
NASA

1
00:00:01,550 --> 00:00:03,410
>> Hi everybody at Saint Vincent Saint Mary.

2
00:00:03,410 --> 00:00:06,050
My name is Dan and I'm joined
here today by Tara Ruttley,

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00:00:06,050 --> 00:00:08,380
who's going to answer some of your questions.

4
00:00:08,380 --> 00:00:10,560
And like you said, we are sitting right now

5
00:00:10,560 --> 00:00:13,840
in the International Space
Station Mission Control Room,

6
00:00:13,840 --> 00:00:17,950
and this is where all the main console
positions are for controlling the systems

7
00:00:17,950 --> 00:00:23,150
on board the station, 24 7, 365 days a year.

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00:00:23,150 --> 00:00:26,440
So without further ado, if you guys
want to go ahead and get started,

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00:00:26,440 --> 00:00:29,920
Tara is very excited to take
some of your questions.

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00:00:29,920 --> 00:00:33,130
>> Yeah. Hey guys.

11
00:00:33,130 --> 00:00:39,570
I'm looking forward to talking with you today
and I'll give my best answers as possible.

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00:00:39,570 --> 00:00:44,010
I think you guys have some pretty good
questions planned, so give it a go.

13
00:00:44,010 --> 00:00:46,610
>> OK. Let's start with Scott.

14
00:00:46,610 --> 00:00:49,050
Introduce yourself and ask the question.

15
00:00:49,050 --> 00:00:50,730
>> Hi. This is Scott.

16
00:00:50,730 --> 00:00:52,350
[Inaudible] the thrill.

17
00:00:52,350 --> 00:00:55,050
What innovations have come from space travel

18
00:00:55,050 --> 00:00:58,000
and what innovations are expected
to come from space travel?

19
00:00:58,000 --> 00:01:00,080
>> OK. What kind of innovations?

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00:01:00,080 --> 00:01:02,810
Whew, boy, the list is a mile long.

21
00:01:02,810 --> 00:01:07,680
And, you know, even crossing my desk on a
regular basis, there are just things still

22
00:01:07,680 --> 00:01:11,110
in pouring from Apollo, but some of
the ones I think that you could relate

23
00:01:11,110 --> 00:01:15,880

to the most would be the
NASA DeBakey Heart Valve.

24
00:01:15,880 --> 00:01:22,790
So, for example, that's a heart valve that saves
a lot of lives, developed based on the concept

25
00:01:22,790 --> 00:01:27,010
of a design that was used in
a fuel pump for NASA vehicles.

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00:01:27,010 --> 00:01:31,340
So that's something that we've taken
just from NASA vehicle use all the way

27
00:01:31,340 --> 00:01:34,740
to how it gets inside of your, your heart.

28
00:01:34,740 --> 00:01:39,250
And Doctor DeBakey was instrumental in
working with NASA on translating that.

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00:01:39,250 --> 00:01:41,360
It's just one example.

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00:01:41,360 --> 00:01:46,660
Right now, for Space Station, I think what
you would find beneficial is something cool

31
00:01:46,660 --> 00:01:53,790
to know is with our ongoing work up on Station,
what's in the works is a vaccine development

32
00:01:53,790 --> 00:01:58,040
for food poisoning for salmonella bacteria.

33
00:01:58,040 --> 00:02:01,370
And so food poisoning, if
you've ever had it, is awful.

34
00:02:01,370 --> 00:02:02,860
But not only does it make you miserable,

35
00:02:02,860 --> 00:02:06,150
it actually kills around the
world thousands of folks.

36
00:02:06,150 --> 00:02:12,600
So, so we have found in space
that bacteria and some viruses,

37
00:02:12,600 --> 00:02:17,130
some of them actually become more aggressive
and not quite sure what's causing it,

38
00:02:17,130 --> 00:02:20,070
but something about the microgravity
environment.

39
00:02:20,070 --> 00:02:23,830
And so we've based on that and
that aggression that's tuned up,

40
00:02:23,830 --> 00:02:28,710
we've been able to identify the genes
responsible for that, that aggression.

41
00:02:28,710 --> 00:02:32,940
And when you know what's going on with a
particular gene, you can manipulate it,

42
00:02:32,940 --> 00:02:35,160
manipulate the proteins that come from it.

43
00:02:35,160 --> 00:02:41,620
And so a commercial company has actually
taken that data and flown a couple

44
00:02:41,620 --> 00:02:49,930

of their own samples and found a way to
create a vaccine targeting that specific gene

45
00:02:49,930 --> 00:02:53,370
against the food poisoning bacteria salmonella.

46
00:02:53,370 --> 00:02:57,140
So what you might potentially see is one
day out of this, it's still in the works,

47
00:02:57,140 --> 00:03:03,050
these things take awhile, is the
vaccine development for food poisoning.

48
00:03:03,050 --> 00:03:06,650
So I know if it were to come out,
I'd be the first in line, I think.

49
00:03:06,650 --> 00:03:11,080
It's an awful feeling to,
to have ingested salmonella.

50
00:03:11,080 --> 00:03:13,060
But these things do take time.

51
00:03:13,060 --> 00:03:15,940
That, that's something you might not
see for a few years as it's going

52
00:03:15,940 --> 00:03:17,840
through the FDA approval process now.

53
00:03:17,840 --> 00:03:21,560
But with regard to Station, I think
that's probably one of the more,

54
00:03:21,560 --> 00:03:24,640
one of the big things to look out for.

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00:03:24,640 --> 00:03:26,350
>> Definitely worth it too.

56
00:03:26,350 --> 00:03:29,080
OK, why don't we move on to the next question.

57
00:03:29,080 --> 00:03:32,770
>> OK. We'll have Greg ask the question.

58
00:03:32,770 --> 00:03:33,710
>> Hi. My name's Greg.

59
00:03:33,710 --> 00:03:39,790
I know, I was just wondering like how do
spacecraft like communicate with each other

60
00:03:39,790 --> 00:03:43,390
to make sure they don't cross paths,
considering that like, I don't know,

61
00:03:43,390 --> 00:03:48,530
direction is kind of relative, cause like
there's no direction I guess in space.

62
00:03:48,530 --> 00:03:50,830
So you don't have the Poles,
so you don't have a compass.

63
00:03:50,830 --> 00:03:55,430
How would you steer clear of
other spacecraft out in space?

64
00:03:55,430 --> 00:03:57,000
>> Yeah, that's a good question.

65
00:03:57,000 --> 00:04:02,090
So, for NASA, we know where all of our vehicles
are at all times, and this is controlled

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00:04:02,090 --> 00:04:05,690
on different levels across the
space agencies around the world.

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00:04:05,690 --> 00:04:10,090
And the space agencies around the world
communicate their launches and landings,

68
00:04:10,090 --> 00:04:15,780
and so at that level, we know what's
going on with regard to space flight,

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00:04:15,780 --> 00:04:18,820
whether it's a manned vehicle
or not, and our satellites.

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00:04:18,820 --> 00:04:21,970
Now there's a different level which is
probably at the level of the Defense,

71
00:04:21,970 --> 00:04:27,320
Department of Defense, that we at NASA have less
insight into, but we coordinate appropriately

72
00:04:27,320 --> 00:04:31,430
so that all the right agencies are all
tuned in to the right place to make sure

73
00:04:31,430 --> 00:04:38,330
that these trajectories are not, are
not critical or threatening with regard

74
00:04:38,330 --> 00:04:40,760
to everything that we have on the maps up there.

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00:04:40,760 --> 00:04:45,350
Now with regard to Space Station vehicles
visiting the Space Station, I know that we,

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00:04:45,350 --> 00:04:49,480

we work regularly with our
partners that are on Space Station,

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00:04:49,480 --> 00:04:53,080
and that would be Russia and Europe and Japan.

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00:04:53,080 --> 00:04:57,740
We all have manned and unmanned, well
Russia has manned and unmanned vehicles.

79
00:04:57,740 --> 00:05:00,390
Japan and Europe have unmanned vehicles.

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00:05:00,390 --> 00:05:02,110
And we all know when those are launching.

81
00:05:02,110 --> 00:05:03,450
We're all in tune with those.

82
00:05:03,450 --> 00:05:08,250
And so we plan around each other for
those because it's not just a matter

83
00:05:08,250 --> 00:05:11,970
of avoiding each other in space, but then
we have to sometimes share docking ports

84
00:05:11,970 --> 00:05:14,310
when we get to Space Station too.

85
00:05:14,310 --> 00:05:17,490
So I hope that answered your question.

86
00:05:17,490 --> 00:05:17,900
>> Alright.

87
00:05:17,900 --> 00:05:18,490
Next question.

88
00:05:18,490 --> 00:05:18,640
>> OK. [Inaudible]

89
00:05:18,640 --> 00:05:21,140
>> Hi. My name is Celeste.

90
00:05:21,140 --> 00:05:29,580
I was reading a little bit about
your zero gravity research facility

91
00:05:29,580 --> 00:05:33,430
and I thought it was really cool, so I was
wondering if you could just kind of tell me

92
00:05:33,430 --> 00:05:35,990
about some of the experiments they do there?

93
00:05:35,990 --> 00:05:44,450
>> So there are a couple of different what
I'd call analog rooms or facilities that are,

94
00:05:44,450 --> 00:05:47,660
that are analogous to what you
might experience in microgravity.

95
00:05:47,660 --> 00:05:49,930
And I'm not quite sure the
one that you're reading about,

96
00:05:49,930 --> 00:05:53,860
but it may be that you're referring
to the drop, the drop towers,

97
00:05:53,860 --> 00:06:01,360
in which you can take an experimental payload
up hundreds of feet, either high into the sky

98
00:06:01,360 --> 00:06:03,570
or deep down into the earth it'll fall.

99
00:06:03,570 --> 00:06:06,800
And you can drop it over a
period of maybe five seconds.

100
00:06:06,800 --> 00:06:11,510
And then with that drop, that's simulating
what you would experience at microgravity,

101
00:06:11,510 --> 00:06:13,250
because that's just really free fall.

102
00:06:13,250 --> 00:06:15,650
And you can, the types of
investigations I think that are good

103
00:06:15,650 --> 00:06:19,700
for this are combustion experiments,
where you can light a flame

104
00:06:19,700 --> 00:06:24,090
and just investigate what's happening with
that flame structure in a short amount of time.

105
00:06:24,090 --> 00:06:27,940
Even fluid physics experiments
are good for that.

106
00:06:27,940 --> 00:06:32,510
So I think any of the basic
fluid type, or gaseous type,

107
00:06:32,510 --> 00:06:35,350
experiments would be really good for that use.

108
00:06:35,350 --> 00:06:38,120
The human physiological experiments
obviously wouldn't be good for that

109

00:06:38,120 --> 00:06:43,350
because drop towers just use a package
of, of hardware that you just drop.

110
00:06:43,350 --> 00:06:49,510
Now if you are referring to the airplane,
there are parabolic airplanes that fly a series

111
00:06:49,510 --> 00:06:52,160
of parabolic arcs over the Gulf of Mexico.

112
00:06:52,160 --> 00:06:55,630
We have one here in Houston, and I
believe there's another one in Germany.

113
00:06:55,630 --> 00:06:59,390
Where you get about 30 seconds, once you're
at the top of that, that parabolee [phonetic],

114
00:06:59,390 --> 00:07:02,800
you get about 30 seconds of actual microgravity.

115
00:07:02,800 --> 00:07:06,870
And that's when you can activate
your investigation.

116
00:07:06,870 --> 00:07:09,970
So it's a little bit more, it
gives you a little bit more time

117
00:07:09,970 --> 00:07:12,920
than the drop towers, and
it's probably more useful.

118
00:07:12,920 --> 00:07:18,050
I've seen some human physiology experiments that
have been able to be performed in those kind

119
00:07:18,050 --> 00:07:24,790
of situations, particularly with regard to

exercise type of experiments and just taking,

120
00:07:24,790 --> 00:07:27,800
you know, looking at heart
rate and changes in physiology.

121
00:07:27,800 --> 00:07:33,100
But obviously, it's the longer period of time
you can get, I think it's the more beneficial.

122
00:07:33,100 --> 00:07:34,680
>> And a lot.

123
00:07:34,680 --> 00:07:38,610
Like you were talking about, any of the analogs
that we do here on the ground are just pale

124
00:07:38,610 --> 00:07:41,760
in comparison to the amount of time you can
get up on the International Space Station.

125
00:07:41,760 --> 00:07:41,850
>> Uh huh.

126
00:07:41,850 --> 00:07:47,110
Yeah. The Space Station is the scientist's dream
because, and you're talking months and months

127
00:07:47,110 --> 00:07:50,030
and months of being able to
operate an investigation on orbit.

128
00:07:50,030 --> 00:07:54,010
And the cool thing about Space Station,
it's, it's analogous to a real laboratory.

129
00:07:54,010 --> 00:07:58,160
If you were a scientist, you don't do one
experiment once and, and solve your hypothesis

130
00:07:58,160 --> 00:07:59,820
and come to a conclusion right away.

131
00:07:59,820 --> 00:08:02,510
You do that same experiment multiple times,

132
00:08:02,510 --> 00:08:06,150
and you manipulate all the
different variables that you can.

133
00:08:06,150 --> 00:08:09,020
And the you thing you can't manipulate
here on the ground is gravity.

134
00:08:09,020 --> 00:08:14,090
You can manipulate that in, in Space
Station, and you're afforded the facilities

135
00:08:14,090 --> 00:08:18,140
and the timeline that you need to be able to
repeat your experiment over and over again

136
00:08:18,140 --> 00:08:21,090
so that you can arrive at
a, at a final conclusion

137
00:08:21,090 --> 00:08:23,240
and see if it, you can test your hypothesis.

138
00:08:23,240 --> 00:08:24,220
So that's cool.

139
00:08:24,220 --> 00:08:24,830
>> Very cool.

140
00:08:24,830 --> 00:08:25,420
>> Yeah.

141

00:08:25,420 --> 00:08:28,240
>> OK. Next question please.

142
00:08:28,240 --> 00:08:29,090
>> Mike.

143
00:08:29,090 --> 00:08:30,440
>> Hi. I'm Mike.

144
00:08:30,440 --> 00:08:36,260
I was just wondering about how far does
this space station travel in one day.

145
00:08:36,260 --> 00:08:39,720
>> I think it, doesn't it orbit
the earth about 90 times a day?

146
00:08:39,720 --> 00:08:42,110
Is that, no, no I'm sorry, 15 times a day, so

147
00:08:42,110 --> 00:08:43,470
>> It orbit's about 15 times a day

148
00:08:43,470 --> 00:08:43,680
>> Yeah.

149
00:08:43,680 --> 00:08:45,710
>> and [inaudible] one orbit
roughly every 90 minutes.

150
00:08:45,710 --> 00:08:46,400
>> Every 90 minutes.

151
00:08:46,400 --> 00:08:52,900
Yeah. So that's about 17,500 miles an hour,
I believe is what the, what the stats are.

152
00:08:52,900 --> 00:08:56,600
>> So, it travels about 17,500 miles an hour.

153
00:08:56,600 --> 00:09:01,570
Times that by 24, it's a little over
400,000, about 420,000 miles in one day.

154
00:09:01,570 --> 00:09:02,990
>> Whew.

155
00:09:02,990 --> 00:09:04,320
>> So, pretty far.

156
00:09:04,320 --> 00:09:08,010
Next question please.

157
00:09:08,010 --> 00:09:09,630
>> OK. Bennett.

158
00:09:09,630 --> 00:09:11,780
>> Hi. I'm Ryan.

159
00:09:11,780 --> 00:09:15,810
I know that space travel can put the
human body through a lot of stress.

160
00:09:15,810 --> 00:09:18,960
What kind of medical testing
does an astronaut have to go

161
00:09:18,960 --> 00:09:22,550
through to be physically and
mentally fit for a launch?

162
00:09:22,550 --> 00:09:23,980
>> That's a good question.

163
00:09:23,980 --> 00:09:29,560
And I think there are standard tests that
have been, that have been performed at NASA

164
00:09:29,560 --> 00:09:32,870
through the history of NASA, but it,
but it actually changes with different,

165
00:09:32,870 --> 00:09:34,130
with the different launch programs.

166
00:09:34,130 --> 00:09:39,470
So, for shuttle, when you're looking at shorter
duration of maybe two weeks max for a flight,

167
00:09:39,470 --> 00:09:43,080
they're a little bit different than what they
go through these days to be able to qualify

168
00:09:43,080 --> 00:09:47,000
for long duration stays on Station,
which could be up to six months.

169
00:09:47,000 --> 00:09:52,830
So for Station, you really want to focus on
a history of kidney stones or renal stones.

170
00:09:52,830 --> 00:09:55,580
You want to maybe take a
good look at their vision.

171
00:09:55,580 --> 00:09:59,340
Make sure it's correctable if it's,
if it's dropping off a little bit.

172
00:09:59,340 --> 00:10:03,850
Cardiovascular-wise, their, their
heart needs to be in really good shape.

173
00:10:03,850 --> 00:10:08,340
Muscle. They need to build muscle, because
all of these things are actually affected

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00:10:08,340 --> 00:10:09,690
in that microgravity environment.

175
00:10:09,690 --> 00:10:13,290
For example, once you're on
orbit and you're free falling

176
00:10:13,290 --> 00:10:17,200
and you're not using your postural muscles
like you are to stand up all the time,

177
00:10:17,200 --> 00:10:21,510
or walk around like you do here in
gravity, those muscles start to break down.

178
00:10:21,510 --> 00:10:22,490
It's use or lose, right?

179
00:10:22,490 --> 00:10:23,780
So they start to atrophy.

180
00:10:23,780 --> 00:10:27,600
So one thing they need to be sure of is that
they have really good muscle strength and tone

181
00:10:27,600 --> 00:10:30,910
and mass before they, before they get up there.

182
00:10:30,910 --> 00:10:33,820
The other thing is cardiovascular-wise,

183
00:10:33,820 --> 00:10:37,540
once you're in space, all
of the fluid tends to shift.

184
00:10:37,540 --> 00:10:41,200
It's because of surface tension and the fact
that you're not using your legs anymore.

185

00:10:41,200 --> 00:10:43,150
All of the fluid in your body, the blood flows,

186
00:10:43,150 --> 00:10:46,270
tends to shift towards your
central cavity and your head.

187
00:10:46,270 --> 00:10:51,360
So what that means is that the heart
doesn't, you know the heart starts to,

188
00:10:51,360 --> 00:10:52,720
just doesn't have to work so hard.

189
00:10:52,720 --> 00:10:56,540
So the cardiovascular system
starts to get deconditioned.

190
00:10:56,540 --> 00:11:01,630
And the other thing is, we found recently that
the vision starts to deteriorate on orbit.

191
00:11:01,630 --> 00:11:05,580
Not quite sure what's causing that, but it's
happening more in the long duration astronauts.

192
00:11:05,580 --> 00:11:11,350
And with regard to kidney stones, you
really don't want to be susceptible that,

193
00:11:11,350 --> 00:11:14,580
because when you're on orbit and you're
not walking around a lot, you're,

194
00:11:14,580 --> 00:11:16,970
you're not getting that impact on bone.

195
00:11:16,970 --> 00:11:21,420
Bone stays healthy because you're loading
it constantly when you walk and run.

196
00:11:21,420 --> 00:11:26,850
In space, you miss that load, so you tend
to start the bones -- use or lose, right?

197
00:11:26,850 --> 00:11:30,190
There's, there's little cells in there
that start to break that bone apart

198
00:11:30,190 --> 00:11:32,350
and it doesn't remodel as quickly.

199
00:11:32,350 --> 00:11:35,570
So the breakdown of that bone goes
through the cardiovascular system,

200
00:11:35,570 --> 00:11:40,330
gets filtered through the kidneys, and you
could end up with that mineral in your kidneys,

201
00:11:40,330 --> 00:11:42,020
creating what's called the kidney stone.

202
00:11:42,020 --> 00:11:45,210
So you definitely don't want
to be susceptible to that.

203
00:11:45,210 --> 00:11:50,340
So there a few key things that we look at
for long duration flight in the astronauts,

204
00:11:50,340 --> 00:11:53,250
but most of the time you hear our,
our astronauts are really fit.

205
00:11:53,250 --> 00:11:54,570
They can run far and fast.

206
00:11:54,570 --> 00:11:59,580

And some can run faster than others, you know, and it just varies by individual,

207
00:11:59,580 --> 00:12:02,410
but we do try to meet the basics.

208
00:12:02,410 --> 00:12:02,970
>> Alright.

209
00:12:02,970 --> 00:12:03,370
Thanks Tara.

210
00:12:03,370 --> 00:12:06,730
Next question please.

211
00:12:06,730 --> 00:12:07,100
>> OK.

212
00:12:07,100 --> 00:12:08,050
>> Hi. I'm Dan.

213
00:12:08,050 --> 00:12:14,010
Does debris from the spacecraft break down if it's released into space?

214
00:12:14,010 --> 00:12:15,130
>> That's a good question.

215
00:12:15,130 --> 00:12:16,870
It depends on the type of debris.

216
00:12:16,870 --> 00:12:22,650
You know, although there's not technically oxygen in space, there's still atomic oxygen,

217
00:12:22,650 --> 00:12:26,830
and atomic oxygen is a small, little -- it's a little component if you're familiar with it --

218
00:12:26,830 --> 00:12:30,560
that it just travels super fast, and
depending on what the material is,

219
00:12:30,560 --> 00:12:34,430
that material could be subject
to, to breakdown, by just.

220
00:12:34,430 --> 00:12:38,620
Atomic oxygen is just one example, but
ultraviolet radiation, ionizing radiation,

221
00:12:38,620 --> 00:12:44,380
all the different types of little components
that are still actually out there in space that,

222
00:12:44,380 --> 00:12:48,470
that, that are constantly bombarding
the, the metal and the debris.

223
00:12:48,470 --> 00:12:52,420
And so we actually have an investigation on
Space Station right now that's called Misse,

224
00:12:52,420 --> 00:12:58,210
M I S S E, and it's a pallet just
sitting externally on the space station

225
00:12:58,210 --> 00:13:02,960
that has all these different types of
materials on it, and so what we use it

226
00:13:02,960 --> 00:13:05,020
for is we just subject all those materials

227
00:13:05,020 --> 00:13:08,240
to whatever is happening
out there in, in, in space.

228

00:13:08,240 --> 00:13:13,050
So, and we get those samples back and we look
at what happened here, and we look at them

229
00:13:13,050 --> 00:13:16,880
under microscopes and we do destructive
testing and, and all these other things,

230
00:13:16,880 --> 00:13:20,610
and so we get good input as to what
materials actually are more susceptible

231
00:13:20,610 --> 00:13:23,530
to the damaging effects of
the space environment.

232
00:13:23,530 --> 00:13:25,360
Some are more so than others.

233
00:13:25,360 --> 00:13:30,610
Some of those samples right now, actually, have
the future spacesuit design samples on there,

234
00:13:30,610 --> 00:13:33,160
so that'd be kind of neat
to get those results back.

235
00:13:33,160 --> 00:13:36,870
But so far, some of the investigation
samples have come back on that.

236
00:13:36,870 --> 00:13:41,330
We've already, we've already made changes
in some of our satellite material designs

237
00:13:41,330 --> 00:13:42,880
and solar ray designs just based

238
00:13:42,880 --> 00:13:45,340
on the information we're getting

back from these Misse investigations.

239
00:13:45,340 --> 00:13:47,520
So, so it's a really good question.

240
00:13:47,520 --> 00:13:51,580
That information is still, still going on and
we're still trying to figure that one out.

241
00:13:51,580 --> 00:13:52,290
>> Alright.

242
00:13:52,290 --> 00:13:55,130
Cool. Next question please.

243
00:13:55,130 --> 00:13:58,960
>> Brian Davis

244
00:13:58,960 --> 00:14:00,830
>> Hi. I'm Brian.

245
00:14:00,830 --> 00:14:05,700
And do you have to take into account the
gravitational pull of the other planets

246
00:14:05,700 --> 00:14:10,210
and stars when you calculate the space
station's orbit, or is it just so small

247
00:14:10,210 --> 00:14:13,130
that it doesn't have to be taken into account?

248
00:14:13,130 --> 00:14:17,570
>> Right. So technically, Space Station
is still in LEO -- Low Earth Orbit --

249
00:14:17,570 --> 00:14:22,090
and so we're still technically under
the effects of Earth's gravity.

250
00:14:22,090 --> 00:14:22,840
Big time, still.

251
00:14:22,840 --> 00:14:26,630
Even though it's at the micro value,
because we call it microgravity,

252
00:14:26,630 --> 00:14:31,290
so I'm not an orbital mechanics expert,
but I don't believe they have to take

253
00:14:31,290 --> 00:14:33,810
into effect the calculation of other bodies.

254
00:14:33,810 --> 00:14:37,710
I think those are so far out and so
far away from our Low Earth Orbit.

255
00:14:37,710 --> 00:14:41,760
I would imagine the further out you go, you do
have to take these things into consideration,

256
00:14:41,760 --> 00:14:48,000
but with Station being so still within the pull
of gravity, I don't believe those are factors.

257
00:14:48,000 --> 00:14:48,460
>> Alright.

258
00:14:48,460 --> 00:14:49,820
Next question please.

259
00:14:49,820 --> 00:14:50,590
>> Alright.

260
00:14:50,590 --> 00:14:50,900
[Inaudible] there.

261
00:14:50,900 --> 00:14:53,040
Go ahead.

262
00:14:54,050 --> 00:14:55,340
>> Hello. I'm [inaudible].

263
00:14:55,340 --> 00:14:58,800
What would be some practical
uses of microgravity

264
00:14:58,800 --> 00:15:02,110
that could be applied to everyday life on Earth?

265
00:15:02,110 --> 00:15:04,320
>> Ah, so gee, practical uses.

266
00:15:04,320 --> 00:15:07,160
Wouldn't it be fun if we could
just take microgravity down here

267
00:15:07,160 --> 00:15:09,620
and practically apply it directly.

268
00:15:09,620 --> 00:15:10,210
>> [Inaudible] fly around.

269
00:15:10,210 --> 00:15:12,870
>> Kind of fly around and translate.

270
00:15:12,870 --> 00:15:18,290
But, but, but indirectly, certainly
some of the investigations, I think,

271
00:15:18,290 --> 00:15:20,890
that are happening with Space Station right now.

272
00:15:20,890 --> 00:15:23,690
It's a, it's a laboratory that investigates,

273
00:15:23,690 --> 00:15:26,640
you've got to have why microgravity
-- why, why, why.

274
00:15:26,640 --> 00:15:31,720
And so practically speaking, in my mind, when
I'm asked that question, I think people want

275
00:15:31,720 --> 00:15:35,900
to hear direct Earth benefits, but to
me it's partly about discovery too.

276
00:15:35,900 --> 00:15:39,600
Like, we think we know who we
are and how the body develops,

277
00:15:39,600 --> 00:15:42,790
but for example, how would a person develop?

278
00:15:42,790 --> 00:15:47,990
Think about how you're designed, your muscles,
your bones, your brain, your eye shape,

279
00:15:47,990 --> 00:15:54,600
just the whole shape and way that we move is
designed based on that gravity environment.

280
00:15:54,600 --> 00:15:58,560
So to me, it's about finding out what
happens when you take that microgravity away.

281
00:15:58,560 --> 00:16:03,950
What happens when you have a developing,
living being in a microgravity environment?

282
00:16:03,950 --> 00:16:05,080
What can we learn?

283

00:16:05,080 --> 00:16:06,280
How will it look different?

284
00:16:06,280 --> 00:16:08,070
Or how will it function differently?

285
00:16:08,070 --> 00:16:13,640
Plants have evolved around microgravity, around
the presence of gravity for millions of years,

286
00:16:13,640 --> 00:16:15,920
and they are very, very highly sensitive to it.

287
00:16:15,920 --> 00:16:21,390
So it's things like the fundamental
discoveries, for example, fluid flow.

288
00:16:21,390 --> 00:16:24,760
Fluid behaves completely different
in a microgravity environment,

289
00:16:24,760 --> 00:16:31,400
and I don't think of course the average person's
not aware of it, but it, it, it behaves in ways

290
00:16:31,400 --> 00:16:37,770
that we've never seen on the ground, but by
knowing, by being able to collect that data,

291
00:16:37,770 --> 00:16:40,600
we can create models that
benefit things here on the ground.

292
00:16:40,600 --> 00:16:46,390
For example, like cleaning up pollution
in the soil, figuring out better ways to,

293
00:16:46,390 --> 00:16:53,610
to water our plants because, because those,
because soil is a complex environment

294
00:16:53,610 --> 00:16:56,850
and fluid flows complex through
that complex environment.

295
00:16:56,850 --> 00:17:02,750
And we actually don't have any clue as to,
as to how to predict fluid flow through soil.

296
00:17:02,750 --> 00:17:04,920
Imagine what that might mean for flooding.

297
00:17:04,920 --> 00:17:09,840
And just imagine what that might mean
for crop production and maybe draught.

298
00:17:09,840 --> 00:17:13,090
So there are these fundamental
discoveries that I think are cool,

299
00:17:13,090 --> 00:17:17,410
just by being on Space Station, but what
we really care about here are the things

300
00:17:17,410 --> 00:17:20,620
like cleaning up the soil pollution, the,

301
00:17:20,620 --> 00:17:25,390
the vaccine development for
things like food poisoning.

302
00:17:25,390 --> 00:17:29,380
Another one that I think was really cool
that came from Space Station was improvements

303
00:17:29,380 --> 00:17:32,270
on existing cancer treatment technology.

304
00:17:32,270 --> 00:17:34,930

You know, cancer, there's, there's
a way that you can treat cancer.

305
00:17:34,930 --> 00:17:39,170
It's been done since the 70's, and it's
by taking these little micro-balloons

306
00:17:39,170 --> 00:17:41,550
and filling them with anti-tumor drugs,

307
00:17:41,550 --> 00:17:44,930
and actually injecting them
right into the site of the tumor.

308
00:17:44,930 --> 00:17:49,170
And what some NASA scientists did was they
thought, hey, we don't know what we don't know.

309
00:17:49,170 --> 00:17:54,640
What happens if we send a machine up to Space
Station and use that microgravity environment

310
00:17:54,640 --> 00:17:58,660
to see how we can manipulate
fluid mixing in space

311
00:17:58,660 --> 00:18:03,990
and maybe create improvements
on these little micro-bubbles.

312
00:18:03,990 --> 00:18:05,980
And that's called micro encapsulation.

313
00:18:05,980 --> 00:18:06,630
And so they did.

314
00:18:06,630 --> 00:18:11,410
They sent a machine up to Space Station, made
some micro-balloons, sent them back to Earth,

315
00:18:11,410 --> 00:18:16,370
investigated them, found brand new
properties of these things, and were able to,

316
00:18:16,370 --> 00:18:20,770
in their own laboratory testing
studies, show an improvement in, in,

317
00:18:20,770 --> 00:18:23,720
in rat prostate treatment in cancer.

318
00:18:23,720 --> 00:18:27,370
So, it was I think it was
by 60 percent improvement.

319
00:18:27,370 --> 00:18:31,170
And so this team has now gone off and
patented a machine that can do the same thing.

320
00:18:31,170 --> 00:18:34,930
It can actually replicate what was
done in a microgravity environment,

321
00:18:34,930 --> 00:18:39,030
and now they're about to go through,
they're raising funds right now to go

322
00:18:39,030 --> 00:18:43,670
through clinical trials at MD Anderson,
which is a major cancer center.

323
00:18:43,670 --> 00:18:46,830
But it's, it's things like, we
don't know what we don't know,

324
00:18:46,830 --> 00:18:48,910
and sometimes you do it because of that.

325
00:18:48,910 --> 00:18:53,940

Sometimes you do it because we want to
improve fluid flow predictions in space

326
00:18:53,940 --> 00:18:57,640
because it helps us design better fuel tanks,
but it also helps us to clean up our soil.

327
00:18:57,640 --> 00:19:01,090
So for me, it's just fundamental
discovery and you can take just

328
00:19:01,090 --> 00:19:04,910
about every fundamental discovery
and apply it to your everyday life.

329
00:19:04,910 --> 00:19:07,530
And, it's just, the list is long.

330
00:19:07,530 --> 00:19:10,380
But it's a good list.

331
00:19:10,380 --> 00:19:12,620
>> It is incredibly long.

332
00:19:12,620 --> 00:19:14,690
Alright, next question please.

333
00:19:14,690 --> 00:19:15,910
>> OK [inaudible].

334
00:19:15,910 --> 00:19:23,260
>> Hi. My name is Meredith, and I was wondering
that, if there was like a natural disaster

335
00:19:23,260 --> 00:19:28,820
or nuclear war or something to happen here
on Earth and everyone on Earth was killed,

336
00:19:28,820 --> 00:19:34,150

what would the astronauts that are
in the space station supposed to do.

337
00:19:34,150 --> 00:19:36,130
>> I think they'd have to figure that one out.

338
00:19:36,130 --> 00:19:39,330
If no one was left on the
planet, do they want to come home?

339
00:19:39,330 --> 00:19:40,570
>> Kind of be left on their own.

340
00:19:40,570 --> 00:19:41,580
>> They kind of, yeah.

341
00:19:41,580 --> 00:19:45,150
>> We don't have any protocols
like that in place.

342
00:19:45,150 --> 00:19:49,700
>> Although the, I think the return
vehicles, the Soyuz up there,

343
00:19:49,700 --> 00:19:51,510
could technically send them home, right?

344
00:19:51,510 --> 00:19:53,520
Even if no one was manning the station.

345
00:19:53,520 --> 00:19:58,780
>> They could, but the return vehicles have
an on orbit lifetime of only about 200 days.

346
00:19:58,780 --> 00:20:00,560
>> So they'd have to figure out fast what their

347
00:20:00,560 --> 00:20:02,320
>> So they could either stay

on board the station,

348
00:20:02,320 --> 00:20:06,830
which has limited consumables,
or come back down to the earth.

349
00:20:06,830 --> 00:20:10,900
>> And so then I guess it's up to your
imagination as to what happens next.

350
00:20:10,900 --> 00:20:12,250
>> It would be a difficult choice.

351
00:20:12,250 --> 00:20:14,160
>> Yeah.

352
00:20:14,160 --> 00:20:14,570
>> Alright.

353
00:20:14,570 --> 00:20:16,750
Next question please.

354
00:20:16,750 --> 00:20:18,110
>> Isabella.

355
00:20:18,110 --> 00:20:22,850
>> Hi. Is it true that flames
become spherical in microgravity?

356
00:20:22,850 --> 00:20:23,630
>> Yeah, it is.

357
00:20:23,630 --> 00:20:24,570
That's a good question.

358
00:20:24,570 --> 00:20:26,230
There's an investigation.

359

00:20:26,230 --> 00:20:29,360
Actually, they did part of it this week.

360
00:20:29,360 --> 00:20:32,850
There's lots of combustion and
flame experiments in microgravity.

361
00:20:32,850 --> 00:20:37,770
But this one in particular is called
SLICE, S L I C E. And you can look it

362
00:20:37,770 --> 00:20:40,030
up at nasa.gov if you're interested.

363
00:20:40,030 --> 00:20:41,770
I think we may have even written a story on it.

364
00:20:41,770 --> 00:20:46,660
But yeah, because there's no, there's
no gravity, so when, when you,

365
00:20:46,660 --> 00:20:51,510
when you light a flame in gravity, right,
the hot air will, you know, rise to the top,

366
00:20:51,510 --> 00:20:54,140
and the cold air will just
start, that's how you circulate.

367
00:20:54,140 --> 00:20:56,070
The hot air rises to the
top and then the cold part

368
00:20:56,070 --> 00:20:59,200
of the flame will just get
heated and moved to the top.

369
00:20:59,200 --> 00:21:03,840
But without, without, that's part
buoyancy and part convection.

370
00:21:03,840 --> 00:21:07,120
But without, without gravity, and you
get this microgravity environment,

371
00:21:07,120 --> 00:21:11,180
now you don't have buoyancy or minimal
buoyancy, you have minimal convection.

372
00:21:11,180 --> 00:21:16,730
So, so the flame tends to just stay in a
spherical ball just attracted to itself,

373
00:21:16,730 --> 00:21:21,730
rather than being able to have that hot air rise
up in the way that you see it here on the earth.

374
00:21:21,730 --> 00:21:24,140
So in space, you don't get
that hot air that's rising up.

375
00:21:24,140 --> 00:21:28,700
The hot air, the hot, the hot part of the
flame just stays in a ball to each other.

376
00:21:28,700 --> 00:21:29,530
It's where it's happiest.

377
00:21:29,530 --> 00:21:32,980
It's molecules are, are, more, more efficient.

378
00:21:32,980 --> 00:21:37,460
And so, so yeah, everything that we
use in space that has anything to do

379
00:21:37,460 --> 00:21:39,530
with the flame has to be treated differently.

380
00:21:39,530 --> 00:21:43,420

Every kind of, not only experiment,
but system that might use that.

381
00:21:43,420 --> 00:21:48,070
So, so the investigation that
happened this week is actually looking

382
00:21:48,070 --> 00:21:50,600
at something called flame detachment.

383
00:21:50,600 --> 00:21:53,620
How is a flame, truly, they're
getting the characteristics.

384
00:21:53,620 --> 00:21:57,500
You know we've got these nice pictures
that you alluded to, but we're truly trying

385
00:21:57,500 --> 00:22:02,990
to understand, really zone in on the,
the characteristic structure of a flame

386
00:22:02,990 --> 00:22:06,140
in microgravity and gain
more information of that.

387
00:22:06,140 --> 00:22:12,490
Not just that, but also the amount of soot
that's produced in microgravity from a flame.

388
00:22:12,490 --> 00:22:18,060
And so the combustion affects fire in
space such that it produces more soot

389
00:22:18,060 --> 00:22:20,100
than a flame would produce on the ground.

390
00:22:20,100 --> 00:22:22,290
And that was a pretty interesting
finding, because that,

391
00:22:22,290 --> 00:22:28,140
that means a lot of different things to be
able to detect smoke instances on orbit.

392
00:22:28,140 --> 00:22:30,160
Our smoke detectors would have, you know, are,

393
00:22:30,160 --> 00:22:34,740
are designed to specifically
address the soot formation in a way

394
00:22:34,740 --> 00:22:37,090
that we had never developed here on Earth.

395
00:22:37,090 --> 00:22:43,450
So, so yeah, flames are just one way, one thing
that behaves differently thanks to the minimized

396
00:22:43,450 --> 00:22:47,030
or the massed buoyancy and
convection affects of microgravity.

397
00:22:47,030 --> 00:22:47,580
>> Alright.

398
00:22:47,580 --> 00:22:51,840
And I think we have time for one more question.

399
00:22:51,840 --> 00:22:53,510
Real quick.

400
00:22:53,510 --> 00:22:58,230
[Inaudible audience comments]

401
00:22:58,230 --> 00:22:58,970
>> Hi. I'm Erica.

402

00:22:58,970 --> 00:23:01,990
I was just wondering about
how much force is needed

403
00:23:01,990 --> 00:23:04,570
for a spacecraft to break
through the atmosphere.

404
00:23:04,570 --> 00:23:08,660
>> I don't know numbers, exactly, but it's my
understanding it would have to be a velocity

405
00:23:08,660 --> 00:23:13,000
at an angle great enough to be able to
escape, to create enough energy to be able

406
00:23:13,000 --> 00:23:17,760
to escape Earth's gravity, which is what
guys, 9 point 8 meters per second squared?

407
00:23:17,760 --> 00:23:19,550
Do you know any numbers?

408
00:23:19,550 --> 00:23:21,140
>> I don't know exact numbers.

409
00:23:21,140 --> 00:23:23,900
A lot of times people confuse
it with escape velocity.

410
00:23:23,900 --> 00:23:24,630
>> Yeah, yeah.

411
00:23:24,630 --> 00:23:28,570
>> Which, if that was true, you'd have
to be going about 25,000 miles an hour,

412
00:23:28,570 --> 00:23:31,900
but that's if you had no
more propulsion behind you.

413
00:23:31,900 --> 00:23:32,570
>> Yeah.

414
00:23:32,570 --> 00:23:36,730
>> So it's actually a fairly difficult
question, but if you just look at the speeds

415
00:23:36,730 --> 00:23:42,010
that our spacecraft attain, they get about
17,500 miles just to maintain an orbit,

416
00:23:42,010 --> 00:23:47,280
so if you continued on that path, you could
feasibly escape Earth's gravity at that speed,

417
00:23:47,280 --> 00:23:49,800
as long as you still had
propulsion pushing you outwards.

418
00:23:49,800 --> 00:23:50,740
>> Yeah. Right.

419
00:23:50,740 --> 00:23:53,500
And I would imagine at the level of
launch, if you're talking about launch,

420
00:23:53,500 --> 00:23:56,590
it probably is vehicle-dependent too.

421
00:23:56,590 --> 00:23:57,120
So.

422
00:23:57,120 --> 00:23:57,680
>> Alright.

423
00:23:57,680 --> 00:24:00,000
Well, that'll about wrap it up with us today.

424
00:24:00,000 --> 00:24:02,270
I really want to thank you
guys for your great questions.

425
00:24:02,270 --> 00:24:02,630
>> Yeah, thank you.

426
00:24:02,630 --> 00:24:03,680
It's good talking to you guys.

427
00:24:03,680 --> 00:24:05,740
>> And it was great talking to you guys.