00:08:03,980

So we're taking advantage of the fact that the ATV is a non-reusable vehicle and will break

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00:08:03,980 --> 00:08:07,080

up supposedly in the earth  
at the earth's atmosphere.

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00:08:07,080 --> 00:08:12,690

So REBER is a device, it stands for reentry  
break up recorder and what it does is

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00:08:12,690 --> 00:08:20,370

as the ATV's orbit is decaying and break  
up, reentry starts about 120 kilometers.

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00:08:20,370 --> 00:08:25,230

The host which will call the ATV starts  
breaking up, the REBER is deployed

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00:08:25,230 --> 00:08:29,490

and it starts recording some of  
that process, that breakup process.

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00:08:29,490 --> 00:08:31,130

So it records the temperature.

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00:08:31,130 --> 00:08:36,070

It records the acceleration, the rotational  
rates and positions of some of the debris

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00:08:36,070 --> 00:08:40,040

that comes from the breakup phenomenon.

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00:08:40,040 --> 00:08:43,360  
And researchers are ultimately  
trying to make that reentry safer.

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00:08:43,360 --> 00:08:48,530  
Predict because we know some pieces survive  
so being able to predict the trajectory

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00:08:48,530 --> 00:08:53,360  
and ultimately make the population  
safe is the objective.

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00:08:53,360 --> 00:08:54,850  
>> Pat Ryan: The REBER doesn't survive, does it?

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00:08:54,850 --> 00:09:04,950  
>> Camille Alleyne: No, it actually -- it sends  
the information back to the ground team but yes,

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00:09:04,950 --> 00:09:08,420  
ultimately it's supposed to self destruct.

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00:09:08,420 --> 00:09:10,740  
>> Pat Ryan: We've often talked  
about how the research that's done

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00:09:10,740 --> 00:09:16,240  
on the station can impact people like  
you and me who aren't in space at all.

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00:09:16,240 --> 00:09:19,220  
This week's Program Scientist,  
Dr. Julie Robinson, your boss --

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00:09:19,220 --> 00:09:20,130  
>> Camille Alleyne: My boss.

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00:09:20,130 --> 00:09:24,010  
>> Pat Ryan: Announced a new website to  
help spread word about what's being done.

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00:09:24,010 --> 00:09:26,000

Fill me in on this new website.

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00:09:26,000 --> 00:09:27,870

It's called Benefits for Humanity.

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00:09:27,870 --> 00:09:32,750

>> Camille Alleyne: Benefits for Humanity is an extraordinary accomplishment for us.

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00:09:32,750 --> 00:09:39,570

We just launched this website that features stories that are significant in the scientific,

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00:09:39,570 --> 00:09:43,540

technological and educational accomplishments that have come from research

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00:09:43,540 --> 00:09:45,690

on the space station to date that --

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00:09:45,690 --> 00:09:49,530

it has an impact on life at earth and so I'll give you a little bit

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00:09:49,530 --> 00:09:52,060

of context for the earth benefits.

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00:09:52,060 --> 00:09:55,250

When we talk about the value of the International Space Station,

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00:09:55,250 --> 00:09:57,230

we talk about it in the following ways.

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00:09:57,230 --> 00:10:02,660

We talk about it in a way -- we say a 3 by 3 messaging so we talk

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00:10:02,660 --> 00:10:04,400

about the engineering achievements --

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00:10:04,400 --> 00:10:04,610

>>Pat Ryan: Right.

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00:10:04,610 --> 00:10:07,280

>> Camille Alleyne: The benefits we have gotten from the engineering achievement

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00:10:07,280 --> 00:10:09,800

of building this extraordinary space craft.

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00:10:09,800 --> 00:10:12,000

We talk about the international achievement.

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00:10:12,000 --> 00:10:18,970

The fact that we have worked across the globe, five space agencies working together to develop,

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00:10:18,970 --> 00:10:23,170

design, assemble the International Space Station.

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00:10:23,170 --> 00:10:28,860

And finally the research accomplishment which is now fully being realized and those --

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00:10:28,860 --> 00:10:34,790

that's the benefit we get from the knowledge we gain by doing research on the space station.

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00:10:34,790 --> 00:10:37,470

And we've seen three benefits in that area.

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00:10:37,470 --> 00:10:43,610

Its scientific discovery which is the fundamental knowledge that we get from research,

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00:10:43,610 --> 00:10:46,070

things that could rewrite textbooks.

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00:10:46,070 --> 00:10:51,080

And then there are those things that would help us further explore space

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00:10:51,080 --> 00:10:52,930

and then there are the earth benefits.

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00:10:52,930 --> 00:10:57,570

And so in that context we launched this website to feature the earth benefits.

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00:10:57,570 --> 00:11:01,850

And we focused on three areas, human health, education,

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00:11:01,850 --> 00:11:05,860

and earth observation and disaster response.

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00:11:05,860 --> 00:11:08,530

And I can give an example in one --

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00:11:08,530 --> 00:11:09,810

>> Pat Ryan: Give me one.

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00:11:09,810 --> 00:11:12,140

>> Camille Alleyne: One example.

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00:11:12,140 --> 00:11:14,430

There's so many phenomenal examples

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00:11:14,430 --> 00:11:16,740

but the first one I'll talk about is neuroarm [phonetic].

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00:11:16,740 --> 00:11:23,910

It's in the area of human health and neuroarm came this family of space robots.

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00:11:23,910 --> 00:11:26,200

You know we had the Canada [inaudible] shuttle.

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00:11:26,200 --> 00:11:29,850

Now we have the Canada [inaudible] 2 [inaudible] on the space station

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00:11:29,850 --> 00:11:35,010

and so what biomedical engineers in Canada and physicians had been trying

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00:11:35,010 --> 00:11:41,940

to work towards was coming up with a technology that would assist in neurosurgery.

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00:11:41,940 --> 00:11:50,030

Right now when they -- when a patient is doing an MRI and there needs to be an operation done

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00:11:50,030 --> 00:11:56,930

in a specific place that's very sensitive, the best human hands can't accomplish that task.

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00:11:56,930 --> 00:12:03,000

And so they came up using the space robotic technology, applied that to developing a robot

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00:12:03,000 --> 00:12:10,640

that now assists in neurosurgery and dozens of people since 2008 have been treated successfully

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00:12:10,640 --> 00:12:14,040

with this kind of surgery and technology.

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00:12:14,040 --> 00:12:16,580

>> Pat Ryan: That's great and there -- I don't

want to spoil the surprise for everybody.

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00:12:16,580 --> 00:12:18,730

We'll let them read about  
some of the other things.

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00:12:18,730 --> 00:12:19,090

>> Camille Alleyne: Right.

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00:12:19,090 --> 00:12:19,900

Absolutely.

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00:12:19,900 --> 00:12:23,670

>> Pat Ryan: And the website, the  
Benefits for Humanity website, great.

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00:12:23,670 --> 00:12:28,060

>> Camille Alleyne: [www.nasa.gov/ISS/science](http://www.nasa.gov/ISS/science).

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00:12:28,060 --> 00:12:32,110

You go to research and technology, click  
benefits and you'll see the stories.

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00:12:32,110 --> 00:12:32,510

>> Pat Ryan: And good.

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00:12:32,510 --> 00:12:34,570

We put it up on the screens  
so people can see it too.

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00:12:34,570 --> 00:12:34,960

>> Camille Alleyne: Fantastic.

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00:12:34,960 --> 00:12:36,070

>> Pat Ryan: You know thanks very much.

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00:12:36,070 --> 00:12:37,210

>> Camille Alleyne: Thank  
you so much for having me.

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00:12:37,210 --> 00:12:37,720

>> Pat Ryan: I enjoyed the discussion.