



1
00:00:19,830 --> 00:00:17,269
good morning i'm tabitha thompson with

2
00:00:21,990 --> 00:00:19,840
nasa's office of communication welcome

3
00:00:24,070 --> 00:00:22,000
to what's on board at nasa's kennedy

4
00:00:25,670 --> 00:00:24,080
space center over the next hour we'll

5
00:00:27,429 --> 00:00:25,680
discuss research investigations

6
00:00:29,109 --> 00:00:27,439
launching on the upcoming spacex

7
00:00:30,470 --> 00:00:29,119
resupply mission to the international

8
00:00:33,110 --> 00:00:30,480
space station

9
00:00:35,030 --> 00:00:33,120
in addition to crew supplies the space

10
00:00:37,510 --> 00:00:35,040
craft will deliver new experiments that

11
00:00:38,709 --> 00:00:37,520
have the potential to improve life on

12
00:00:40,229 --> 00:00:38,719
earth

13
00:00:42,310 --> 00:00:40,239

in addition to taking questions from

14

00:00:44,150 --> 00:00:42,320

people attending in person for the

15

00:00:46,150 --> 00:00:44,160

launch you can submit questions via

16

00:00:47,750 --> 00:00:46,160

social media with

17

00:00:49,830 --> 00:00:47,760

ask nasa

18

00:00:51,510 --> 00:00:49,840

joining us first are tara rutley

19

00:00:53,590 --> 00:00:51,520

associate program scientist for the

20

00:00:55,270 --> 00:00:53,600

international space station and patrick

21

00:00:57,350 --> 00:00:55,280

o'neill with the center for the

22

00:00:59,430 --> 00:00:57,360

advancement of science in space which

23

00:01:07,030 --> 00:00:59,440

manages the us national lab on the space

24

00:01:12,870 --> 00:01:09,990

thank you let's see good morning it's

25

00:01:15,030 --> 00:01:12,880

very cool to be here i want to just open

26

00:01:17,109 --> 00:01:15,040

by saying patrick and i are excited to

27

00:01:18,469 --> 00:01:17,119

have a little coffee chat with you guys

28

00:01:19,830 --> 00:01:18,479

this morning about the science that's

29

00:01:21,109 --> 00:01:19,840

going up on the international space

30

00:01:22,550 --> 00:01:21,119

station

31

00:01:24,550 --> 00:01:22,560

i don't know about you it's been a long

32

00:01:25,910 --> 00:01:24,560

time since i've been here at ksc and

33

00:01:28,070 --> 00:01:25,920

when i drove up this morning there's

34

00:01:29,910 --> 00:01:28,080

nothing like the sight of everything

35

00:01:32,230 --> 00:01:29,920

that's happening out there it's very

36

00:01:33,910 --> 00:01:32,240

alive it's very exciting to be here i

37

00:01:36,069 --> 00:01:33,920

think the audience here is really ramped

38

00:01:38,469 --> 00:01:36,079

up and we're all just excited to see

39

00:01:40,230 --> 00:01:38,479

what's happening here tomorrow but i'm

40

00:01:42,230 --> 00:01:40,240

really excited about the science that's

41

00:01:44,630 --> 00:01:42,240

happening on the space station um that's

42

00:01:46,389 --> 00:01:44,640

where i'm from and that's why we have

43

00:01:49,030 --> 00:01:46,399

the space station is to do

44

00:01:50,230 --> 00:01:49,040

research and develop technology

45

00:01:52,069 --> 00:01:50,240

patrick's going to tell you a lot about

46

00:01:54,310 --> 00:01:52,079

why we do it for benefits on earth we

47

00:01:56,950 --> 00:01:54,320

also do it for exploration and this

48

00:01:59,670 --> 00:01:56,960

particular spacex launch is going to

49

00:02:01,670 --> 00:01:59,680

send supplies and research up that's

50

00:02:03,350 --> 00:02:01,680

going to support over well just about

51
00:02:05,670 --> 00:02:03,360
300 investigations that's going to be

52
00:02:07,670 --> 00:02:05,680
happening over the next six month period

53
00:02:09,270 --> 00:02:07,680
they're going to represent those

54
00:02:12,470 --> 00:02:09,280
investigations are going to represent

55
00:02:14,309 --> 00:02:12,480
800 scientists work on the ground around

56
00:02:16,309 --> 00:02:14,319
the planet that's going to be done by

57
00:02:18,550 --> 00:02:16,319
six people on orbit

58
00:02:20,630 --> 00:02:18,560
so the science is being multiplied the

59
00:02:22,150 --> 00:02:20,640
technology the advancements in how we do

60
00:02:24,550 --> 00:02:22,160
business and how we understand how

61
00:02:26,070 --> 00:02:24,560
things behave is going to be advanced

62
00:02:28,229 --> 00:02:26,080
over the next several months because of

63
00:02:30,229 --> 00:02:28,239

this particular flight and we get to get

64

00:02:31,990 --> 00:02:30,239

samples home because of the spacex

65

00:02:33,350 --> 00:02:32,000

return vehicle as well

66

00:02:34,869 --> 00:02:33,360

so why do we do

67

00:02:37,350 --> 00:02:34,879

science in space

68

00:02:39,270 --> 00:02:37,360

most of you probably have some kind of a

69

00:02:40,470 --> 00:02:39,280

clue if you're here you know why for

70

00:02:41,750 --> 00:02:40,480

those of you who are just kind of you

71

00:02:44,229 --> 00:02:41,760

know asking yourselves i don't really

72

00:02:45,589 --> 00:02:44,239

know um you know because it's cool

73

00:02:48,390 --> 00:02:45,599

because because things behave

74

00:02:50,710 --> 00:02:48,400

differently yeah it's a resource

75

00:02:53,270 --> 00:02:50,720

that only we have access to that you

76

00:02:55,190 --> 00:02:53,280

can't get access to here on earth

77

00:02:57,750 --> 00:02:55,200

the space flight environment not just

78

00:02:59,830 --> 00:02:57,760

microgravity and that take that gravity

79

00:03:01,990 --> 00:02:59,840

vector out of the work that you do but

80

00:03:03,589 --> 00:03:02,000

also the external environment of space

81

00:03:05,509 --> 00:03:03,599

the ability to look down at our planet

82

00:03:07,110 --> 00:03:05,519

the ability to look beyond our planet

83

00:03:09,670 --> 00:03:07,120

the ability to test new materials in the

84

00:03:11,509 --> 00:03:09,680

external environment the ability to test

85

00:03:14,070 --> 00:03:11,519

inside the environment

86

00:03:16,869 --> 00:03:14,080

by using microgravity to see how changes

87

00:03:20,070 --> 00:03:16,879

happen in living systems or how

88

00:03:22,229 --> 00:03:20,080

unpredictably physical sciences can

89
00:03:24,550 --> 00:03:22,239
problems can behave things that you know

90
00:03:27,589 --> 00:03:24,560
that are predictable in terms of science

91
00:03:29,110 --> 00:03:27,599
or everyday behavior here on the planet

92
00:03:30,869 --> 00:03:29,120
could be totally unpredictable once you

93
00:03:33,190 --> 00:03:30,879
get into space and that's why the

94
00:03:35,110 --> 00:03:33,200
scientists want to use that environment

95
00:03:37,509 --> 00:03:35,120
that particular laboratory that you

96
00:03:39,910 --> 00:03:37,519
can't do here on earth and it's a good

97
00:03:42,070 --> 00:03:39,920
time to be a space scientist or a space

98
00:03:44,309 --> 00:03:42,080
technologist or just a very curious

99
00:03:45,910 --> 00:03:44,319
human being here on earth

100
00:03:47,589 --> 00:03:45,920
with that i'm going to pass along to

101

00:03:48,789 --> 00:03:47,599

patrick who can tell you a lot about

102

00:03:50,309 --> 00:03:48,799

some of the investigations that are

103

00:03:52,229 --> 00:03:50,319

going to be happening on the national

104

00:03:54,390 --> 00:03:52,239

laboratory portfolio cool well thank you

105

00:03:55,990 --> 00:03:54,400

very much tara and thank you all for

106

00:03:57,190 --> 00:03:56,000

being here this morning again my name is

107

00:03:59,110 --> 00:03:57,200

patrick o'neill with the center for the

108

00:04:00,550 --> 00:03:59,120

advancement of science and space and we

109

00:04:02,949 --> 00:04:00,560

do manage the us national lab on the

110

00:04:04,390 --> 00:04:02,959

space station um show of hands real

111

00:04:05,509 --> 00:04:04,400

quick uh because one of the cool things

112

00:04:06,869 --> 00:04:05,519

about the nasa social group that

113

00:04:09,429 --> 00:04:06,879

typically comes out for this is that it

114

00:04:10,550 --> 00:04:09,439

kind of changes a little bit um how many

115

00:04:12,070 --> 00:04:10,560

people here

116

00:04:15,110 --> 00:04:12,080

knew that the iss was a national

117

00:04:16,789 --> 00:04:15,120

laboratory before showing up this week

118

00:04:17,909 --> 00:04:16,799

oh well that's good uh oftentimes

119

00:04:19,830 --> 00:04:17,919

there's a lot of people that really

120

00:04:21,270 --> 00:04:19,840

don't know that the iss was declared a

121

00:04:23,909 --> 00:04:21,280

national laboratory and a little

122

00:04:25,510 --> 00:04:23,919

background on that in 2005 congress

123

00:04:28,230 --> 00:04:25,520

they did they wanted they wanted to try

124

00:04:29,590 --> 00:04:28,240

to open up channels for researchers and

125

00:04:30,950 --> 00:04:29,600

the reason they wanted to do that was

126
00:04:32,469 --> 00:04:30,960
because they looked at the research that

127
00:04:34,070 --> 00:04:32,479
nasa was doing and they were saying gosh

128
00:04:35,430 --> 00:04:34,080
you know what there's so much incredible

129
00:04:38,390 --> 00:04:35,440
things that are happening on the space

130
00:04:39,909 --> 00:04:38,400
station and it's such a an enabler for

131
00:04:41,749 --> 00:04:39,919
everything from life sciences to

132
00:04:43,510 --> 00:04:41,759
material sciences physical sciences

133
00:04:45,670 --> 00:04:43,520
technology development earth observation

134
00:04:47,189 --> 00:04:45,680
remote sensing student research

135
00:04:48,390 --> 00:04:47,199
but right now all the things that nasa

136
00:04:50,150 --> 00:04:48,400
is doing it's kind of focused more

137
00:04:51,430 --> 00:04:50,160
towards exploration

138
00:04:52,710 --> 00:04:51,440

what if we turned things around and

139

00:04:54,390 --> 00:04:52,720

started looking at how we can use

140

00:04:55,909 --> 00:04:54,400

microgravity to benefit life on earth

141

00:04:57,830 --> 00:04:55,919

that would enable so many more

142

00:04:59,670 --> 00:04:57,840

researchers to take advantage of this

143

00:05:02,070 --> 00:04:59,680

platform and so that's what the national

144

00:05:04,390 --> 00:05:02,080

laboratory is about it's about providing

145

00:05:05,590 --> 00:05:04,400

this microgravity environment to you

146

00:05:07,909 --> 00:05:05,600

this is something that we have all

147

00:05:09,590 --> 00:05:07,919

invested in into and something that now

148

00:05:11,830 --> 00:05:09,600

is available for each researchers to

149

00:05:13,510 --> 00:05:11,840

take advantage of so tara talked about

150

00:05:14,710 --> 00:05:13,520

the excitement of being here and you

151

00:05:17,110 --> 00:05:14,720

know i think that it's it's a very

152

00:05:19,270 --> 00:05:17,120

exciting time in general to be involved

153

00:05:20,550 --> 00:05:19,280

in kind of the launch business and more

154

00:05:22,710 --> 00:05:20,560

importantly though from us though it's

155

00:05:23,990 --> 00:05:22,720

exciting not about just the launches but

156

00:05:25,430 --> 00:05:24,000

what's going to be happening inside of

157

00:05:27,110 --> 00:05:25,440

those launches what's going up to the

158

00:05:29,189 --> 00:05:27,120

space station that's what we're here

159

00:05:31,590 --> 00:05:29,199

about the talk about the science and you

160

00:05:33,670 --> 00:05:31,600

know again as we kind of morph into the

161

00:05:35,110 --> 00:05:33,680

national lab payloads there's an awful

162

00:05:36,390 --> 00:05:35,120

lot that's going up and so one of the

163

00:05:38,469 --> 00:05:36,400

things that terra alluded to was the

164

00:05:39,909 --> 00:05:38,479

notion that spacex has the ability to

165

00:05:41,749 --> 00:05:39,919

not only send research to the space

166

00:05:43,749 --> 00:05:41,759

station but to also send research back

167

00:05:45,430 --> 00:05:43,759

down to the ground and so what we've

168

00:05:46,790 --> 00:05:45,440

come to find with a lot of the spacex

169

00:05:49,029 --> 00:05:46,800

missions is that it really caters

170

00:05:50,790 --> 00:05:49,039

heavily towards the life sciences and on

171

00:05:53,350 --> 00:05:50,800

this particular mission that is no

172

00:05:55,670 --> 00:05:53,360

different so in total we have about 30

173

00:05:57,029 --> 00:05:55,680

over 35 iss national lab payloads that

174

00:05:59,110 --> 00:05:57,039

are destined for the space station the

175

00:06:00,950 --> 00:05:59,120

vast majority of which are focused on

176
00:06:02,629 --> 00:06:00,960
life sciences and it really does kind of

177
00:06:04,790 --> 00:06:02,639
stretch the the boundaries of life

178
00:06:07,430 --> 00:06:04,800
science from protein crystallography to

179
00:06:09,110 --> 00:06:07,440
stem cell investigations to uh cell

180
00:06:11,590 --> 00:06:09,120
culture design drug discovery drug

181
00:06:13,430 --> 00:06:11,600
development and all of these are done

182
00:06:14,790 --> 00:06:13,440
with the intention of benefiting life on

183
00:06:16,230 --> 00:06:14,800
earth so we're going to hear about some

184
00:06:18,230 --> 00:06:16,240
of the researchers today and some of

185
00:06:19,909 --> 00:06:18,240
their investigations and in general

186
00:06:22,710 --> 00:06:19,919
again it's just a really great time to

187
00:06:24,309 --> 00:06:22,720
be involved in space-based research and

188
00:06:25,510 --> 00:06:24,319

i guess at this point we're happy to

189

00:06:26,629 --> 00:06:25,520

answer any questions that you might have

190

00:06:30,790 --> 00:06:26,639

about some of the payloads that are on

191

00:06:33,350 --> 00:06:32,150

if you have a question just raise your

192

00:06:42,450 --> 00:06:33,360

hand and someone will come to you with a

193

00:06:45,350 --> 00:06:43,670

[Music]

194

00:06:47,189 --> 00:06:45,360

so

195

00:06:48,950 --> 00:06:47,199

those who are on the international space

196

00:06:51,909 --> 00:06:48,960

station right now they're going to get

197

00:06:53,350 --> 00:06:51,919

the uh the the the payload of the from the

198

00:06:56,150 --> 00:06:53,360

the um

199

00:06:57,749 --> 00:06:56,160

the crs 10 that's that's going up um

200

00:06:59,510 --> 00:06:57,759

what kind of scientists are there now

201
00:07:01,350 --> 00:06:59,520
and what kind of experiments are they

202
00:07:03,670 --> 00:07:01,360
going to perform

203
00:07:05,110 --> 00:07:03,680
that's a very good question so the the

204
00:07:06,550 --> 00:07:05,120
astronauts who are going to receive this

205
00:07:08,230 --> 00:07:06,560
set of payloads are going to perform

206
00:07:12,309 --> 00:07:08,240
experiments across many different

207
00:07:14,150 --> 00:07:12,319
disciplines we have experiments uh to

208
00:07:15,670 --> 00:07:14,160
look at the earth we're sending up a

209
00:07:18,469 --> 00:07:15,680
aerosol experiment you'll hear more

210
00:07:19,510 --> 00:07:18,479
about that this morning looking at ozone

211
00:07:20,710 --> 00:07:19,520
they're going to be looking they're

212
00:07:22,870 --> 00:07:20,720
going to be performing a whole bunch of

213
00:07:24,309 --> 00:07:22,880

human physiology experiments so we've

214

00:07:26,870 --> 00:07:24,319

got resources that are going up to

215

00:07:28,629 --> 00:07:26,880

support that because we want to advance

216

00:07:30,550 --> 00:07:28,639

benefits to knowledge about that on

217

00:07:32,550 --> 00:07:30,560

earth but also huge for space

218

00:07:34,550 --> 00:07:32,560

exploration beyond low earth orbit

219

00:07:36,230 --> 00:07:34,560

biological sciences you'll hear about

220

00:07:38,150 --> 00:07:36,240

some of the genetics and some of the

221

00:07:40,390 --> 00:07:38,160

bacterial research that's happening this

222

00:07:42,469 --> 00:07:40,400

morning from some of our speakers

223

00:07:45,029 --> 00:07:42,479

we've got physical sciences we've got

224

00:07:47,670 --> 00:07:45,039

processing of materials alloys we've got

225

00:07:48,790 --> 00:07:47,680

some fluid physics we've got a whole

226

00:07:51,110 --> 00:07:48,800

suite of things and we've got

227

00:07:53,270 --> 00:07:51,120

educational experiments going up too

228

00:07:55,110 --> 00:07:53,280

that students themselves designed as

229

00:07:56,790 --> 00:07:55,120

well as little cubesats that get

230

00:07:59,510 --> 00:07:56,800

launched from the space station from

231

00:08:02,070 --> 00:07:59,520

commercial companies so this particular

232

00:08:03,350 --> 00:08:02,080

crew is going to receive a wide range of

233

00:08:04,309 --> 00:08:03,360

things and they've been trained on

234

00:08:06,469 --> 00:08:04,319

everything they're supposed to be

235

00:08:08,070 --> 00:08:06,479

working on and they are knowledgeable in

236

00:08:11,560 --> 00:08:08,080

it and they are going to be our proxy

237

00:08:14,629 --> 00:08:11,570

scientists for this mission

238

00:08:16,629 --> 00:08:14,639

[Music]

239

00:08:18,550 --> 00:08:16,639

uh this question this ask nasa question

240

00:08:20,230 --> 00:08:18,560

is from a student named janet and she

241

00:08:21,909 --> 00:08:20,240

asks will these supply missions help

242

00:08:23,749 --> 00:08:21,919

achieve the goal of transporting humans

243

00:08:25,589 --> 00:08:23,759

to mars

244

00:08:26,390 --> 00:08:25,599

oh definitely that's a really good

245

00:08:28,629 --> 00:08:26,400

question

246

00:08:31,029 --> 00:08:28,639

always so exploring beyond low earth

247

00:08:33,509 --> 00:08:31,039

orbit that is nasa's one of nasa's main

248

00:08:35,670 --> 00:08:33,519

goals right so that is a good question

249

00:08:38,389 --> 00:08:35,680

because this is the time now that we

250

00:08:40,709 --> 00:08:38,399

have this laboratory in microgravity to

251
00:08:42,469 --> 00:08:40,719
test out every type of technology and

252
00:08:44,389 --> 00:08:42,479
understand every type of change that

253
00:08:48,150 --> 00:08:44,399
happens in the body so that we can go

254
00:08:49,910 --> 00:08:48,160
and explore explore uh mars so so quite

255
00:08:52,710 --> 00:08:49,920
definitely a lot of the human

256
00:08:54,070 --> 00:08:52,720
physiological sciences will will take

257
00:08:56,310 --> 00:08:54,080
charge of that but also some of the

258
00:08:57,750 --> 00:08:56,320
technology development too so you'll

259
00:09:00,230 --> 00:08:57,760
hear about some of those this morning

260
00:09:02,949 --> 00:09:00,240
that are going to enable that as well

261
00:09:04,389 --> 00:09:02,959
from places and groups such as the space

262
00:09:08,949 --> 00:09:04,399
test program

263
00:09:11,509 --> 00:09:08,959

that the dod is sponsoring this morning

264

00:09:14,230 --> 00:09:11,519

uh so speaking of sorry speaking of

265

00:09:16,070 --> 00:09:14,240

physiological changes i know that um

266

00:09:18,070 --> 00:09:16,080

we learned some really interesting stuff

267

00:09:19,430 --> 00:09:18,080

when scott kelly came back recently

268

00:09:21,110 --> 00:09:19,440

particularly about

269

00:09:22,870 --> 00:09:21,120

the telomere lengthening and i know

270

00:09:24,710 --> 00:09:22,880

everyone's super excited about that i'm

271

00:09:26,710 --> 00:09:24,720

very excited about it and i know they've

272

00:09:29,670 --> 00:09:26,720

got a pcr machine up there on the space

273

00:09:31,829 --> 00:09:29,680

station so is there a plan to follow up

274

00:09:33,590 --> 00:09:31,839

specifically with that there are plans

275

00:09:34,630 --> 00:09:33,600

you know the human research program is

276

00:09:36,630 --> 00:09:34,640

still

277

00:09:38,470 --> 00:09:36,640

looking at the uh the results of that

278

00:09:40,389 --> 00:09:38,480

investigation i too when i heard the

279

00:09:42,070 --> 00:09:40,399

telomere lengthening i thought

280

00:09:44,550 --> 00:09:42,080

how how i don't even know how that's

281

00:09:47,110 --> 00:09:44,560

possible right uh so space flight go

282

00:09:49,030 --> 00:09:47,120

figure um but so those results are still

283

00:09:51,110 --> 00:09:49,040

being um investigated and we're going to

284

00:09:52,949 --> 00:09:51,120

give some time for the human research

285

00:09:54,230 --> 00:09:52,959

program to come up with a new plan and

286

00:09:56,790 --> 00:09:54,240

how they want to go forward on those

287

00:09:58,470 --> 00:09:56,800

evaluations but the technology that we

288

00:10:00,470 --> 00:09:58,480

are creating for space stations such as

289

00:10:03,509 --> 00:10:00,480

the pcr device or all these other

290

00:10:05,030 --> 00:10:03,519

genomics analytics that are now on space

291

00:10:06,949 --> 00:10:05,040

station that i have access that all

292

00:10:09,110 --> 00:10:06,959

scientists have access to

293

00:10:10,150 --> 00:10:09,120

are part of the suite of improvements

294

00:10:17,590 --> 00:10:10,160

that can

295

00:10:23,590 --> 00:10:18,949

we i think we could take two more

296

00:10:28,790 --> 00:10:25,910

okay um because of the number and

297

00:10:31,030 --> 00:10:28,800

diversity of experiments what kind of um

298

00:10:32,630 --> 00:10:31,040

education and prep

299

00:10:34,150 --> 00:10:32,640

is required of the people who are on the

300

00:10:36,069 --> 00:10:34,160

space station like what is the length of

301
00:10:38,550 --> 00:10:36,079
time that they have to prepare for these

302
00:10:41,190 --> 00:10:38,560
experiments yeah so and feel free to

303
00:10:42,470 --> 00:10:41,200
jump in anything anytime you know i'm

304
00:10:43,590 --> 00:10:42,480
just the marketing guy you're you're

305
00:10:45,590 --> 00:10:43,600
that you're the size i'm just gonna do

306
00:10:46,470 --> 00:10:45,600
all the talking patrick's like you got

307
00:10:48,949 --> 00:10:46,480
this

308
00:10:50,790 --> 00:10:48,959
um so the crew members train about a

309
00:10:52,550 --> 00:10:50,800
year and a half once they're assigned to

310
00:10:53,990 --> 00:10:52,560
a space station mission and they have to

311
00:10:55,509 --> 00:10:54,000
learn about the vehicle right they've

312
00:10:57,430 --> 00:10:55,519
got to learn how to stay alive how to

313
00:10:59,509 --> 00:10:57,440

stay safe how to to keep the mission

314

00:11:01,509 --> 00:10:59,519

going but also part of their training

315

00:11:03,670 --> 00:11:01,519

very critical part of their training is

316

00:11:06,230 --> 00:11:03,680

the um all the science so they're

317

00:11:08,150 --> 00:11:06,240

assigned to a set of science experiments

318

00:11:09,910 --> 00:11:08,160

and that becomes theirs and so they're

319

00:11:10,870 --> 00:11:09,920

trained on those particularly all across

320

00:11:13,030 --> 00:11:10,880

the country they'll work with the

321

00:11:14,550 --> 00:11:13,040

investigators they'll work with the

322

00:11:16,630 --> 00:11:14,560

trainers at johnson space center and at

323

00:11:18,150 --> 00:11:16,640

marshall space flight center

324

00:11:19,269 --> 00:11:18,160

and they ask questions and then once on

325

00:11:20,710 --> 00:11:19,279

orbit

326

00:11:22,710 --> 00:11:20,720

you know they can call down and talk to

327

00:11:23,750 --> 00:11:22,720

the investigator too if they need to

328

00:11:27,269 --> 00:11:23,760

so

329

00:11:30,150 --> 00:11:27,279

everything that happens on space station

330

00:11:30,949 --> 00:11:30,160

in terms of experiments are using humans

331

00:11:32,389 --> 00:11:30,959

some of these some of these

332

00:11:33,829 --> 00:11:32,399

investigations are automated which is

333

00:11:35,269 --> 00:11:33,839

very cool too

334

00:11:37,190 --> 00:11:35,279

but they're trained all through the

335

00:11:38,949 --> 00:11:37,200

science and they are also trained before

336

00:11:40,389 --> 00:11:38,959

they're assigned they have baseline

337

00:11:42,069 --> 00:11:40,399

training that keeps them

338

00:11:43,509 --> 00:11:42,079

up on their life sciences skills and

339

00:11:44,790 --> 00:11:43,519

their biomedical skills and their

340

00:11:49,430 --> 00:11:44,800

physical sciences and those kind of

341

00:11:53,829 --> 00:11:51,509

okay so mine's not as scientific but it

342

00:11:55,269 --> 00:11:53,839

has to do with taking stuff up there um

343

00:11:57,350 --> 00:11:55,279

a couple weeks ago we had the super bowl

344

00:11:59,509 --> 00:11:57,360

and i noticed that the people had the

345

00:12:01,190 --> 00:11:59,519

right jerseys i'm thinking do they just

346

00:12:03,030 --> 00:12:01,200

have a jersey for every team that could

347

00:12:05,269 --> 00:12:03,040

possibly win the super bowl i mean how

348

00:12:07,750 --> 00:12:05,279

do they get that up there

349

00:12:09,670 --> 00:12:07,760

probably so i heard i i was on one of

350

00:12:11,030 --> 00:12:09,680

those super bowl tours with a public

351
00:12:12,790 --> 00:12:11,040
affairs person and they were asked the

352
00:12:15,350 --> 00:12:12,800
same question and she said

353
00:12:17,670 --> 00:12:15,360
lots of preparation

354
00:12:19,030 --> 00:12:17,680
i don't really know but my guess is

355
00:12:21,110 --> 00:12:19,040
somebody's pretty smart on what's

356
00:12:22,629 --> 00:12:21,120
happening on the football field there

357
00:12:24,150 --> 00:12:22,639
and and they're watching their their

358
00:12:25,910 --> 00:12:24,160
maybe they're in fantasy football now i

359
00:12:27,509 --> 00:12:25,920
don't know but uh yeah someone's pretty

360
00:12:29,190 --> 00:12:27,519
smart and can launch these things ahead

361
00:12:31,269 --> 00:12:29,200
of time and it takes a lot of a lot of

362
00:12:33,350 --> 00:12:31,279
prep my bigger question was did they

363
00:12:35,590 --> 00:12:33,360

send that football up inflated or was it

364

00:12:37,110 --> 00:12:35,600

deflated you know i guess

365

00:12:42,790 --> 00:12:37,120

you think they think of all the pressure

366

00:12:47,610 --> 00:12:45,190

thank you both very much all right thank

367

00:12:51,350 --> 00:12:47,620

you patrick and tara

368

00:12:53,030 --> 00:12:51,360

[Applause]

369

00:12:54,790 --> 00:12:53,040

a great explanation of of the research

370

00:12:57,829 --> 00:12:54,800

headed up as well as what the crew does

371

00:12:59,590 --> 00:12:57,839

to prepare um next we'll hear about two

372

00:13:01,590 --> 00:12:59,600

instruments that will provide valuable

373

00:13:03,190 --> 00:13:01,600

earth science data joining us are

374

00:13:05,670 --> 00:13:03,200

michael freilick earth science division

375

00:13:07,190 --> 00:13:05,680

at nasa headquarters mike suzuki from

376

00:13:09,110 --> 00:13:07,200

nasa's langley research center and

377

00:13:18,949 --> 00:13:09,120

richard blakeslee from nasa's marshall

378

00:13:24,230 --> 00:13:21,190

well thanks very much and thanks to all

379

00:13:25,910 --> 00:13:24,240

of you for waking up early in the day

380

00:13:28,629 --> 00:13:25,920

and coming out

381

00:13:30,550 --> 00:13:28,639

and helping to spread the word uh to all

382

00:13:31,990 --> 00:13:30,560

of your followers about the great things

383

00:13:36,550 --> 00:13:32,000

that we're doing

384

00:13:39,750 --> 00:13:36,560

on the iss and in the crs 10 uh flight

385

00:13:41,990 --> 00:13:39,760

so when crs 10 launches as as you heard

386

00:13:45,750 --> 00:13:42,000

it's actually going to have two earth

387

00:13:47,910 --> 00:13:45,760

observing instruments on it sage 3 to

388

00:13:51,350 --> 00:13:47,920

measure atmospheric constituents and

389

00:13:53,990 --> 00:13:51,360

aerosols and a lightning imaging sensor

390

00:13:56,310 --> 00:13:54,000

so we're going to go from the earth

391

00:13:59,990 --> 00:13:56,320

to the space station in order to look

392

00:14:02,870 --> 00:14:00,000

back down on the earth and that's not as

393

00:14:06,069 --> 00:14:02,880

weird as it might seem because our

394

00:14:09,590 --> 00:14:06,079

planet is a really complex system we

395

00:14:12,550 --> 00:14:09,600

have processes on the ocean on the land

396

00:14:15,910 --> 00:14:12,560

in the atmosphere physical processes

397

00:14:19,269 --> 00:14:15,920

chemical processes biological processes

398

00:14:22,310 --> 00:14:19,279

and the key to understanding our planet

399

00:14:25,269 --> 00:14:22,320

is to not unders not only understand

400

00:14:28,550 --> 00:14:25,279

individual processes but the connections

401
00:14:31,750 --> 00:14:28,560
between them and only from the vantage

402
00:14:34,069 --> 00:14:31,760
point of space can we make measurements

403
00:14:36,949 --> 00:14:34,079
that have global extent

404
00:14:38,150 --> 00:14:36,959
but high spatial resolution fine

405
00:14:41,110 --> 00:14:38,160
resolution

406
00:14:42,069 --> 00:14:41,120
on on the surface uh frequently at every

407
00:14:44,949 --> 00:14:42,079
point

408
00:14:47,430 --> 00:14:44,959
over long periods of time a first uh

409
00:14:48,389 --> 00:14:47,440
slide please

410
00:14:51,269 --> 00:14:48,399
and

411
00:14:53,750 --> 00:14:51,279
in nasa what we are doing in order to

412
00:14:56,389 --> 00:14:53,760
understand the interactions between

413
00:14:59,590 --> 00:14:56,399

processes our whole environment is that

414

00:15:02,629 --> 00:14:59,600

we are making measurements of many

415

00:15:06,629 --> 00:15:02,639

different variables using an on-orbit

416

00:15:09,829 --> 00:15:06,639

fleet of about 20 spacecraft and major

417

00:15:13,670 --> 00:15:09,839

instruments in the lower half of this

418

00:15:16,949 --> 00:15:13,680

visual and we have firm plans over the

419

00:15:19,990 --> 00:15:16,959

next five years or so to launch about

420

00:15:23,750 --> 00:15:20,000

another 20

421

00:15:27,430 --> 00:15:23,760

instruments and major missions uh into

422

00:15:30,230 --> 00:15:27,440

space so that we have measurements of

423

00:15:33,509 --> 00:15:30,240

many different variables all at the same

424

00:15:36,470 --> 00:15:33,519

time covering the entire globe next

425

00:15:42,470 --> 00:15:39,990

and we are not only flying our own

426

00:15:44,870 --> 00:15:42,480

satellites or putting instruments on

427

00:15:48,310 --> 00:15:44,880

partner satellites or even

428

00:15:49,829 --> 00:15:48,320

private sector satellites but of course

429

00:15:52,389 --> 00:15:49,839

since you're here today and we're here

430

00:15:54,870 --> 00:15:52,399

today we are also making measurements

431

00:15:57,990 --> 00:15:54,880

from the international space station and

432

00:16:00,629 --> 00:15:58,000

it turns out to be extremely efficient

433

00:16:03,430 --> 00:16:00,639

and from a scientific standpoint

434

00:16:05,910 --> 00:16:03,440

extremely useful to use the space

435

00:16:10,389 --> 00:16:05,920

station because the space station orbit

436

00:16:12,629 --> 00:16:10,399

is really unique and we presently today

437

00:16:15,590 --> 00:16:12,639

have one instrument the cloud aerosol

438

00:16:19,269 --> 00:16:15,600

transport system which is operating on

439

00:16:21,910 --> 00:16:19,279

the space station lis and sage three

440

00:16:24,389 --> 00:16:21,920

will be launching on crs 10 and we have

441

00:16:26,790 --> 00:16:24,399

firm plans for about another five or

442

00:16:29,990 --> 00:16:26,800

more instruments to fly to the space

443

00:16:32,150 --> 00:16:30,000

station over the next several years so

444

00:16:35,990 --> 00:16:32,160

with that i think i'll stop with the

445

00:16:37,670 --> 00:16:36,000

introduction and turn to uh our my two

446

00:16:38,710 --> 00:16:37,680

colleagues here

447

00:16:41,910 --> 00:16:38,720

mike

448

00:16:44,790 --> 00:16:41,920

and rich to talk in detail about the

449

00:16:47,590 --> 00:16:44,800

measurements from sage three and the

450

00:16:48,949 --> 00:16:47,600

lightning imaging sensor

451
00:16:50,870 --> 00:16:48,959
thank you mike

452
00:16:52,949 --> 00:16:50,880
i'm very excited to be here today to

453
00:16:54,949 --> 00:16:52,959
share with you about stage three and so

454
00:16:56,470 --> 00:16:54,959
if we can get the first chart

455
00:16:58,629 --> 00:16:56,480
i'm going to start off with a little bit

456
00:17:01,430 --> 00:16:58,639
of history so you guys have the right

457
00:17:03,509 --> 00:17:01,440
context and can go ahead and understand

458
00:17:05,590 --> 00:17:03,519
what we do and how we fit

459
00:17:08,710 --> 00:17:05,600
the first sage-like measurements from

460
00:17:10,470 --> 00:17:08,720
space were made in 1975 by astronaut

461
00:17:12,470 --> 00:17:10,480
dick slayton

462
00:17:15,429 --> 00:17:12,480
dick used a little

463
00:17:17,669 --> 00:17:15,439

window mounted sun photometer to go

464

00:17:20,549 --> 00:17:17,679

ahead and measure the atmosphere

465

00:17:23,990 --> 00:17:20,559

during sunset and sunrise as the apollo

466

00:17:26,630 --> 00:17:24,000

capsule rotated or orbited the earth

467

00:17:28,630 --> 00:17:26,640

since that time scientists and engineers

468

00:17:29,590 --> 00:17:28,640

at nasa's langley research center where

469

00:17:30,950 --> 00:17:29,600

i'm from

470

00:17:33,590 --> 00:17:30,960

have basically

471

00:17:37,669 --> 00:17:33,600

continually improve that technique

472

00:17:41,029 --> 00:17:38,470

the

473

00:17:42,310 --> 00:17:41,039

sage 3 instrument payload you see behind

474

00:17:44,870 --> 00:17:42,320

me

475

00:17:46,710 --> 00:17:44,880

is the latest in that series

476
00:17:48,950 --> 00:17:46,720
we're going to be mounted outside of the

477
00:17:50,070 --> 00:17:48,960
space station okay in the vacuum of

478
00:17:52,070 --> 00:17:50,080
space

479
00:17:53,990 --> 00:17:52,080
and from there we'll go ahead and make

480
00:17:57,350 --> 00:17:54,000
high vertical resolution

481
00:18:00,470 --> 00:17:57,360
measurements of the atmosphere of ozone

482
00:18:01,990 --> 00:18:00,480
nitrogen dioxide water vapor

483
00:18:04,390 --> 00:18:02,000
and aerosols

484
00:18:07,830 --> 00:18:04,400
to go ahead and understand

485
00:18:10,070 --> 00:18:07,840
our atmosphere in the ozone layer

486
00:18:12,549 --> 00:18:10,080
back in the 1980s

487
00:18:14,870 --> 00:18:12,559
scientists warned the public about the

488
00:18:18,070 --> 00:18:14,880

dangers of chlorofluorocarbons okay

489

00:18:19,029 --> 00:18:18,080

mostly freon's used in air conditioning

490

00:18:23,350 --> 00:18:19,039

and

491

00:18:26,150 --> 00:18:23,360

right they implemented the montreal

492

00:18:28,150 --> 00:18:26,160

protocol to go ahead and and eliminate

493

00:18:29,590 --> 00:18:28,160

the harmful chemicals to protect the

494

00:18:31,350 --> 00:18:29,600

ozone layer

495

00:18:32,310 --> 00:18:31,360

and the great news guys is is that it

496

00:18:34,710 --> 00:18:32,320

worked

497

00:18:37,190 --> 00:18:34,720

so data from sage ii

498

00:18:39,190 --> 00:18:37,200

and other nasa sensors that mike just

499

00:18:41,270 --> 00:18:39,200

went ahead and showed you have showed

500

00:18:43,750 --> 00:18:41,280

that the decline of the ozone layer is

501
00:18:44,870 --> 00:18:43,760
stopped and atmospheric models are

502
00:18:47,830 --> 00:18:44,880
predicting

503
00:18:49,909 --> 00:18:47,840
a full recovery by mid-century

504
00:18:51,669 --> 00:18:49,919
so how does sage 3 fit into that we're

505
00:18:53,510 --> 00:18:51,679
going to make measurements right now

506
00:18:54,789 --> 00:18:53,520
from the space station

507
00:18:57,430 --> 00:18:54,799
that show

508
00:18:59,029 --> 00:18:57,440
the recovery is on track

509
00:19:00,789 --> 00:18:59,039
so i think that from a science

510
00:19:01,830 --> 00:19:00,799
perspective it doesn't get any better

511
00:19:03,990 --> 00:19:01,840
than that

512
00:19:06,070 --> 00:19:04,000
um so um

513
00:19:09,110 --> 00:19:06,080

behind me next please i've got a short

514

00:19:13,830 --> 00:19:11,350

this is a animation prepared by the

515

00:19:15,350 --> 00:19:13,840

robotics team at the nasa johnson space

516

00:19:16,870 --> 00:19:15,360

flight center

517

00:19:18,070 --> 00:19:16,880

and this is showing the assembly

518

00:19:20,950 --> 00:19:18,080

sequence

519

00:19:22,470 --> 00:19:20,960

on orbit okay that's done all by

520

00:19:24,390 --> 00:19:22,480

robotics

521

00:19:25,590 --> 00:19:24,400

to go ahead and install us to the space

522

00:19:27,510 --> 00:19:25,600

station

523

00:19:30,310 --> 00:19:27,520

and what you're seeing here is really

524

00:19:31,350 --> 00:19:30,320

accelerated this is 13 days of work two

525

00:19:34,070 --> 00:19:31,360

shifts

526

00:19:35,909 --> 00:19:34,080

um in about 30 seconds

527

00:19:37,750 --> 00:19:35,919

and just kind of think of this this

528

00:19:39,270 --> 00:19:37,760

assembly sequence is extremely

529

00:19:42,789 --> 00:19:39,280

complicated

530

00:19:45,510 --> 00:19:42,799

system that we're going to go ahead and

531

00:19:47,909 --> 00:19:45,520

help measure with sage 3.

532

00:19:50,710 --> 00:19:47,919

to wrap it up we're extremely excited

533

00:19:52,310 --> 00:19:50,720

about launch on spacex okay

534

00:19:54,950 --> 00:19:52,320

getting on with the installation

535

00:19:56,630 --> 00:19:54,960

sequence and you guys understand how

536

00:19:58,710 --> 00:19:56,640

important the data is that we're going

537

00:20:01,270 --> 00:19:58,720

to collect from the space station to

538

00:20:03,430 --> 00:20:01,280

monitor the health of the ozone layer so

539

00:20:06,310 --> 00:20:03,440

if you guys are interested in more check

540

00:20:10,230 --> 00:20:06,320

our website out sage.nasa.gov

541

00:20:14,070 --> 00:20:12,549

good morning my name is uh richard

542

00:20:16,390 --> 00:20:14,080

blakesley i'm the

543

00:20:17,590 --> 00:20:16,400

science lead for the lightning imaging

544

00:20:18,710 --> 00:20:17,600

sensor

545

00:20:21,110 --> 00:20:18,720

this was an instrument that was

546

00:20:23,029 --> 00:20:21,120

developed by nasa marshall space flight

547

00:20:24,230 --> 00:20:23,039

center and the university of alabama in

548

00:20:26,310 --> 00:20:24,240

huntsville

549

00:20:28,789 --> 00:20:26,320

and we're really excited

550

00:20:31,190 --> 00:20:28,799

for this mission of opportunity to place

551
00:20:33,510 --> 00:20:31,200
the liz instrument on the international

552
00:20:35,190 --> 00:20:33,520
space station to measure global

553
00:20:37,270 --> 00:20:35,200
lightning

554
00:20:40,070 --> 00:20:37,280
but let me begin by noting that this

555
00:20:42,710 --> 00:20:40,080
instrument really is a tried and true

556
00:20:47,110 --> 00:20:42,720
sensor and the reason i say that is it's

557
00:20:48,149 --> 00:20:47,120
a uh it's a carbon copy of an instrument

558
00:20:53,110 --> 00:20:48,159
that

559
00:20:55,110 --> 00:20:53,120
tropical rainfall measuring mission for

560
00:20:57,270 --> 00:20:55,120
17 years

561
00:20:58,549 --> 00:20:57,280
and therefore by placing the liz

562
00:21:01,750 --> 00:20:58,559
instrument

563
00:21:03,990 --> 00:21:01,760

on the international space station

564

00:21:06,950 --> 00:21:04,000

we can not only continue

565

00:21:08,710 --> 00:21:06,960

that 17-year record of tropical

566

00:21:11,510 --> 00:21:08,720

lightning measurements

567

00:21:13,029 --> 00:21:11,520

but we can also expand the latitudinal

568

00:21:13,830 --> 00:21:13,039

coverage

569

00:21:16,230 --> 00:21:13,840

to

570

00:21:18,549 --> 00:21:16,240

latitudes that were not possibly were

571

00:21:20,549 --> 00:21:18,559

not possible to see from the trim

572

00:21:22,390 --> 00:21:20,559

spacecraft

573

00:21:23,430 --> 00:21:22,400

in addition we're excited that this

574

00:21:26,230 --> 00:21:23,440

instrument

575

00:21:28,630 --> 00:21:26,240

can be used

576
00:21:31,510 --> 00:21:28,640
to help calibrate and validate

577
00:21:33,110 --> 00:21:31,520
the new geostationary lightning mapper

578
00:21:37,029 --> 00:21:33,120
this was an instrument that was launched

579
00:21:39,669 --> 00:21:37,039
in november uh on noaa's

580
00:21:43,590 --> 00:21:39,679
new newest weather satellite

581
00:21:48,630 --> 00:21:45,590
but however one of the most important

582
00:21:49,510 --> 00:21:48,640
science objectives uh for for this

583
00:21:52,230 --> 00:21:49,520
mission

584
00:21:54,789 --> 00:21:52,240
is to better understand the processes

585
00:21:57,110 --> 00:21:54,799
that create lightning and also the

586
00:21:58,390 --> 00:21:57,120
connections between lightning

587
00:21:59,510 --> 00:21:58,400
and and

588
00:22:02,149 --> 00:21:59,520

uh

589

00:22:03,430 --> 00:22:02,159

subsequent severe weather events

590

00:22:06,310 --> 00:22:03,440

um

591

00:22:08,390 --> 00:22:06,320

in nasa recently just experienced one of

592

00:22:09,750 --> 00:22:08,400

these in in one of its facilities when

593

00:22:12,950 --> 00:22:09,760

they uh

594

00:22:15,750 --> 00:22:12,960

had a damaging tornado

595

00:22:16,630 --> 00:22:15,760

so our improved understanding will lead

596

00:22:18,549 --> 00:22:16,640

to

597

00:22:20,149 --> 00:22:18,559

improved weather forecasts

598

00:22:22,630 --> 00:22:20,159

and and

599

00:22:23,669 --> 00:22:22,640

and this will lead to saving lives and

600

00:22:26,470 --> 00:22:23,679

property

601
00:22:28,310 --> 00:22:26,480
here in the united states and and also

602
00:22:30,390 --> 00:22:28,320
elsewhere in the world

603
00:22:33,750 --> 00:22:30,400
could i have my first uh

604
00:22:38,950 --> 00:22:36,710
so once the liz is delivered to the

605
00:22:41,909 --> 00:22:38,960
international space station like sage it

606
00:22:44,230 --> 00:22:41,919
will be robotically uh transferred to a

607
00:22:46,470 --> 00:22:44,240
position on the outside of of the space

608
00:22:47,510 --> 00:22:46,480
station where it can continuously

609
00:22:49,430 --> 00:22:47,520
observe

610
00:22:53,270 --> 00:22:49,440
the lightning as the

611
00:22:56,710 --> 00:22:55,669
what what liz actually measures is the

612
00:22:58,710 --> 00:22:56,720
amount

613
00:23:00,470 --> 00:22:58,720

rate and radiant energy

614

00:23:03,190 --> 00:23:00,480
of lightning and it does this both

615

00:23:05,830 --> 00:23:03,200
during the night and day

616

00:23:08,549 --> 00:23:05,840
and and does it with high detection

617

00:23:10,470 --> 00:23:08,559
efficiency and what that means is that

618

00:23:12,470 --> 00:23:10,480
about 90 percent or more of the

619

00:23:13,350 --> 00:23:12,480
lightning that's within the liz field of

620

00:23:15,190 --> 00:23:13,360
view

621

00:23:17,029 --> 00:23:15,200
is detected by this

622

00:23:19,029 --> 00:23:17,039
instrument

623

00:23:20,870 --> 00:23:19,039
one of the very unique features of this

624

00:23:22,870 --> 00:23:20,880
instrument however is that it's able to

625

00:23:25,110 --> 00:23:22,880
detect the lightning during the daytime

626
00:23:26,230 --> 00:23:25,120
conventional cameras cannot see

627
00:23:28,789 --> 00:23:26,240
lightning

628
00:23:32,470 --> 00:23:28,799
during the day and it does this by using

629
00:23:33,430 --> 00:23:32,480
a narrow band near ir

630
00:23:35,830 --> 00:23:33,440
channel

631
00:23:38,950 --> 00:23:35,840
and special processing

632
00:23:42,070 --> 00:23:38,960
to extract the weak lightning signal

633
00:23:43,750 --> 00:23:42,080
from the very strong uh solar light

634
00:23:45,830 --> 00:23:43,760
that's that's reflected off of the

635
00:23:49,110 --> 00:23:45,840
clouds

636
00:23:51,830 --> 00:23:49,120
could i have the next video please

637
00:23:53,830 --> 00:23:51,840
so this video shows what lightning looks

638
00:23:55,909 --> 00:23:53,840

like from space taken from the

639

00:23:57,029 --> 00:23:55,919

international space station and what you

640

00:23:59,510 --> 00:23:57,039

can see

641

00:24:02,549 --> 00:23:59,520

is that the space station provides an

642

00:24:04,549 --> 00:24:02,559

excellent vantage point for viewing from

643

00:24:06,950 --> 00:24:04,559

viewing lightning

644

00:24:09,909 --> 00:24:06,960

and the earth produces a lot of

645

00:24:11,750 --> 00:24:09,919

lightning at any instant in time there's

646

00:24:13,750 --> 00:24:11,760

there's from one to two thousand

647

00:24:16,950 --> 00:24:13,760

thunderstorms occurring

648

00:24:19,750 --> 00:24:16,960

producing 45 flashes per second on

649

00:24:21,990 --> 00:24:19,760

average and even that number was

650

00:24:25,430 --> 00:24:22,000

determined from our previous mission the

651
00:24:26,549 --> 00:24:25,440
liz on the tropical rainfall measurement

652
00:24:27,830 --> 00:24:26,559
mission

653
00:24:29,350 --> 00:24:27,840
so

654
00:24:31,029 --> 00:24:29,360
our team

655
00:24:32,390 --> 00:24:31,039
and really a host of scientists

656
00:24:34,470 --> 00:24:32,400
worldwide

657
00:24:35,990 --> 00:24:34,480
are are excitedly waiting for this

658
00:24:37,990 --> 00:24:36,000
instrument to be turned on and for the

659
00:24:40,470 --> 00:24:38,000
data to start flowing

660
00:24:43,269 --> 00:24:40,480
so they can apply these measurements to

661
00:24:45,110 --> 00:24:43,279
studies in weather climate atmospheric

662
00:24:48,070 --> 00:24:45,120
chemistry and physics

663
00:24:50,950 --> 00:24:49,669

with that we'll open it up for questions

664

00:24:52,230 --> 00:24:50,960

again if you have a question in the room

665

00:24:54,310 --> 00:24:52,240

raise your hand if you're following

666

00:24:56,149 --> 00:24:54,320

along on social media make sure you ask

667

00:24:59,430 --> 00:24:56,159

your questions via

668

00:25:02,070 --> 00:24:59,440

ask nasa what are some of the um

669

00:25:04,470 --> 00:25:02,080

like practical non-weather science

670

00:25:06,630 --> 00:25:04,480

applications for studying the

671

00:25:08,630 --> 00:25:06,640

lightning patterns

672

00:25:10,870 --> 00:25:08,640

so some of the what might be considered

673

00:25:12,549 --> 00:25:10,880

a non-weather uh

674

00:25:15,669 --> 00:25:12,559

science would be looking at the

675

00:25:18,630 --> 00:25:15,679

relationship between lightning and and

676

00:25:21,110 --> 00:25:18,640

uh the nitric oxides uh lightning is a

677

00:25:23,590 --> 00:25:21,120

natural producer of nitric oxide it's

678

00:25:25,430 --> 00:25:23,600

one of the largest producers

679

00:25:27,830 --> 00:25:25,440

and that nitric oxides can also then

680

00:25:29,590 --> 00:25:27,840

produce ozone and and so we want to know

681

00:25:32,149 --> 00:25:29,600

what's actually happening that man isn't

682

00:25:41,190 --> 00:25:32,159

producing so this this is a useful way

683

00:25:45,590 --> 00:25:43,029

i was really interested to hear about

684

00:25:48,070 --> 00:25:45,600

the potential ozone recovery i wasn't

685

00:25:50,390 --> 00:25:48,080

aware of that that's amazing and really

686

00:25:51,830 --> 00:25:50,400

exciting um and in light of that i was

687

00:25:53,990 --> 00:25:51,840

actually gonna ask this question anyway

688

00:25:55,350 --> 00:25:54,000

but it's even more pertinent now um

689

00:25:57,110 --> 00:25:55,360

we obviously have an administration

690

00:25:59,350 --> 00:25:57,120

that's actively

691

00:26:00,710 --> 00:25:59,360

pursuing deregulation of waste and

692

00:26:02,630 --> 00:26:00,720

emissions

693

00:26:05,029 --> 00:26:02,640

trying to roll back other environmental

694

00:26:06,950 --> 00:26:05,039

protection and climate change policy

695

00:26:09,029 --> 00:26:06,960

can something like sage iii and the data

696

00:26:11,110 --> 00:26:09,039

that you're gathering help to present

697

00:26:12,950 --> 00:26:11,120

more concrete evidence uh that what

698

00:26:15,430 --> 00:26:12,960

we're doing is or is not hurting the

699

00:26:17,110 --> 00:26:15,440

planet and help to influence that future

700

00:26:19,830 --> 00:26:17,120

legislation

701
00:26:21,990 --> 00:26:19,840
so so our job is is really to go ahead

702
00:26:24,230 --> 00:26:22,000
and produce the data

703
00:26:25,110 --> 00:26:24,240
and so the sage the sage has been doing

704
00:26:27,830 --> 00:26:25,120
that

705
00:26:30,070 --> 00:26:27,840
you know going back to the 70s the sage

706
00:26:33,590 --> 00:26:30,080
ii we flew on the earth radiation budget

707
00:26:34,470 --> 00:26:33,600
satellite launched in 1984 lasted 21

708
00:26:36,549 --> 00:26:34,480
years

709
00:26:37,590 --> 00:26:36,559
and so we've been producing high quality

710
00:26:40,310 --> 00:26:37,600
data

711
00:26:42,549 --> 00:26:40,320
that we go ahead and openly publish

712
00:26:44,710 --> 00:26:42,559
and goes out to the scientific community

713
00:26:47,269 --> 00:26:44,720

so they can address exactly that kind of

714

00:26:52,310 --> 00:26:47,279

question and my expectation is is that

715

00:26:52,320 --> 00:27:05,909

we have a question toward the back

716

00:27:09,510 --> 00:27:07,669

heinz can you just explain a little bit

717

00:27:11,190 --> 00:27:09,520

of the difference between the the

718

00:27:13,110 --> 00:27:11,200

lightning sensor on this and then the

719

00:27:15,110 --> 00:27:13,120

recently launched satellite is it just

720

00:27:16,549 --> 00:27:15,120

the altitude that gives you a different

721

00:27:19,110 --> 00:27:16,559

perspective

722

00:27:21,590 --> 00:27:19,120

yes so geostationary lightning mapper is

723

00:27:23,510 --> 00:27:21,600

actually its heritage is based on this

724

00:27:25,669 --> 00:27:23,520

instrument that we're flying now

725

00:27:26,630 --> 00:27:25,679

uh of course because it's geostationary

726

00:27:28,950 --> 00:27:26,640

it's going to be looking at the

727

00:27:29,990 --> 00:27:28,960

lightning in the western hemisphere it's

728

00:27:32,070 --> 00:27:30,000

going to be

729

00:27:33,750 --> 00:27:32,080

looking at it continuously

730

00:27:35,590 --> 00:27:33,760

this instrument will be observing

731

00:27:38,149 --> 00:27:35,600

lightning globally

732

00:27:40,470 --> 00:27:38,159

but it's also a well characterized

733

00:27:42,230 --> 00:27:40,480

sensor and so it's very useful we want

734

00:27:45,590 --> 00:27:42,240

to have a we want to continue our

735

00:27:47,669 --> 00:27:45,600

climatic record of of storms and and and

736

00:27:53,510 --> 00:27:47,679

by by comparing intercomparing the two

737

00:28:00,789 --> 00:27:55,510

we have a question

738

00:28:04,070 --> 00:28:02,230

good morning um

739

00:28:06,070 --> 00:28:04,080

excuse me i'm emily bonedrake i'm a

740

00:28:07,750 --> 00:28:06,080

social studies teacher at morris tech in

741

00:28:09,350 --> 00:28:07,760

new jersey and my students have been

742

00:28:10,789 --> 00:28:09,360

learning how this mission

743

00:28:12,149 --> 00:28:10,799

connects to things in history we've

744

00:28:14,549 --> 00:28:12,159

learned about from the scientific

745

00:28:19,110 --> 00:28:14,559

revolution and exploration and stuff but

746

00:28:21,590 --> 00:28:19,120

also how it can affect humanity now um

747

00:28:23,510 --> 00:28:21,600

so the question that was asked the most

748

00:28:25,190 --> 00:28:23,520

by my students is that we studied the

749

00:28:26,710 --> 00:28:25,200

idea of a renaissance man or a woman or

750

00:28:28,549 --> 00:28:26,720

a polymath and

751

00:28:29,830 --> 00:28:28,559

right away the talk of lightning as a

752

00:28:32,549 --> 00:28:29,840

history teacher makes you think of ben

753

00:28:34,870 --> 00:28:32,559

franklin um so they they've been curious

754

00:28:36,070 --> 00:28:34,880

as to how modern

755

00:28:38,149 --> 00:28:36,080

renaissance

756

00:28:39,990 --> 00:28:38,159

men or women are impacting these

757

00:28:41,430 --> 00:28:40,000

scientific missions today

758

00:28:43,750 --> 00:28:41,440

so they were

759

00:28:45,750 --> 00:28:43,760

just curious on a personal basis has

760

00:28:48,070 --> 00:28:45,760

there been an interest in the humanity

761

00:28:49,669 --> 00:28:48,080

something outside math or science

762

00:28:52,389 --> 00:28:49,679

we've already mentioned political

763

00:28:54,230 --> 00:28:52,399

aspects and historical aspects that have

764

00:28:56,470 --> 00:28:54,240

inspired your curiosity and made you

765

00:28:59,669 --> 00:28:56,480

better scientists or researchers or

766

00:29:02,710 --> 00:28:59,679

things like that that's a that's really

767

00:29:05,190 --> 00:29:02,720

a a great question and a great insight

768

00:29:07,350 --> 00:29:05,200

from your students

769

00:29:10,230 --> 00:29:07,360

as we said the earth is is really

770

00:29:11,430 --> 00:29:10,240

complex but it's the place that we all

771

00:29:12,909 --> 00:29:11,440

live

772

00:29:14,549 --> 00:29:12,919

we all have

773

00:29:15,990 --> 00:29:14,559

experiences

774

00:29:21,430 --> 00:29:16,000

and

775

00:29:23,029 --> 00:29:21,440

in order to

776

00:29:26,389 --> 00:29:23,039

understand more

777

00:29:29,350 --> 00:29:26,399

we have to be broader we have to not

778

00:29:32,549 --> 00:29:29,360

just measure the atmosphere not just

779

00:29:35,830 --> 00:29:32,559

measure the ocean not just do

780

00:29:37,110 --> 00:29:35,840

research on land but we have to

781

00:29:39,269 --> 00:29:37,120

understand

782

00:29:42,549 --> 00:29:39,279

how the processes

783

00:29:44,070 --> 00:29:42,559

interact that requires a broader

784

00:29:46,789 --> 00:29:44,080

scientific

785

00:29:49,269 --> 00:29:46,799

understanding but since it's the planet

786

00:29:50,549 --> 00:29:49,279

on which we all live we can take that

787

00:29:53,750 --> 00:29:50,559

understanding

788

00:29:56,630 --> 00:29:53,760

very straightforwardly and turn it into

789

00:29:59,269 --> 00:29:56,640

societal benefit the predictions that

790

00:30:00,149 --> 00:29:59,279

are being made the policies

791

00:30:03,110 --> 00:30:00,159

that

792

00:30:06,070 --> 00:30:03,120

are based on the analysis

793

00:30:07,510 --> 00:30:06,080

analyses that we do require

794

00:30:11,269 --> 00:30:07,520

a tremendous

795

00:30:16,710 --> 00:30:11,279

knowledge of social sciences of national

796

00:30:20,630 --> 00:30:16,720

objectives etc uh beyond just working in

797

00:30:22,389 --> 00:30:20,640

a laboratory or doing focused research

798

00:30:23,669 --> 00:30:22,399

so earth system

799

00:30:27,029 --> 00:30:23,679

science

800

00:30:30,789 --> 00:30:27,039

is a key broadening

801
00:30:32,870 --> 00:30:30,799
feature of what it is that we do and

802
00:30:35,990 --> 00:30:32,880
makes what we do with its societal

803
00:30:37,909 --> 00:30:36,000
benefit connections probably unique

804
00:30:40,310 --> 00:30:37,919
among all of

805
00:30:44,310 --> 00:30:40,320
of the of the scientific

806
00:30:51,770 --> 00:30:45,590
thank you thank you gentlemen thank you

807
00:30:59,110 --> 00:30:56,630
[Applause]

808
00:31:01,430 --> 00:30:59,120
up next we have jolyn russell to discuss

809
00:31:04,389 --> 00:31:01,440
raven a technology demonstration aimed

810
00:31:06,070 --> 00:31:04,399
at approving autonomous docking ms

811
00:31:07,990 --> 00:31:06,080
russell is the deputy robotics program

812
00:31:10,149 --> 00:31:08,000
manager of goddard space flight center

813
00:31:14,070 --> 00:31:10,159

satellite servicing projects division

814

00:31:17,669 --> 00:31:15,509

good morning thanks for the introduction

815

00:31:18,870 --> 00:31:17,679

it's great to be here with all of you

816

00:31:20,789 --> 00:31:18,880

as everyone else has shown their

817

00:31:23,110 --> 00:31:20,799

enthusiasm we too are excited to take

818

00:31:25,029 --> 00:31:23,120

raven to space station i'm really

819

00:31:27,269 --> 00:31:25,039

honored to be here to represent a great

820

00:31:29,190 --> 00:31:27,279

team that brought this project from

821

00:31:30,789 --> 00:31:29,200

basically conception

822

00:31:33,190 --> 00:31:30,799

to ready to ship

823

00:31:35,190 --> 00:31:33,200

within 18 months so that's a no small

824

00:31:37,509 --> 00:31:35,200

feat and of itself

825

00:31:39,750 --> 00:31:37,519

raven is

826
00:31:41,110 --> 00:31:39,760
a technology demonstration mission that

827
00:31:43,269 --> 00:31:41,120
will be

828
00:31:45,269 --> 00:31:43,279
testing and advancing an autopilot

829
00:31:47,110 --> 00:31:45,279
system for spacecraft

830
00:31:48,470 --> 00:31:47,120
it has three sensors

831
00:31:49,909 --> 00:31:48,480
that coupled with some advanced

832
00:31:51,669 --> 00:31:49,919
algorithms

833
00:31:53,669 --> 00:31:51,679
will be used to track the incoming and

834
00:31:54,630 --> 00:31:53,679
departing visiting vehicles from space

835
00:31:56,630 --> 00:31:54,640
station

836
00:31:59,110 --> 00:31:56,640
so this is a brand new technology for

837
00:32:01,669 --> 00:31:59,120
nasa we're really excited about it

838
00:32:03,509 --> 00:32:01,679

we'll use this for many applications the

839

00:32:05,909 --> 00:32:03,519

first of which is a restore I mission

840

00:32:08,230 --> 00:32:05,919

which is a mission that is focused on

841

00:32:11,269 --> 00:32:08,240

refueling where two will be building a

842

00:32:13,750 --> 00:32:11,279

satellite that will rendezvous capture

843

00:32:16,149 --> 00:32:13,760

another satellite and we'll refuel it at

844

00:32:18,149 --> 00:32:16,159

that point extending the capabilities of

845

00:32:19,669 --> 00:32:18,159

satellites in space

846

00:32:21,509 --> 00:32:19,679

addition in addition to that we can use

847

00:32:22,710 --> 00:32:21,519

this technology for journey to mars you

848

00:32:24,149 --> 00:32:22,720

can imagine that there's going to be

849

00:32:26,710 --> 00:32:24,159

refueling and all kinds of other

850

00:32:27,590 --> 00:32:26,720

rendezvous things that we need in that

851
00:32:29,750 --> 00:32:27,600
as we

852
00:32:31,669 --> 00:32:29,760
move on to that new frontier

853
00:32:34,549 --> 00:32:31,679
to put this in a little more perspective

854
00:32:37,269 --> 00:32:34,559
we have a life-size raven here to show

855
00:32:39,430 --> 00:32:37,279
you what we're sending to space station

856
00:32:41,669 --> 00:32:39,440
the silver box is the raven sensor

857
00:32:44,070 --> 00:32:41,679
enclosure in that we have a lidar so

858
00:32:45,509 --> 00:32:44,080
this is the send and receive apertures

859
00:32:47,509 --> 00:32:45,519
we also have

860
00:32:49,830 --> 00:32:47,519
an infrared camera and a visible camera

861
00:32:50,789 --> 00:32:49,840
so these three sensors together provide

862
00:32:52,630 --> 00:32:50,799
data

863
00:32:54,549 --> 00:32:52,640

about the vehicle as it's approaching we

864

00:32:56,789 --> 00:32:54,559

have a two axis gimbal over here so this

865

00:32:58,870 --> 00:32:56,799

gimbal will move the sensor it can

866

00:33:01,509 --> 00:32:58,880

rotate it this way both azimuth and also

867

00:33:03,509 --> 00:33:01,519

an elevation so as the inputs come in it

868

00:33:05,750 --> 00:33:03,519

tracks the vehicle and autonomously with

869

00:33:07,990 --> 00:33:05,760

no input from anyone decides how to

870

00:33:10,710 --> 00:33:08,000

track it until it's birthed

871

00:33:12,310 --> 00:33:10,720

so this is a great testbed for a restore

872

00:33:13,990 --> 00:33:12,320

I mission you can imagine that we can

873

00:33:15,990 --> 00:33:14,000

prove out one of the most complicated

874

00:33:17,509 --> 00:33:16,000

parts of that mission

875

00:33:19,430 --> 00:33:17,519

we also would like to show you a little

876
00:33:21,509 --> 00:33:19,440
bit about how raven came together so we

877
00:33:22,870 --> 00:33:21,519
have a video for that

878
00:33:25,110 --> 00:33:22,880
and we built this at goddard space

879
00:33:26,470 --> 00:33:25,120
flight center up in maryland

880
00:33:27,909 --> 00:33:26,480
we did the work in the clean room this

881
00:33:30,149 --> 00:33:27,919
was a big day for us when we brought

882
00:33:31,750 --> 00:33:30,159
together the sensor enclosure here with

883
00:33:34,310 --> 00:33:31,760
the gimbal kind of bringing the two

884
00:33:36,310 --> 00:33:34,320
systems together was a big step forward

885
00:33:37,990 --> 00:33:36,320
in our in our process all the work done

886
00:33:40,070 --> 00:33:38,000
here is in a clean room you can imagine

887
00:33:41,669 --> 00:33:40,080
that we don't want to get a camera in

888
00:33:42,950 --> 00:33:41,679

space just to have a smudge or a piece

889

00:33:43,750 --> 00:33:42,960

of dirt on it

890

00:33:45,029 --> 00:33:43,760

so

891

00:33:47,350 --> 00:33:45,039

once we get through the integration

892

00:33:49,830 --> 00:33:47,360

process we depart the clean room we go

893

00:33:51,430 --> 00:33:49,840

into a test suite where we'll

894

00:33:53,430 --> 00:33:51,440

go through a vibration test to make sure

895

00:33:55,350 --> 00:33:53,440

we can survive the rocket launch we'll

896

00:33:56,710 --> 00:33:55,360

also do some thermal back testing to

897

00:33:58,389 --> 00:33:56,720

make sure we can

898

00:34:00,470 --> 00:33:58,399

we have all the capabilities at both hot

899

00:34:01,830 --> 00:34:00,480

and cold once we get through all that we

900

00:34:03,590 --> 00:34:01,840

test and make sure we still have

901
00:34:04,310 --> 00:34:03,600
functionality

902
00:34:06,070 --> 00:34:04,320
so

903
00:34:07,509 --> 00:34:06,080
that's a big once we get through all

904
00:34:09,829 --> 00:34:07,519
that we're confident that we're ready to

905
00:34:11,990 --> 00:34:09,839
launch of course the biggest test of all

906
00:34:13,669 --> 00:34:12,000
is the actual rocket ride tomorrow

907
00:34:15,430 --> 00:34:13,679
this is showing once we get there we get

908
00:34:17,109 --> 00:34:15,440
docked on space station you saw some of

909
00:34:18,710 --> 00:34:17,119
the acrobatics that go along with that

910
00:34:20,950 --> 00:34:18,720
we'll go through a similar robotic

911
00:34:22,470 --> 00:34:20,960
install for raven

912
00:34:24,230 --> 00:34:22,480
and this is an image of how we will

913
00:34:25,990 --> 00:34:24,240

track the visiting vehicles coming in

914

00:34:27,109 --> 00:34:26,000

switching between the sensors and using

915

00:34:29,909 --> 00:34:27,119

that input

916

00:34:31,750 --> 00:34:29,919

to track it to birth

917

00:34:33,510 --> 00:34:31,760

looking forward to this we should be up

918

00:34:35,430 --> 00:34:33,520

there in the next couple days and if all

919

00:34:37,190 --> 00:34:35,440

goes to plan we will the first thing we

920

00:34:38,710 --> 00:34:37,200

see leave is the dragon capsule that we

921

00:34:44,149 --> 00:34:38,720

came in on so

922

00:34:47,750 --> 00:34:46,310

if you have questions please remember to

923

00:34:49,510 --> 00:34:47,760

raise your hand you can also ask

924

00:34:54,950 --> 00:34:49,520

questions via social media with the

925

00:34:54,960 --> 00:34:58,950

we have a question back here

926
00:35:02,550 --> 00:35:00,950
well this uh decrease the time it takes

927
00:35:04,950 --> 00:35:02,560
for like a

928
00:35:06,790 --> 00:35:04,960
a delivery vehicle to to attach it to

929
00:35:08,870 --> 00:35:06,800
the station because i noticed you know i

930
00:35:10,390 --> 00:35:08,880
i've seen one of those before and

931
00:35:12,950 --> 00:35:10,400
you see the vehicle from the space

932
00:35:15,109 --> 00:35:12,960
station it looks so close and then the

933
00:35:16,790 --> 00:35:15,119
the caption says it'll be connected in

934
00:35:18,150 --> 00:35:16,800
like 24 hours and you go wait it's right

935
00:35:19,430 --> 00:35:18,160
there why doesn't it just connect so

936
00:35:20,790 --> 00:35:19,440
fast

937
00:35:23,030 --> 00:35:20,800
we're not trying to speed up that

938
00:35:25,190 --> 00:35:23,040

well-tuned process by any means we're

939

00:35:26,950 --> 00:35:25,200

trying to develop the technology for

940

00:35:28,710 --> 00:35:26,960

other missions and doing the tracking

941

00:35:30,710 --> 00:35:28,720

and incoming but this will give us some

942

00:35:32,550 --> 00:35:30,720

new looks at the vehicles coming in that

943

00:35:37,349 --> 00:35:32,560

we don't have before so we're happy to

944

00:35:37,359 --> 00:35:41,109

questions

945

00:35:44,710 --> 00:35:42,950

does this kind of sensor require some

946

00:35:46,390 --> 00:35:44,720

sort of consistent framework whenever

947

00:35:48,150 --> 00:35:46,400

rockets are built in order for it to be

948

00:35:49,589 --> 00:35:48,160

compatible or is it more about the

949

00:35:52,550 --> 00:35:49,599

material that's used in order for the

950

00:35:54,069 --> 00:35:52,560

sensors to be able to track the location

951
00:35:56,550 --> 00:35:54,079
so you've hit on one of the very key

952
00:35:58,310 --> 00:35:56,560
elements of our whole mission in general

953
00:35:59,670 --> 00:35:58,320
so most of the satellites in fact all

954
00:36:01,430 --> 00:35:59,680
the satellites that are in space right

955
00:36:03,270 --> 00:36:01,440
now that we would target for refueling

956
00:36:05,270 --> 00:36:03,280
and other kinds of operation are not

957
00:36:06,950 --> 00:36:05,280
cooperative um they weren't planned to

958
00:36:08,710 --> 00:36:06,960
be captured and so this kind of

959
00:36:10,230 --> 00:36:08,720
technology is more complicated in that

960
00:36:12,630 --> 00:36:10,240
we're trying to pick up on features that

961
00:36:13,750 --> 00:36:12,640
just happen to be there and use those to

962
00:36:15,349 --> 00:36:13,760
track

963
00:36:17,510 --> 00:36:15,359

so one of our goals of our group in

964

00:36:19,270 --> 00:36:17,520

general is to make things more

965

00:36:20,950 --> 00:36:19,280

cooperative to put certain targets on

966

00:36:23,109 --> 00:36:20,960

them so that things are easier to find

967

00:36:24,150 --> 00:36:23,119

going forward but with what we have now

968

00:36:30,550 --> 00:36:24,160

we're trying to develop the

969

00:36:30,560 --> 00:36:35,720

great thank you ms russell

970

00:36:41,750 --> 00:36:39,589

[Applause]

971

00:36:43,430 --> 00:36:41,760

and now please welcome paul reichert

972

00:36:45,430 --> 00:36:43,440

he's associate principal scientist for

973

00:36:47,349 --> 00:36:45,440

merck research labs who will discuss the

974

00:36:49,510 --> 00:36:47,359

potential value of the space station's

975

00:36:57,190 --> 00:36:49,520

microgravity environment for improving

976
00:37:03,030 --> 00:37:00,310
good morning um i'm from merck research

977
00:37:04,550 --> 00:37:03,040
laboratories in kenilworth new jersey

978
00:37:06,829 --> 00:37:04,560
glad to see there was somebody else from

979
00:37:08,390 --> 00:37:06,839
new jersey here which was a pleasant

980
00:37:10,630 --> 00:37:08,400
surprise

981
00:37:13,430 --> 00:37:10,640
and i'm going to be telling you about my

982
00:37:15,030 --> 00:37:13,440
experiment or mercs experiment

983
00:37:17,510 --> 00:37:15,040
to grow

984
00:37:18,470 --> 00:37:17,520
crystalline suspensions in space

985
00:37:20,790 --> 00:37:18,480
and

986
00:37:23,589 --> 00:37:20,800
anybody who's been familiar with most of

987
00:37:26,230 --> 00:37:23,599
the experiments people have talked about

988
00:37:28,710 --> 00:37:26,240

in microgravity have been to grow

989

00:37:31,190 --> 00:37:28,720

large single crystals

990

00:37:33,829 --> 00:37:31,200

for structural studies

991

00:37:35,750 --> 00:37:33,839

and when i say large this means crystals

992

00:37:36,710 --> 00:37:35,760

that you can barely see with the naked

993

00:37:39,430 --> 00:37:36,720

eye

994

00:37:41,030 --> 00:37:39,440

but the focus of my experiment

995

00:37:43,190 --> 00:37:41,040

will be to grow

996

00:37:44,150 --> 00:37:43,200

crystalline suspensions so i'm looking

997

00:37:46,550 --> 00:37:44,160

to grow

998

00:37:49,750 --> 00:37:46,560

millions of crystalline particles a

999

00:37:51,349 --> 00:37:49,760

uniform size and high quality and high

1000

00:37:52,550 --> 00:37:51,359

order

1001
00:37:55,190 --> 00:37:52,560
and

1002
00:37:56,950 --> 00:37:55,200
these crystals have applications for

1003
00:37:59,349 --> 00:37:56,960
drug delivery

1004
00:38:00,630 --> 00:37:59,359
for formulation

1005
00:38:02,790 --> 00:38:00,640
and for

1006
00:38:04,870 --> 00:38:02,800
purification and

1007
00:38:07,430 --> 00:38:04,880
storage so what does this have to do

1008
00:38:10,150 --> 00:38:07,440
with microgravity you know why what does

1009
00:38:11,750 --> 00:38:10,160
microgravity have to offer us and

1010
00:38:14,150 --> 00:38:11,760
actually there's three effects that

1011
00:38:16,829 --> 00:38:14,160
we're trying to take advantage of number

1012
00:38:19,349 --> 00:38:16,839
one is is that there's reduced

1013
00:38:21,430 --> 00:38:19,359

sedimentation so these particles as they

1014

00:38:23,990 --> 00:38:21,440

grow have mass

1015

00:38:25,589 --> 00:38:24,000

and then as they grow in the solution

1016

00:38:27,750 --> 00:38:25,599

they tend to sediment and there's

1017

00:38:30,230 --> 00:38:27,760

turbulence around those particles and

1018

00:38:32,630 --> 00:38:30,240

that turbulence causes the particles not

1019

00:38:36,310 --> 00:38:32,640

to be as high ordered as they could

1020

00:38:38,150 --> 00:38:36,320

possibly be okay and the second effect

1021

00:38:40,550 --> 00:38:38,160

is that there's minimal convection

1022

00:38:43,190 --> 00:38:40,560

currents and the way i look at this is

1023

00:38:45,670 --> 00:38:43,200

that if you ever look at a pot boiling

1024

00:38:46,390 --> 00:38:45,680

and you see that swirling that's in that

1025

00:38:47,750 --> 00:38:46,400

pot

1026

00:38:50,950 --> 00:38:47,760

that's due to

1027

00:38:52,790 --> 00:38:50,960

that's a a gravity driven process where

1028

00:38:55,430 --> 00:38:52,800

there's not a uniform temperature

1029

00:38:58,310 --> 00:38:55,440

gradient in that solution

1030

00:39:01,190 --> 00:38:58,320

fortunately in microgravity what you get

1031

00:39:03,829 --> 00:39:01,200

is you get a uniform temperature

1032

00:39:06,069 --> 00:39:03,839

gradient throughout your solution

1033

00:39:08,150 --> 00:39:06,079

so if you have a

1034

00:39:10,069 --> 00:39:08,160

certain temperature where you need to

1035

00:39:12,390 --> 00:39:10,079

get crystals to grow

1036

00:39:14,950 --> 00:39:12,400

you can very exquisitely

1037

00:39:16,950 --> 00:39:14,960

reach that point get nucleation and

1038

00:39:17,990 --> 00:39:16,960

growth so we have a really exquisite

1039

00:39:21,109 --> 00:39:18,000

control

1040

00:39:22,710 --> 00:39:21,119

of the crystallization process

1041

00:39:26,150 --> 00:39:22,720

and the other effect that we'd like to

1042

00:39:29,510 --> 00:39:26,160

take advantage of is that there is

1043

00:39:30,710 --> 00:39:29,520

reduced uh molecular diffusion rates

1044

00:39:33,750 --> 00:39:30,720

and uh

1045

00:39:35,109 --> 00:39:33,760

what that well the way i i look at that

1046

00:39:38,630 --> 00:39:35,119

it's like a

1047

00:39:40,870 --> 00:39:38,640

uh a bricklayer who's building a wall

1048

00:39:43,430 --> 00:39:40,880

and if he's got to do it quick what it

1049

00:39:45,990 --> 00:39:43,440

does is the the bricks aren't nicely

1050

00:39:48,310 --> 00:39:46,000

gapped and with cement in between them

1051
00:39:50,870 --> 00:39:48,320
and then the wall is kind of crooked if

1052
00:39:53,030 --> 00:39:50,880
you can slow that process down and bring

1053
00:39:55,030 --> 00:39:53,040
in bricks one at a time and have a nice

1054
00:39:58,069 --> 00:39:55,040
water you're going to have

1055
00:40:00,390 --> 00:39:58,079
very nice well-ordered crystals of high

1056
00:40:02,310 --> 00:40:00,400
purity so that's our that's our goal

1057
00:40:05,430 --> 00:40:02,320
that we're trying to do here

1058
00:40:07,270 --> 00:40:05,440
um and uh the uh

1059
00:40:10,309 --> 00:40:07,280
protein that we're flying for this

1060
00:40:13,349 --> 00:40:10,319
experiment is actually a very uh

1061
00:40:15,710 --> 00:40:13,359
important new drug product from mark

1062
00:40:18,309 --> 00:40:15,720
it's called k trudeau and that's our

1063
00:40:20,230 --> 00:40:18,319

anti-pd-1 therapy

1064

00:40:21,910 --> 00:40:20,240

pd-1 is our

1065

00:40:23,349 --> 00:40:21,920

program death

1066

00:40:25,910 --> 00:40:23,359

protein

1067

00:40:27,750 --> 00:40:25,920

this drug

1068

00:40:30,230 --> 00:40:27,760

helps

1069

00:40:34,470 --> 00:40:30,240

your immune system

1070

00:40:37,349 --> 00:40:34,480

detect

1071

00:40:39,430 --> 00:40:37,359

fight and destroy tumor cells all right

1072

00:40:41,670 --> 00:40:39,440

so let me just quickly show you some of

1073

00:40:42,710 --> 00:40:41,680

the hardware that we're flying all right

1074

00:40:44,230 --> 00:40:42,720

the first

1075

00:40:45,990 --> 00:40:44,240

hardware

1076

00:40:48,550 --> 00:40:46,000

is the protein

1077

00:40:51,190 --> 00:40:48,560

crystallization growth

1078

00:40:53,829 --> 00:40:51,200

box all right and then this is the six

1079

00:40:56,150 --> 00:40:53,839

pack so there's five of these six packs

1080

00:40:58,550 --> 00:40:56,160

in here all right and then

1081

00:41:00,710 --> 00:40:58,560

there are six individual chambers in

1082

00:41:03,030 --> 00:41:00,720

here in each one of these chambers

1083

00:41:05,430 --> 00:41:03,040

there's a tiny little insert where we

1084

00:41:07,750 --> 00:41:05,440

put the protein and a little bit of

1085

00:41:09,670 --> 00:41:07,760

precipitant and then below that is

1086

00:41:13,109 --> 00:41:09,680

precipitant that's there

1087

00:41:15,910 --> 00:41:13,119

um and what happens is on launch

1088

00:41:18,150 --> 00:41:15,920

that insert is turned sideways so it's

1089

00:41:20,630 --> 00:41:18,160

protected all right and then once the

1090

00:41:24,550 --> 00:41:20,640

astronaut gets up there he just turns

1091

00:41:27,750 --> 00:41:24,560

the crank and turns that insert in vapor

1092

00:41:30,150 --> 00:41:27,760

contact with the solution below and what

1093

00:41:32,309 --> 00:41:30,160

will happen over time is that drop will

1094

00:41:34,550 --> 00:41:32,319

shrink and if we're fortunate and

1095

00:41:36,309 --> 00:41:34,560

conditions are right we'll get crystals

1096

00:41:38,470 --> 00:41:36,319

to grow okay

1097

00:41:39,430 --> 00:41:38,480

all right the other hardware that we're

1098

00:41:42,069 --> 00:41:39,440

flying

1099

00:41:45,750 --> 00:41:42,079

is called the protein crystallization

1100

00:41:48,390 --> 00:41:45,760

facility which is an aluminum uh box

1101

00:41:51,670 --> 00:41:48,400

that's under vacuum and then there's

1102

00:41:53,589 --> 00:41:51,680

individual 1ml bottles that are in there

1103

00:41:56,230 --> 00:41:53,599

and this is where temperature comes in

1104

00:41:59,109 --> 00:41:56,240

we we have our monoclonal antibody in

1105

00:42:00,790 --> 00:41:59,119

there and we have our prot our

1106

00:42:03,829 --> 00:42:00,800

precipitant in there

1107

00:42:06,230 --> 00:42:03,839

and the aluminum cap with the change in

1108

00:42:08,230 --> 00:42:06,240

temperature this is in an incubator

1109

00:42:10,390 --> 00:42:08,240

we can get a nice temperature gradient

1110

00:42:13,270 --> 00:42:10,400

across that bottle and that's how we

1111

00:42:14,230 --> 00:42:13,280

hope to get really high quality

1112

00:42:16,550 --> 00:42:14,240

pure

1113

00:42:18,550 --> 00:42:16,560

uh protein to crystallize

1114

00:42:20,230 --> 00:42:18,560

and we have

1115

00:42:23,430 --> 00:42:20,240

two of these modules

1116

00:42:25,670 --> 00:42:23,440

uh dedicated to two different uh

1117

00:42:28,710 --> 00:42:25,680

conditions to get crystals for drug

1118

00:42:32,150 --> 00:42:28,720

delivery and one of them are dedicated

1119

00:42:33,750 --> 00:42:32,160

to where we take relatively very impure

1120

00:42:36,790 --> 00:42:33,760

protein we take

1121

00:42:38,710 --> 00:42:36,800

uh the protein as it's grown in the

1122

00:42:41,109 --> 00:42:38,720

fermenter and we can get it to

1123

00:42:43,109 --> 00:42:41,119

crystallize on earth and we want to see

1124

00:42:45,510 --> 00:42:43,119

what happens in a microgravity

1125

00:42:47,750 --> 00:42:45,520

environment so i'm very excited about

1126

00:42:50,069 --> 00:42:47,760

this experiment because of the because

1127

00:42:52,950 --> 00:42:50,079

of of how different it is to pass

1128

00:42:54,950 --> 00:42:52,960

protein crystal growth experiments

1129

00:42:56,150 --> 00:42:54,960

i'm also

1130

00:42:57,349 --> 00:42:56,160

like to

1131

00:42:58,470 --> 00:42:57,359

thank

1132

00:43:01,109 --> 00:42:58,480

kasis

1133

00:43:03,349 --> 00:43:01,119

and nasa to give me an opportunity to do

1134

00:43:05,910 --> 00:43:03,359

research in the most unique laboratory

1135

00:43:08,150 --> 00:43:05,920

in the world and it is a laboratory

1136

00:43:11,030 --> 00:43:08,160

for doing research

1137

00:43:13,910 --> 00:43:11,040

i would like to say that we plan to

1138

00:43:16,069 --> 00:43:13,920

publish these results so that we can

1139

00:43:18,470 --> 00:43:16,079

share this with the broader community

1140

00:43:19,190 --> 00:43:18,480

and i'd like to say that we hope

1141

00:43:22,790 --> 00:43:19,200

that

1142

00:43:26,230 --> 00:43:22,800

these experiments benefit both

1143

00:43:33,109 --> 00:43:26,240

our patients as well as caregivers so

1144

00:43:35,910 --> 00:43:34,550

again if you have questions just raise

1145

00:43:37,510 --> 00:43:35,920

your hand wait for the microphone to get

1146

00:43:39,270 --> 00:43:37,520

to you before you start speaking so that

1147

00:43:40,870 --> 00:43:39,280

everyone can hear and if you have a

1148

00:43:42,309 --> 00:43:40,880

question and you're following along via

1149

00:43:47,829 --> 00:43:42,319

social media you can submit your

1150

00:43:52,870 --> 00:43:50,550

we have two questions in the back um

1151

00:43:55,430 --> 00:43:52,880

we're in the middle

1152

00:43:57,510 --> 00:43:55,440

hi thank you for the demonstration it's

1153

00:43:59,670 --> 00:43:57,520

very cool um so in addition to the

1154

00:44:01,670 --> 00:43:59,680

programmed cell death investigation what

1155

00:44:03,589 --> 00:44:01,680

other pharmaceutical applications are

1156

00:44:05,349 --> 00:44:03,599

you looking at with this particular

1157

00:44:06,309 --> 00:44:05,359

experiment

1158

00:44:09,030 --> 00:44:06,319

um

1159

00:44:10,390 --> 00:44:09,040

well the three the three things are drug

1160

00:44:14,150 --> 00:44:10,400

delivery

1161

00:44:16,390 --> 00:44:14,160

and one of the uh issues with

1162

00:44:19,030 --> 00:44:16,400

uh monoclonal uh

1163

00:44:22,630 --> 00:44:19,040

antibody therapy right now

1164

00:44:25,670 --> 00:44:22,640

is that there is relatively

1165

00:44:28,069 --> 00:44:25,680

insoluble drugs so they generally have

1166

00:44:30,790 --> 00:44:28,079

to be given in an iv

1167

00:44:32,710 --> 00:44:30,800

setting as a constant infusion and we're

1168

00:44:35,750 --> 00:44:32,720

looking at opportunities to make a

1169

00:44:38,069 --> 00:44:35,760

concentrated crystalline suspension

1170

00:44:41,430 --> 00:44:38,079

that could potentially be given as a

1171

00:44:42,309 --> 00:44:41,440

sub-q injection so this could alleviate

1172

00:44:45,030 --> 00:44:42,319

those

1173

00:44:47,349 --> 00:44:45,040

uh hours that a patient as well as a

1174

00:44:49,030 --> 00:44:47,359

caregiver has to do

1175

00:44:50,390 --> 00:44:49,040

three times a week

1176

00:44:53,109 --> 00:44:50,400

so

1177

00:44:55,910 --> 00:44:53,119

and then get a single injection in a

1178

00:44:57,990 --> 00:44:55,920

doctor's office or self-injection so

1179

00:45:00,790 --> 00:44:58,000

that that's one of the key

1180

00:45:09,270 --> 00:45:00,800

you know applications that i could see

1181

00:45:12,710 --> 00:45:11,109

thank you so if this experiment is

1182

00:45:15,109 --> 00:45:12,720

successful in space with the

1183

00:45:16,470 --> 00:45:15,119

crystallization how will you then

1184

00:45:18,390 --> 00:45:16,480

replicate it

1185

00:45:20,870 --> 00:45:18,400

for the masses

1186

00:45:23,270 --> 00:45:20,880

i always get that question

1187

00:45:25,589 --> 00:45:23,280

all right so the the there are things

1188

00:45:27,510 --> 00:45:25,599

that we can do i mean what we're going

1189

00:45:31,109 --> 00:45:27,520

to try to do is

1190

00:45:33,670 --> 00:45:31,119

uh to get uh the learn what are the key

1191

00:45:35,910 --> 00:45:33,680

variables for crystal growth that's

1192

00:45:37,510 --> 00:45:35,920

there and then apply them to earth

1193

00:45:39,589 --> 00:45:37,520

processes

1194

00:45:42,470 --> 00:45:39,599

we don't have plans of doing

1195

00:45:44,710 --> 00:45:42,480

manufacturing space i personally would

1196

00:45:46,630 --> 00:45:44,720

like to see that but

1197

00:45:49,910 --> 00:45:46,640

you know in the short term i think we're

1198

00:45:52,470 --> 00:45:49,920

using this as a research tool to tell us

1199

00:45:59,349 --> 00:45:52,480

better on what are the key variables to

1200

00:46:04,550 --> 00:46:00,950

great questions oh we have one more

1201
00:46:08,870 --> 00:46:06,790
this question comes from a k-12 student

1202
00:46:10,950 --> 00:46:08,880
with the society of women engineers and

1203
00:46:13,750 --> 00:46:10,960
how will this in a sentence or two in

1204
00:46:15,030 --> 00:46:13,760
future missions incorporate biochemical

1205
00:46:18,710 --> 00:46:15,040
research

1206
00:46:23,190 --> 00:46:20,550
one of the things i i've been very

1207
00:46:26,150 --> 00:46:23,200
fortunate in that i worked with nasa

1208
00:46:28,870 --> 00:46:26,160
during the the shuttle era and now uh

1209
00:46:31,990 --> 00:46:28,880
currently working with cases

1210
00:46:34,550 --> 00:46:32,000
and i it always seems like every time we

1211
00:46:36,309 --> 00:46:34,560
plan an experiment like this we plan to

1212
00:46:38,710 --> 00:46:36,319
get single crystals we get a lot of

1213
00:46:41,430 --> 00:46:38,720

little ones and we can figure out why we

1214

00:46:44,309 --> 00:46:41,440

did that or we or the opposite happens

1215

00:46:46,309 --> 00:46:44,319

or we find something else out about the

1216

00:46:49,670 --> 00:46:46,319

protein that we didn't know

1217

00:46:51,270 --> 00:46:49,680

and just the process of setting up these

1218

00:46:53,750 --> 00:46:51,280

experiments

1219

00:46:56,069 --> 00:46:53,760

a lot of researchers

1220

00:46:58,870 --> 00:46:56,079

improved the quality of research that

1221

00:47:01,670 --> 00:46:58,880

they do because they're so focused

1222

00:47:02,390 --> 00:47:01,680

in the uh in the experiment they have to

1223

00:47:03,829 --> 00:47:02,400

do

1224

00:47:06,470 --> 00:47:03,839

and they're

1225

00:47:09,109 --> 00:47:06,480

they're restricted in the in the

1226

00:47:11,670 --> 00:47:09,119

hardware and the design of the

1227

00:47:14,390 --> 00:47:11,680

experiment really forces us to do a

1228

00:47:16,470 --> 00:47:14,400

better job or understand the processes

1229

00:47:18,710 --> 00:47:16,480

that were of the experiments that we're

1230

00:47:20,870 --> 00:47:18,720

doing

1231

00:47:23,030 --> 00:47:20,880

we have one more question from

1232

00:47:24,710 --> 00:47:23,040

social media sure this asked ask a

1233

00:47:26,470 --> 00:47:24,720

question is from paul and he asks will

1234

00:47:28,230 --> 00:47:26,480

those crystalline experiments be

1235

00:47:29,589 --> 00:47:28,240

returned to earth for analysis or all

1236

00:47:31,510 --> 00:47:29,599

done on orbit

1237

00:47:32,470 --> 00:47:31,520

yes they will they are definitely coming

1238

00:47:35,670 --> 00:47:32,480

back

1239

00:47:38,549 --> 00:47:35,680

um and on in the dragon

1240

00:47:41,270 --> 00:47:38,559

and we'll bring them back to new jersey

1241

00:47:42,710 --> 00:47:41,280

and characterize those with a battery of

1242

00:47:43,750 --> 00:47:42,720

biochemical

1243

00:47:46,150 --> 00:47:43,760

uh

1244

00:47:47,510 --> 00:47:46,160

experiments

1245

00:47:49,030 --> 00:47:47,520

great thank you again mr reichert and

1246

00:47:55,270 --> 00:47:49,040

thank for thank you for the wonderful

1247

00:47:58,950 --> 00:47:57,589

i want to say this with even more

1248

00:48:00,710 --> 00:47:58,960

gratitude than normal for the two

1249

00:48:02,630 --> 00:48:00,720

researchers who are joining us today um

1250

00:48:05,270 --> 00:48:02,640

just so you know they have been up since

1251

00:48:07,190 --> 00:48:05,280

midnight where they had to be on site

1252

00:48:09,270 --> 00:48:07,200

getting their experiment ready to go to

1253

00:48:11,910 --> 00:48:09,280

the international space station

1254

00:48:13,829 --> 00:48:11,920

so please join me in welcoming rasha

1255

00:48:15,829 --> 00:48:13,839

hamamia who's director of integrative

1256

00:48:18,230 --> 00:48:15,839

systems biology with the u.s army

1257

00:48:20,069 --> 00:48:18,240

medical research and materiel command

1258

00:48:21,750 --> 00:48:20,079

and melissa casino who is associate

1259

00:48:23,829 --> 00:48:21,760

professor of orthopedic surgery at

1260

00:48:26,470 --> 00:48:23,839

indiana university school of medicine

1261

00:48:28,470 --> 00:48:26,480

they have information on research that

1262

00:48:35,349 --> 00:48:28,480

could improve wound healing please join

1263

00:48:38,790 --> 00:48:37,109

well thank you tabitha for uh

1264

00:48:41,430 --> 00:48:38,800

introduction and thank you all for being

1265

00:48:43,589 --> 00:48:41,440

here um as sabbath said we haven't slept

1266

00:48:45,030 --> 00:48:43,599

in the last 24 hours so if we start

1267

00:48:47,990 --> 00:48:45,040

mumbling or speaking a different

1268

00:48:48,870 --> 00:48:48,000

language please bear with us

1269

00:48:50,950 --> 00:48:48,880

so

1270

00:48:52,870 --> 00:48:50,960

i'm from the army

1271

00:48:54,630 --> 00:48:52,880

medical command

1272

00:48:56,870 --> 00:48:54,640

my institute is called u.s army center

1273

00:49:01,030 --> 00:48:56,880

for environmental health research

1274

00:49:06,309 --> 00:49:03,190

the biology and mechanisms of diseases

1275

00:49:07,349 --> 00:49:06,319

of military relevance so we screen for

1276

00:49:12,470 --> 00:49:07,359

thousands

1277

00:49:15,109 --> 00:49:12,480

proteins metabolites in the body to

1278

00:49:17,589 --> 00:49:15,119

understand mechanisms of diseases

1279

00:49:19,430 --> 00:49:17,599

we focus again on the service member

1280

00:49:21,670 --> 00:49:19,440

and this is one of the reasons why we're

1281

00:49:24,150 --> 00:49:21,680

working on bone healing

1282

00:49:25,670 --> 00:49:24,160

melissa and i met at one of the military

1283

00:49:27,349 --> 00:49:25,680

health

1284

00:49:29,670 --> 00:49:27,359

symposium

1285

00:49:31,430 --> 00:49:29,680

where we started discussing

1286

00:49:33,990 --> 00:49:31,440

potential collaborations because we are

1287

00:49:36,630 --> 00:49:34,000

very good on the biomarker research

1288

00:49:38,309 --> 00:49:36,640

melissa is an expert on orthopedic

1289

00:49:40,710 --> 00:49:38,319

research

1290

00:49:42,309 --> 00:49:40,720

we decided to work together we have more

1291

00:49:44,150 --> 00:49:42,319

than one project

1292

00:49:46,950 --> 00:49:44,160

studying bone healing and melissa had

1293

00:49:50,470 --> 00:49:46,960

developed a drug um that she's testing

1294

00:49:53,030 --> 00:49:50,480

now for bone healing that seems to be

1295

00:49:55,430 --> 00:49:53,040

safer than available drugs or fda

1296

00:49:57,349 --> 00:49:55,440

approved drugs

1297

00:49:59,589 --> 00:49:57,359

so this is this is how we started and we

1298

00:50:01,190 --> 00:49:59,599

started talking about microgravity and

1299

00:50:03,589 --> 00:50:01,200

melissa will tell you more about why

1300

00:50:06,230 --> 00:50:03,599

we're using microgravity if you go to

1301
00:50:08,150 --> 00:50:06,240
the first slide please

1302
00:50:10,710 --> 00:50:08,160
so this is the hardware that we spend

1303
00:50:13,430 --> 00:50:10,720
the whole night loading

1304
00:50:16,390 --> 00:50:13,440
now it's on the truck on the way to the

1305
00:50:19,430 --> 00:50:16,400
spacex um hopefully everything will be

1306
00:50:22,150 --> 00:50:19,440
as planned um as you see um

1307
00:50:24,630 --> 00:50:22,160
well maybe i should explain more but um

1308
00:50:29,430 --> 00:50:24,640
again why are we interested in this um

1309
00:50:33,109 --> 00:50:31,270
this is one of the pictures that i got

1310
00:50:35,190 --> 00:50:33,119
from melissa and this published that

1311
00:50:38,230 --> 00:50:35,200
shows um

1312
00:50:40,150 --> 00:50:38,240
bone fractures and bone injury

1313
00:50:42,790 --> 00:50:40,160

service members and soldiers coming back

1314

00:50:44,390 --> 00:50:42,800

from the war zone um bone injury is one

1315

00:50:45,910 --> 00:50:44,400

of the um

1316

00:50:48,230 --> 00:50:45,920

most common

1317

00:50:49,430 --> 00:50:48,240

injuries that the service member

1318

00:50:51,349 --> 00:50:49,440

would sustain

1319

00:50:52,870 --> 00:50:51,359

um this is why one of the reasons why

1320

00:50:56,069 --> 00:50:52,880

we're trying to understand what happened

1321

00:50:58,069 --> 00:50:56,079

in the body as the bone starts healing

1322

00:51:01,349 --> 00:50:58,079

looking at genes and proteins and

1323

00:51:02,950 --> 00:51:01,359

metabolites are differentially expressed

1324

00:51:03,910 --> 00:51:02,960

while the bone is healing so this will

1325

00:51:05,510 --> 00:51:03,920

help us

1326
00:51:06,549 --> 00:51:05,520
once we understand the mechanism will

1327
00:51:08,870 --> 00:51:06,559
help us

1328
00:51:10,390 --> 00:51:08,880
also in developing

1329
00:51:12,710 --> 00:51:10,400
drugs

1330
00:51:15,030 --> 00:51:12,720
to for for bone healing and i think i'll

1331
00:51:19,190 --> 00:51:15,040
turn to melissa now so great thank you

1332
00:51:22,630 --> 00:51:20,710
as you look at this

1333
00:51:24,390 --> 00:51:22,640
image of this x-ray as i think you can

1334
00:51:26,470 --> 00:51:24,400
imagine it's going to be very difficult

1335
00:51:29,109 --> 00:51:26,480
to heal and it will not heal on its own

1336
00:51:30,630 --> 00:51:29,119
without some sort of drug therapy so

1337
00:51:33,030 --> 00:51:30,640
that's what the orthopedic surgeon will

1338
00:51:33,829 --> 00:51:33,040

do at the time of surgery is help with

1339

00:51:36,950 --> 00:51:33,839

the

1340

00:51:39,349 --> 00:51:36,960

a drug and a lot to allow that to heal

1341

00:51:41,349 --> 00:51:39,359

now if you go to the next slide

1342

00:51:43,190 --> 00:51:41,359

um

1343

00:51:46,390 --> 00:51:43,200

we're having a

1344

00:51:48,230 --> 00:51:46,400

model using mice and you can see there's

1345

00:51:50,309 --> 00:51:48,240

an injury at the middle

1346

00:51:52,150 --> 00:51:50,319

in the slide to the left if you go to

1347

00:51:54,630 --> 00:51:52,160

the middle slide that shows that it

1348

00:51:56,950 --> 00:51:54,640

won't heal without the drug and now if

1349

00:51:58,870 --> 00:51:56,960

you use a drug on the right you see it

1350

00:51:59,990 --> 00:51:58,880

bridges and it allows for the healing of

1351
00:52:02,390 --> 00:52:00,000
the bone

1352
00:52:04,069 --> 00:52:02,400
and um so i think a lot of people would

1353
00:52:05,829 --> 00:52:04,079
say okay great well you can heal bones

1354
00:52:06,790 --> 00:52:05,839
fine on earth why do we need to go to

1355
00:52:08,549 --> 00:52:06,800
space

1356
00:52:11,430 --> 00:52:08,559
and you can go ahead and

1357
00:52:13,829 --> 00:52:11,440
show the the video loop while i talk

1358
00:52:15,589 --> 00:52:13,839
about this but really the important

1359
00:52:17,670 --> 00:52:15,599
thing is that

1360
00:52:18,470 --> 00:52:17,680
first image of the human fracture of the

1361
00:52:20,790 --> 00:52:18,480
leg

1362
00:52:23,589 --> 00:52:20,800
that's devastating those soldiers are

1363
00:52:25,750 --> 00:52:23,599

going to be about six months bedridden

1364

00:52:27,510 --> 00:52:25,760

on crutches it's going to be a long time

1365

00:52:29,750 --> 00:52:27,520

where they're not bearing weight

1366

00:52:32,069 --> 00:52:29,760

what happens to the animals that we

1367

00:52:34,230 --> 00:52:32,079

study here on earth immediately after

1368

00:52:36,470 --> 00:52:34,240

surgery they walk around

1369

00:52:37,670 --> 00:52:36,480

very different healing dynamics when

1370

00:52:38,549 --> 00:52:37,680

this occurs

1371

00:52:41,829 --> 00:52:38,559

and

1372

00:52:44,309 --> 00:52:41,839

a lot of our drug therapies are enhanced

1373

00:52:45,829 --> 00:52:44,319

when you are bearing weight and so

1374

00:52:49,109 --> 00:52:45,839

a lot of times things that work in

1375

00:52:51,430 --> 00:52:49,119

animals don't work in humans and we

1376

00:52:53,270 --> 00:52:51,440

think that this is because our model is

1377

00:52:55,109 --> 00:52:53,280

not perfect and so by using the

1378

00:52:57,430 --> 00:52:55,119

international space station we have a

1379

00:52:59,510 --> 00:52:57,440

much better model where we can test the

1380

00:53:01,670 --> 00:52:59,520

therapies and hopefully better translate

1381

00:53:04,870 --> 00:53:01,680

what works in animals to humans and so

1382

00:53:07,430 --> 00:53:04,880

that's really what our focus is here

1383

00:53:08,710 --> 00:53:07,440

and now russia might sum up on how we'll

1384

00:53:10,950 --> 00:53:08,720

also take some of this with the

1385

00:53:12,470 --> 00:53:10,960

molecular data she'll gain so the value

1386

00:53:14,630 --> 00:53:12,480

of what we call the whole genome

1387

00:53:16,390 --> 00:53:14,640

analysis is now we can screen for tens

1388

00:53:17,910 --> 00:53:16,400

of thousands of genes and proteins at

1389

00:53:20,309 --> 00:53:17,920

the same time

1390

00:53:22,230 --> 00:53:20,319

and and again understand mechanisms of

1391

00:53:24,150 --> 00:53:22,240

healing and what's very important is

1392

00:53:26,549 --> 00:53:24,160

that some of these mice will be treated

1393

00:53:28,630 --> 00:53:26,559

with melissa's drug and

1394

00:53:31,109 --> 00:53:28,640

on microgravity and this will help us

1395

00:53:34,150 --> 00:53:31,119

understand efficacy how what's happening

1396

00:53:36,630 --> 00:53:34,160

in the body as in as a response to the

1397

00:53:39,670 --> 00:53:36,640

specific drug we can understand how this

1398

00:53:41,510 --> 00:53:39,680

drug is healing the bone in microgravity

1399

00:53:43,109 --> 00:53:41,520

and again we have the ground control so

1400

00:53:45,990 --> 00:53:43,119

we can compare what's happening in

1401
00:53:48,870 --> 00:53:46,000
microgravity to the ground control

1402
00:53:51,910 --> 00:53:48,880
the other thing is

1403
00:53:54,470 --> 00:53:51,920
we don't only get the bones we can also

1404
00:53:56,309 --> 00:53:54,480
understand how microgravity or the space

1405
00:53:59,270 --> 00:53:56,319
flight space environment is affecting

1406
00:54:01,829 --> 00:53:59,280
our organ systems so we can also study

1407
00:54:03,510 --> 00:54:01,839
genes and proteins and metabolites

1408
00:54:05,270 --> 00:54:03,520
in the different organs and this will

1409
00:54:07,190 --> 00:54:05,280
help us understand

1410
00:54:09,349 --> 00:54:07,200
the health effects of

1411
00:54:11,510 --> 00:54:09,359
the space environment on our organ

1412
00:54:14,230 --> 00:54:11,520
systems and if i can add just one other

1413
00:54:16,390 --> 00:54:14,240

item so the drugs that the orthopedics

1414

00:54:18,549 --> 00:54:16,400

currently use in in the or a few years

1415

00:54:20,230 --> 00:54:18,559

ago were identified as having an

1416

00:54:22,470 --> 00:54:20,240

increased risk of developing cancer in

1417

00:54:24,069 --> 00:54:22,480

some cases and so that's why we think

1418

00:54:26,710 --> 00:54:24,079

our drug may be safer than what's

1419

00:54:28,950 --> 00:54:26,720

currently out there and by utilizing her

1420

00:54:31,349 --> 00:54:28,960

molecular knowledge we can try to prove

1421

00:54:33,030 --> 00:54:31,359

that it is safer

1422

00:54:35,430 --> 00:54:33,040

i would just like to

1423

00:54:37,190 --> 00:54:35,440

finish with just letting you know that

1424

00:54:39,349 --> 00:54:37,200

this is a huge

1425

00:54:41,430 --> 00:54:39,359

group effort that includes indiana

1426

00:54:42,789 --> 00:54:41,440

university the dod

1427

00:54:46,470 --> 00:54:42,799

the cases

1428

00:54:47,430 --> 00:54:46,480

nasa and dod space test program in the

1429

00:54:50,150 --> 00:54:47,440

lab

1430

00:54:50,829 --> 00:54:50,160

this morning or late at night we had

1431

00:54:54,470 --> 00:54:50,839

more

1432

00:54:57,750 --> 00:54:54,480

than 40 people in the lab just working

1433

00:54:59,109 --> 00:54:57,760

to get everything ready um but so it was

1434

00:55:00,549 --> 00:54:59,119

it was a huge effort and we're very

1435

00:55:01,829 --> 00:55:00,559

excited about it we're very happy to be

1436

00:55:07,829 --> 00:55:01,839

here

1437

00:55:11,510 --> 00:55:10,069

thank you both again as usual if you

1438

00:55:12,870 --> 00:55:11,520

have a question raise your hand make

1439

00:55:14,309 --> 00:55:12,880

sure the mic gets to you before you

1440

00:55:17,270 --> 00:55:14,319

start speaking and if you're following

1441

00:55:19,430 --> 00:55:17,280

along on social media use the hashtag

1442

00:55:21,910 --> 00:55:19,440

ask nasa

1443

00:55:24,390 --> 00:55:21,920

so obviously if these drugs could help

1444

00:55:26,309 --> 00:55:24,400

people um wound broken bones or

1445

00:55:28,549 --> 00:55:26,319

fractures that would be amazing could

1446

00:55:30,630 --> 00:55:28,559

there also be connections um and i asked

1447

00:55:32,870 --> 00:55:30,640

on behalf of my mother charlotte bone

1448

00:55:35,430 --> 00:55:32,880

who's had advanced osteoporosis from a

1449

00:55:37,109 --> 00:55:35,440

very young age can it have help a lot of

1450

00:55:39,349 --> 00:55:37,119

those medications don't help especially

1451

00:55:40,789 --> 00:55:39,359

if it's already progressed do you think

1452

00:55:42,710 --> 00:55:40,799

there's an impact that it could help

1453

00:55:45,190 --> 00:55:42,720

people who suffer from that as well that

1454

00:55:47,510 --> 00:55:45,200

that's a a great question and so i i'm

1455

00:55:50,549 --> 00:55:47,520

sure this audience is well aware that up

1456

00:55:52,549 --> 00:55:50,559

in up in space you lose bone in fact

1457

00:55:55,430 --> 00:55:52,559

astronauts lose about one to three

1458

00:55:57,510 --> 00:55:55,440

percent of their bone density in a month

1459

00:56:00,230 --> 00:55:57,520

somebody with advanced osteoporosis

1460

00:56:02,470 --> 00:56:00,240

loses closer to one percent in a year so

1461

00:56:04,309 --> 00:56:02,480

you can imagine how much the astronauts

1462

00:56:05,109 --> 00:56:04,319

are losing up in space

1463

00:56:07,349 --> 00:56:05,119

and

1464

00:56:09,190 --> 00:56:07,359

our therapy while it's going to be del

1465

00:56:11,670 --> 00:56:09,200

what what the orthopedic surgeons use in

1466

00:56:13,990 --> 00:56:11,680

our therapy is delivered locally these

1467

00:56:16,150 --> 00:56:14,000

drugs can be delivered systemically and

1468

00:56:16,950 --> 00:56:16,160

there is some evidence that it could

1469

00:56:18,710 --> 00:56:16,960

help

1470

00:56:20,630 --> 00:56:18,720

rebuild your bone

1471

00:56:22,230 --> 00:56:20,640

systemically so you're right it could

1472

00:56:25,270 --> 00:56:22,240

have applications not only for bone

1473

00:56:29,030 --> 00:56:25,280

healing but also for osteoporosis

1474

00:56:32,630 --> 00:56:30,950

what are some of the uh blood biomarkers

1475

00:56:34,630 --> 00:56:32,640

and genetic markers in particular i'm

1476
00:56:36,870 --> 00:56:34,640
sure there are many that you're looking

1477
00:56:39,349 --> 00:56:36,880
at i mean i'm thinking like hscrp and

1478
00:56:41,510 --> 00:56:39,359
white blood cells and um but i'm sure

1479
00:56:42,870 --> 00:56:41,520
there's so so so in the blood we're

1480
00:56:45,670 --> 00:56:42,880
we're taking the whole blood and

1481
00:56:49,349 --> 00:56:45,680
screening for all 40 000 genes

1482
00:56:51,430 --> 00:56:49,359
850 000 sites of dni of dna

1483
00:56:53,829 --> 00:56:51,440
so we're screening for everything and

1484
00:56:56,549 --> 00:56:53,839
the it's you know by screening for

1485
00:56:59,270 --> 00:56:56,559
everything we can then identify what's

1486
00:57:01,910 --> 00:56:59,280
significantly expressed so we don't

1487
00:57:03,910 --> 00:57:01,920
target specific gene or protein we

1488
00:57:05,750 --> 00:57:03,920

screen for all genes or proteins in the

1489

00:57:08,710 --> 00:57:05,760

body

1490

00:57:10,309 --> 00:57:08,720

methylation and expression exactly yes

1491

00:57:13,030 --> 00:57:10,319

i was told that

1492

00:57:14,390 --> 00:57:13,040

what yeah would what we do in dna

1493

00:57:17,510 --> 00:57:14,400

methylation we have

1494

00:57:20,309 --> 00:57:17,520

we do 850 000 dna

1495

00:57:22,069 --> 00:57:20,319

sites just to screen for methylation

1496

00:57:24,470 --> 00:57:22,079

we'll do micro rna

1497

00:57:26,549 --> 00:57:24,480

messenger rna as well as metabolomic

1498

00:57:28,549 --> 00:57:26,559

analysis and protein analysis

1499

00:57:31,270 --> 00:57:28,559

we'll also do the telomerase activity

1500

00:57:35,349 --> 00:57:31,280

and telomere length yeah just

1501

00:57:35,359 --> 00:57:37,670

hi

1502

00:57:41,349 --> 00:57:39,510

people with injuries with spending in

1503

00:57:43,990 --> 00:57:41,359

physical therapy

1504

00:57:46,150 --> 00:57:44,000

i think that's a great question so

1505

00:57:47,910 --> 00:57:46,160

our drug may not heal the bone any

1506

00:57:49,670 --> 00:57:47,920

quicker than the current therapies i

1507

00:57:52,549 --> 00:57:49,680

think it's going to be safer but

1508

00:57:54,230 --> 00:57:52,559

certainly i think as we learn

1509

00:57:56,230 --> 00:57:54,240

what weight bearing or what weight

1510

00:57:58,630 --> 00:57:56,240

bearing doesn't do for the bone that

1511

00:58:03,430 --> 00:57:58,640

your therapy regimens may change as a

1512

00:58:03,440 --> 00:58:07,670

other questions in the room

1513

00:58:13,230 --> 00:58:08,470

okay

1514

00:58:17,829 --> 00:58:15,910

[Applause]

1515

00:58:19,510 --> 00:58:17,839

remarkably coherent for being up online

1516

00:58:20,630 --> 00:58:19,520

i have to say

1517

00:58:22,710 --> 00:58:20,640

thank you very much and thank you for

1518

00:58:24,309 --> 00:58:22,720

the fantastic questions up next we have

1519

00:58:26,390 --> 00:58:24,319

dr anita gowell who's chairman and

1520

00:58:28,549 --> 00:58:26,400

scientific director for nanobiosim she

1521

00:58:30,630 --> 00:58:28,559

will discuss her research aimed at

1522

00:58:34,950 --> 00:58:30,640

improving response to antibiotic

1523

00:58:36,950 --> 00:58:34,960

resistant bacteria dr gowell

1524

00:58:37,829 --> 00:58:36,960

thank you very much

1525

00:58:39,910 --> 00:58:37,839

um

1526

00:58:40,789 --> 00:58:39,920

it's a pleasure to be here and a great

1527

00:58:42,950 --> 00:58:40,799

uh

1528

00:58:44,710 --> 00:58:42,960

excitement to be launching from where

1529

00:58:45,670 --> 00:58:44,720

the first manned mission to the moon

1530

00:58:46,789 --> 00:58:45,680

went

1531

00:58:49,990 --> 00:58:46,799

um

1532

00:58:51,670 --> 00:58:50,000

we are excited to put mrsa on which is a

1533

00:58:54,150 --> 00:58:51,680

superbug on the international space

1534

00:58:56,950 --> 00:58:54,160

station and investigate the effects of

1535

00:58:59,670 --> 00:58:56,960

microgravity on the growth and mutation

1536

00:59:01,829 --> 00:58:59,680

patterns of these bugs now what is mrsa

1537

00:59:04,549 --> 00:59:01,839

mrsa stands for methicillin-resistant

1538

00:59:07,270 --> 00:59:04,559

staph aureus which is

1539

00:59:09,750 --> 00:59:07,280

a bug a bacteria that has

1540

00:59:12,390 --> 00:59:09,760

evolved to become resistant to the

1541

00:59:14,470 --> 00:59:12,400

antibiotic methicillin and what happens

1542

00:59:16,950 --> 00:59:14,480

is that this is called the superbug

1543

00:59:18,710 --> 00:59:16,960

because it can rapidly mutate and become

1544

00:59:20,789 --> 00:59:18,720

resistant to the currently available

1545

00:59:22,710 --> 00:59:20,799

antibiotics that we have

1546

00:59:24,309 --> 00:59:22,720

and what we want to do is by putting

1547

00:59:25,750 --> 00:59:24,319

this on the international space station

1548

00:59:27,829 --> 00:59:25,760

is investigate

1549

00:59:30,150 --> 00:59:27,839

a what effect does microgravity have on

1550

00:59:32,789 --> 00:59:30,160

its growth on the mutation patterns of

1551
00:59:35,270 --> 00:59:32,799
the genome and the changes in the gene

1552
00:59:37,430 --> 00:59:35,280
expression patterns of this bacteria

1553
00:59:39,670 --> 00:59:37,440
and you may say well why what relevance

1554
00:59:42,870 --> 00:59:39,680
does this have well first this has a

1555
00:59:45,910 --> 00:59:42,880
practical application if we can use

1556
00:59:47,829 --> 00:59:45,920
let's say we have this hypothesis that

1557
00:59:49,990 --> 00:59:47,839
microgravity will accelerate the

1558
00:59:52,710 --> 00:59:50,000
mutation patterns

1559
00:59:55,670 --> 00:59:52,720
if we can use microgravity as a

1560
00:59:57,190 --> 00:59:55,680
accelerator to fast forward and get a

1561
00:59:58,549 --> 00:59:57,200
sneak preview of what these mutations

1562
01:00:00,470 --> 00:59:58,559
will look like

1563
01:00:03,030 --> 01:00:00,480

then we can essentially build smarter

1564

01:00:04,950 --> 01:00:03,040

drugs back on earth so that's the first

1565

01:00:06,710 --> 01:00:04,960

practical application and if i could

1566

01:00:08,069 --> 01:00:06,720

have the animation

1567

01:00:10,390 --> 01:00:08,079

um

1568

01:00:12,710 --> 01:00:10,400

do you guys have that

1569

01:00:14,390 --> 01:00:12,720

so for the past 20 years

1570

01:00:16,309 --> 01:00:14,400

i've had this hypothesis

1571

01:00:18,069 --> 01:00:16,319

that the environment affects the

1572

01:00:21,349 --> 01:00:18,079

information that's retrieved out of the

1573

01:00:23,349 --> 01:00:21,359

dna and my lab works on nanobiosome

1574

01:00:26,150 --> 01:00:23,359

works on this we can take a single

1575

01:00:28,150 --> 01:00:26,160

molecule of dna stretch it out

1576

01:00:30,470 --> 01:00:28,160

and investigate in real time the

1577

01:00:32,230 --> 01:00:30,480

dynamics of a nano machine called

1578

01:00:34,150 --> 01:00:32,240

polymerase as it reads and writes the

1579

01:00:36,870 --> 01:00:34,160

information in dna

1580

01:00:38,710 --> 01:00:36,880

and what we do is by changing different

1581

01:00:41,190 --> 01:00:38,720

knobs in the environment

1582

01:00:44,069 --> 01:00:41,200

we try to investigate what's the effect

1583

01:00:46,150 --> 01:00:44,079

we can have on the real-time dynamics of

1584

01:00:48,309 --> 01:00:46,160

this nano motor

1585

01:00:51,990 --> 01:00:48,319

and this is part of a deeper hypothesis

1586

01:00:54,309 --> 01:00:52,000

that the environment couples into

1587

01:00:56,950 --> 01:00:54,319

how these nanomotors read the

1588

01:00:58,950 --> 01:00:56,960

information stored in dna so how is

1589

01:01:00,549 --> 01:00:58,960

information retrieved from the genome or

1590

01:01:01,430 --> 01:01:00,559

the transcriptome

1591

01:01:03,589 --> 01:01:01,440

and

1592

01:01:05,829 --> 01:01:03,599

here on earth we're trying to manipulate

1593

01:01:07,430 --> 01:01:05,839

one knob at a time but what microgravity

1594

01:01:10,069 --> 01:01:07,440

allows us to do

1595

01:01:12,230 --> 01:01:10,079

is change the fundamental environment by

1596

01:01:14,150 --> 01:01:12,240

going from earth's gravitational field

1597

01:01:16,069 --> 01:01:14,160

to a near zero gravity environment and

1598

01:01:17,910 --> 01:01:16,079

see what is the effect of just changing

1599

01:01:21,589 --> 01:01:17,920

that gravitational

1600

01:01:23,270 --> 01:01:21,599

environment on the dynamics or on this

1601
01:01:25,430 --> 01:01:23,280
gene expression patterns and gene

1602
01:01:28,710 --> 01:01:25,440
mutation patterns which all depend on

1603
01:01:30,870 --> 01:01:28,720
this nano machines called polymerases

1604
01:01:32,549 --> 01:01:30,880
and this is just the tip of the iceberg

1605
01:01:35,510 --> 01:01:32,559
of what that means because first we have

1606
01:01:37,109 --> 01:01:35,520
to get an experimental effect where we

1607
01:01:39,349 --> 01:01:37,119
can tease out

1608
01:01:41,430 --> 01:01:39,359
that the effect that we see

1609
01:01:42,950 --> 01:01:41,440
is a signature of microgravity and not

1610
01:01:45,030 --> 01:01:42,960
some artifact so that's the first

1611
01:01:47,109 --> 01:01:45,040
challenge and the second is if there is

1612
01:01:49,510 --> 01:01:47,119
a real effect how do we tease out that

1613
01:01:51,109 --> 01:01:49,520

mechanism action what is the mechanism

1614

01:01:53,270 --> 01:01:51,119

by which this happens is it because

1615

01:01:54,789 --> 01:01:53,280

we're changing the gravitational field

1616

01:01:57,589 --> 01:01:54,799

or is it because we're going outside of

1617

01:01:59,270 --> 01:01:57,599

earth's atmosphere and there is less

1618

01:02:01,510 --> 01:01:59,280

filtering of various background

1619

01:02:03,990 --> 01:02:01,520

radiation no we don't know the answer to

1620

01:02:07,270 --> 01:02:04,000

that but this opens the door to start to

1621

01:02:08,309 --> 01:02:07,280

explore the physics of these systems and

1622

01:02:09,910 --> 01:02:08,319

and

1623

01:02:12,309 --> 01:02:09,920

so we're actually interested on two

1624

01:02:14,230 --> 01:02:12,319

levels the practical applications as

1625

01:02:16,230 --> 01:02:14,240

well as the um

1626
01:02:20,470 --> 01:02:16,240
fundamental science applications so i'm

1627
01:02:23,829 --> 01:02:21,829
yes

1628
01:02:25,750 --> 01:02:23,839
good morning thank you for this um what

1629
01:02:27,750 --> 01:02:25,760
in your in the last 20 years of your

1630
01:02:29,589 --> 01:02:27,760
hypothesis has led you led you to think

1631
01:02:31,349 --> 01:02:29,599
that either gravity or the presence of

1632
01:02:35,430 --> 01:02:31,359
other cosmic particles outside of our

1633
01:02:37,990 --> 01:02:35,440
atmosphere could have an impact on on

1634
01:02:40,230 --> 01:02:38,000
on the dna sequencing

1635
01:02:42,710 --> 01:02:40,240
that's a very good question so

1636
01:02:43,829 --> 01:02:42,720
i set out with this fundamental premise

1637
01:02:45,349 --> 01:02:43,839
that

1638
01:03:08,950 --> 01:02:45,359

the

1639

01:03:13,190 --> 01:03:11,430

what led me to this is actually using

1640

01:03:14,870 --> 01:03:13,200

i'm a physicist and a medical doctor by

1641

01:03:17,270 --> 01:03:14,880

training and i wanted to really

1642

01:03:19,829 --> 01:03:17,280

understand these systems from a physics

1643

01:03:21,190 --> 01:03:19,839

approach and it seemed to me that we

1644

01:03:22,870 --> 01:03:21,200

have to

1645

01:03:24,630 --> 01:03:22,880

living systems are fundamentally open

1646

01:03:26,630 --> 01:03:24,640

systems they exchange matter energy and

1647

01:03:28,309 --> 01:03:26,640

information with their environment and

1648

01:03:30,549 --> 01:03:28,319

we have to understand the role the

1649

01:03:32,789 --> 01:03:30,559

environment plays and most of our

1650

01:03:34,549 --> 01:03:32,799

mathematical machinery and physics has

1651
01:03:35,750 --> 01:03:34,559
dealt mostly with inanimate systems and

1652
01:03:37,430 --> 01:03:35,760
hasn't come to terms with those

1653
01:03:38,710 --> 01:03:37,440
questions so that's a subject of a

1654
01:03:42,230 --> 01:03:38,720
different lecture so i better not

1655
01:03:44,950 --> 01:03:42,240
digress but the the issue is that

1656
01:03:47,029 --> 01:03:44,960
what i wanted to do is using tools from

1657
01:03:49,430 --> 01:03:47,039
let's say nanotechnology and quantum

1658
01:03:51,510 --> 01:03:49,440
optics could we tease out an effect that

1659
01:03:53,589 --> 01:03:51,520
by changing one knob at a time in the

1660
01:03:55,029 --> 01:03:53,599
environment a physical knob in that

1661
01:03:57,510 --> 01:03:55,039
video we were changing things like the

1662
01:03:58,630 --> 01:03:57,520
mechanical stress on the dna could we

1663
01:04:01,190 --> 01:03:58,640

change

1664

01:04:04,069 --> 01:04:01,200

the pattern of how genes are read or

1665

01:04:06,470 --> 01:04:04,079

written by these little nanomotors whose

1666

01:04:09,430 --> 01:04:06,480

job it is now what microgravity enables

1667

01:04:12,150 --> 01:04:09,440

us to do is to change

1668

01:04:13,670 --> 01:04:12,160

this macro environment around where this

1669

01:04:18,470 --> 01:04:13,680

bacteria

1670

01:04:20,150 --> 01:04:18,480

is replicating and see the overall

1671

01:04:21,670 --> 01:04:20,160

effect

1672

01:04:23,270 --> 01:04:21,680

on the mutation pattern and the gene

1673

01:04:24,230 --> 01:04:23,280

expression pattern now that's

1674

01:04:33,190 --> 01:04:24,240

in

1675

01:04:35,029 --> 01:04:33,200

what's the effect on that and

1676

01:04:36,390 --> 01:04:35,039

you know there's some profound questions

1677

01:04:38,230 --> 01:04:36,400

there because

1678

01:04:39,589 --> 01:04:38,240

you know you would assume that the con

1679

01:04:42,630 --> 01:04:39,599

conventional thinking is all the

1680

01:04:44,710 --> 01:04:42,640

information of a biological organism is

1681

01:04:46,549 --> 01:04:44,720

encoded in its dna

1682

01:04:48,630 --> 01:04:46,559

and the counter

1683

01:04:50,390 --> 01:04:48,640

thesis here is that there is an

1684

01:04:52,470 --> 01:04:50,400

interplay of information in the

1685

01:04:54,150 --> 01:04:52,480

environment and this and a practical

1686

01:04:55,910 --> 01:04:54,160

example is you could have a person who

1687

01:04:58,069 --> 01:04:55,920

has you have two people who have the

1688

01:05:00,230 --> 01:04:58,079

same oncogene one may develop cancer and

1689

01:05:02,390 --> 01:05:00,240

one may not what's the difference it

1690

01:05:04,230 --> 01:05:02,400

must be something in the environment

1691

01:05:05,430 --> 01:05:04,240

and i could go on on that but

1692

01:05:06,870 --> 01:05:05,440

um

1693

01:05:08,309 --> 01:05:06,880

yes

1694

01:05:10,150 --> 01:05:08,319

please wait for the microphone to get to

1695

01:05:17,430 --> 01:05:10,160

you

1696

01:05:19,910 --> 01:05:17,440

question but a statement i've

1697

01:05:21,750 --> 01:05:19,920

unfortunately had numerous mrsa

1698

01:05:24,069 --> 01:05:21,760

infections that my doctor has no idea

1699

01:05:26,630 --> 01:05:24,079

why i keep getting them i just want to

1700

01:05:28,630 --> 01:05:26,640

say from a personal point of view i want

1701
01:05:30,630 --> 01:05:28,640
to thank you and i'm truly interested in

1702
01:05:37,990 --> 01:05:30,640
the research that's being done

1703
01:05:41,670 --> 01:05:39,829
if all of your hypotheses turned out to

1704
01:05:44,789 --> 01:05:41,680
be true what would the on earth

1705
01:05:47,910 --> 01:05:44,799
treatment for mrsa look like

1706
01:05:50,309 --> 01:05:47,920
well this is just the first step but

1707
01:05:52,549 --> 01:05:50,319
if indeed we could use the international

1708
01:05:53,910 --> 01:05:52,559
space station as an accelerator an

1709
01:05:55,589 --> 01:05:53,920
incubator to

1710
01:05:57,430 --> 01:05:55,599
get a sneak preview of what future

1711
01:05:59,910 --> 01:05:57,440
mutations would look like

1712
01:06:01,829 --> 01:05:59,920
on superbugs like mrsa

1713
01:06:04,549 --> 01:06:01,839

we would use that information to develop

1714

01:06:07,430 --> 01:06:04,559

better algorithms on earth so we could

1715

01:06:09,510 --> 01:06:07,440

inform drug discovery and

1716

01:06:10,950 --> 01:06:09,520

faster in a faster way get to smarter

1717

01:06:13,430 --> 01:06:10,960

drugs that are more personalized and

1718

01:06:16,309 --> 01:06:13,440

more precisely targeted to the bug at

1719

01:06:18,549 --> 01:06:16,319

hand or the to the drug resistant strain

1720

01:06:20,390 --> 01:06:18,559

at hand and we would have those bugs

1721

01:06:23,029 --> 01:06:20,400

those drugs ready before those mutant

1722

01:06:24,710 --> 01:06:23,039

strains actually came up emerged on

1723

01:06:26,470 --> 01:06:24,720

earth that's the idea the practical

1724

01:06:29,029 --> 01:06:26,480

application

1725

01:06:33,109 --> 01:06:30,950

oh okay sorry

1726

01:06:35,589 --> 01:06:33,119

um so speaking of the effect of the

1727

01:06:37,510 --> 01:06:35,599

external environment um on the genome

1728

01:06:39,510 --> 01:06:37,520

obviously looking at something in vitro

1729

01:06:41,589 --> 01:06:39,520

is different than in vivo and vivo were

1730

01:06:42,789 --> 01:06:41,599

exposed to the microbiome i know there's

1731

01:06:44,630 --> 01:06:42,799

been a lot of

1732

01:06:47,430 --> 01:06:44,640

interest lately in the microbiomes

1733

01:06:49,029 --> 01:06:47,440

effect on genetic expression and so i'm

1734

01:06:51,109 --> 01:06:49,039

wondering are you going to be examining

1735

01:06:52,870 --> 01:06:51,119

that at all and how microgravity affects

1736

01:06:55,190 --> 01:06:52,880

the microbiome of the even of the

1737

01:06:56,870 --> 01:06:55,200

astronauts on board

1738

01:06:58,870 --> 01:06:56,880

that's a fascinating personal interest

1739

01:07:00,630 --> 01:06:58,880

of mine in fact

1740

01:07:02,950 --> 01:07:00,640

my research institute and company

1741

01:07:04,789 --> 01:07:02,960

nanobios and we have developed a mobile

1742

01:07:07,670 --> 01:07:04,799

tricorder-like device that can do

1743

01:07:09,750 --> 01:07:07,680

real-time dna rna analytics that we hope

1744

01:07:11,190 --> 01:07:09,760

to in a future space mission be able to

1745

01:07:13,109 --> 01:07:11,200

put on the space station so instead of

1746

01:07:15,190 --> 01:07:13,119

waiting for the samples to come back to

1747

01:07:16,950 --> 01:07:15,200

earth to do the analysis you could do

1748

01:07:18,470 --> 01:07:16,960

the analysis in real time and beam the

1749

01:07:20,069 --> 01:07:18,480

data back to earth

1750

01:07:21,750 --> 01:07:20,079

but

1751

01:07:22,470 --> 01:07:21,760

we're we're as a

1752

01:07:25,349 --> 01:07:22,480

as

1753

01:07:27,910 --> 01:07:25,359

health care stand sort of at the cusp of

1754

01:07:29,589 --> 01:07:27,920

a new generation there is an opportunity

1755

01:07:31,750 --> 01:07:29,599

to start personalizing healthcare more

1756

01:07:34,069 --> 01:07:31,760

and by understanding the genomics

1757

01:07:35,510 --> 01:07:34,079

transcriptomics microbiomics

1758

01:07:37,510 --> 01:07:35,520

metabolomics

1759

01:07:40,870 --> 01:07:37,520

by getting real-time information about

1760

01:07:43,270 --> 01:07:40,880

these biomarkers and how to

1761

01:07:45,670 --> 01:07:43,280

how they interplay with

1762

01:07:47,750 --> 01:07:45,680

a person's health is i think one of the

1763

01:07:48,630 --> 01:07:47,760

next emerging frontiers of health on

1764

01:07:50,390 --> 01:07:48,640

earth

1765

01:07:53,029 --> 01:07:50,400

and uh so yeah i'm personally very

1766

01:07:55,109 --> 01:07:53,039

interested in in in that interplay and

1767

01:07:57,670 --> 01:07:55,119

and i think the fundamental hypothesis

1768

01:08:04,230 --> 01:07:57,680

does connect deeply into

1769

01:08:10,950 --> 01:08:08,630

is there any possible impact to the mrsa

1770

01:08:12,870 --> 01:08:10,960

um

1771

01:08:13,990 --> 01:08:12,880

samples

1772

01:08:15,910 --> 01:08:14,000

yeah sorry

1773

01:08:18,229 --> 01:08:15,920

is it is there any possible change that

1774

01:08:19,990 --> 01:08:18,239

can occur um in flight once before it

1775

01:08:20,870 --> 01:08:20,000

gets to the space station like is is

1776

01:08:21,669 --> 01:08:20,880

there

1777

01:08:23,269 --> 01:08:21,679

um

1778

01:08:25,590 --> 01:08:23,279

something about the environment of

1779

01:08:27,590 --> 01:08:25,600

actually traveling from earth into space

1780

01:08:29,269 --> 01:08:27,600

that could also affect

1781

01:08:31,349 --> 01:08:29,279

the behavior

1782

01:08:33,030 --> 01:08:31,359

very good question i mean what our team

1783

01:08:34,149 --> 01:08:33,040

has tried to do is very carefully

1784

01:08:38,789 --> 01:08:34,159

control

1785

01:08:41,590 --> 01:08:38,799

both before the space flight and in

1786

01:08:44,149 --> 01:08:41,600

parallel to the space flight to try to

1787

01:08:45,910 --> 01:08:44,159

to account for all these artifacts that

1788

01:08:47,829 --> 01:08:45,920

could be different uh that could

1789

01:08:49,590 --> 01:08:47,839

potentially lead to changes in gene

1790

01:08:50,870 --> 01:08:49,600

expression and mutation to to try to

1791

01:08:52,149 --> 01:08:50,880

parallelize

1792

01:08:56,950 --> 01:08:52,159

the

1793

01:08:58,789 --> 01:08:56,960

space station so we've tried to make

1794

01:09:01,189 --> 01:08:58,799

them as close as possible

1795

01:09:03,269 --> 01:09:01,199

but uh you're right the the bacteria

1796

01:09:04,709 --> 01:09:03,279

that go on spacex that then get loaded

1797

01:09:05,430 --> 01:09:04,719

onto the international space station

1798

01:09:07,510 --> 01:09:05,440

have

1799

01:09:08,470 --> 01:09:07,520

a traumatic experience in getting there

1800

01:09:10,470 --> 01:09:08,480

and so

1801
01:09:12,550 --> 01:09:10,480
we we're not simulating all of that

1802
01:09:14,550 --> 01:09:12,560
trauma but we are simulating the same

1803
01:09:16,309 --> 01:09:14,560
time and temperature behavior that

1804
01:09:17,910 --> 01:09:16,319
they're going to get exposed to

1805
01:09:20,309 --> 01:09:17,920
in the hopes that we're trying to tease

1806
01:09:23,269 --> 01:09:20,319
out the effects of the growth period in

1807
01:09:24,870 --> 01:09:23,279
microgravity um

1808
01:09:26,390 --> 01:09:24,880
and so i

1809
01:09:28,390 --> 01:09:26,400
would say that but i mean i think the

1810
01:09:30,390 --> 01:09:28,400
first thing is to try to see can we

1811
01:09:33,349 --> 01:09:30,400
tease out an effect that's not due to an

1812
01:09:34,950 --> 01:09:33,359
artifact so your question is well taken

1813
01:09:36,550 --> 01:09:34,960

and the second thing is to then figure

1814

01:09:37,829 --> 01:09:36,560

out what's the mechanism of action

1815

01:09:40,709 --> 01:09:37,839

that's where the sort of theoretical

1816

01:09:41,749 --> 01:09:40,719

physics approach comes into play

1817

01:09:44,789 --> 01:09:41,759

yes

1818

01:09:47,269 --> 01:09:44,799

and by sending this superbug into space

1819

01:09:49,669 --> 01:09:47,279

the iss does this pose any risk to the

1820

01:09:50,870 --> 01:09:49,679

astronauts who are up there

1821

01:09:53,349 --> 01:09:50,880

well it is

1822

01:09:55,830 --> 01:09:53,359

my understanding that the team at nasa

1823

01:09:57,510 --> 01:09:55,840

cases and bioserve who we are working

1824

01:10:01,030 --> 01:09:57,520

closely with have taken great

1825

01:10:03,590 --> 01:10:01,040

precautions to contain these

1826

01:10:06,470 --> 01:10:03,600

superbugs is not the first time bacteria

1827

01:10:07,350 --> 01:10:06,480

or superbugs have been flown uh into

1828

01:10:08,950 --> 01:10:07,360

space

1829

01:10:10,950 --> 01:10:08,960

uh but they're i believe there are three

1830

01:10:12,630 --> 01:10:10,960

levels of containment and they're

1831

01:10:13,750 --> 01:10:12,640

tightly packaged

1832

01:10:15,510 --> 01:10:13,760

and

1833

01:10:16,470 --> 01:10:15,520

there's something called a p pihab

1834

01:10:18,310 --> 01:10:16,480

that's

1835

01:10:20,390 --> 01:10:18,320

sort of a portable habitat for these

1836

01:10:22,630 --> 01:10:20,400

things so the astronauts never come into

1837

01:10:23,590 --> 01:10:22,640

contact with these bacteria and they're

1838

01:10:26,310 --> 01:10:23,600

also

1839

01:10:28,870 --> 01:10:26,320

protected against rapid depressurization

1840

01:10:31,590 --> 01:10:28,880

and all kinds of

1841

01:10:33,990 --> 01:10:31,600

ingenious engineering has gone into

1842

01:10:35,669 --> 01:10:34,000

developing this so uh it is my

1843

01:10:36,630 --> 01:10:35,679

understanding that uh the astronauts

1844

01:10:39,030 --> 01:10:36,640

would

1845

01:10:39,460 --> 01:10:39,040

not come into contact with this and be

1846

01:10:40,790 --> 01:10:39,470

um

1847

01:10:43,030 --> 01:10:40,800

[Music]

1848

01:10:45,350 --> 01:10:43,040

you know it's really just to try to see

1849

01:10:47,669 --> 01:10:45,360

the effects of the microgravity on their

1850

01:10:49,590 --> 01:10:47,679

thing the bacteria themselves are pretty

1851

01:10:52,390 --> 01:10:49,600

shielded from the rest of the

1852

01:10:57,110 --> 01:10:54,550

[Music]

1853

01:10:58,950 --> 01:10:57,120

comes from john on twitter and he asks

1854

01:11:00,470 --> 01:10:58,960

any chance that increased radiation on

1855

01:11:02,229 --> 01:11:00,480

orbit will interfere with the goals of

1856

01:11:04,070 --> 01:11:02,239

your experiment

1857

01:11:06,390 --> 01:11:04,080

well i think it's a it's a very

1858

01:11:08,870 --> 01:11:06,400

important question to tease out

1859

01:11:11,030 --> 01:11:08,880

if there is a signature that we see is

1860

01:11:12,630 --> 01:11:11,040

that signature due to a change in the

1861

01:11:14,229 --> 01:11:12,640

gravitational field is that due to a

1862

01:11:16,149 --> 01:11:14,239

change in the background electromagnetic

1863

01:11:17,510 --> 01:11:16,159

radiation or is it due to some other

1864

01:11:19,590 --> 01:11:17,520

third party artifact that we haven't

1865

01:11:20,630 --> 01:11:19,600

even talked about so i think this is not

1866

01:11:22,950 --> 01:11:20,640

the end

1867

01:11:25,030 --> 01:11:22,960

all be all this is the beginning of

1868

01:11:27,189 --> 01:11:25,040

asking a question and trying to address

1869

01:11:29,030 --> 01:11:27,199

it with the tools we have available

1870

01:11:31,510 --> 01:11:29,040

but

1871

01:11:33,430 --> 01:11:31,520

it could be very possible that you know

1872

01:11:36,470 --> 01:11:33,440

as i said you you've removed the earth's

1873

01:11:38,550 --> 01:11:36,480

atmosphere so that filtration is gone

1874

01:11:41,110 --> 01:11:38,560

and you have more background

1875

01:11:43,030 --> 01:11:41,120

cosmic rays gamma rays subatomic

1876

01:11:45,510 --> 01:11:43,040

particles that are bombarding this and

1877

01:11:46,950 --> 01:11:45,520

could lead to a higher mutation rate the

1878

01:11:48,630 --> 01:11:46,960

the short answer is we don't know the

1879

01:11:50,870 --> 01:11:48,640

right answer yet but

1880

01:11:53,750 --> 01:11:50,880

we can ask the question and thanks to

1881

01:11:55,030 --> 01:11:53,760

microgravity research try to address it

1882

01:11:56,870 --> 01:11:55,040

and we're at the beginning stages of

1883

01:12:01,189 --> 01:11:56,880

addressing that but i think what's

1884

01:12:06,229 --> 01:12:03,510

most of biology

1885

01:12:08,630 --> 01:12:06,239

and the physical sciences have kept

1886

01:12:10,470 --> 01:12:08,640

in their own silos and something like

1887

01:12:13,270 --> 01:12:10,480

this kind of

1888

01:12:15,590 --> 01:12:13,280

space research enables us to bring

1889

01:12:17,189 --> 01:12:15,600

uh it's also what i'm passionate about

1890

01:12:19,830 --> 01:12:17,199

nanotechnology it does the same thing at

1891

01:12:21,270 --> 01:12:19,840

the very small and up in the sky

1892

01:12:23,590 --> 01:12:21,280

it enables us to bring these

1893

01:12:25,830 --> 01:12:23,600

traditionally different silos together

1894

01:12:27,270 --> 01:12:25,840

in an unprecedented way to ask

1895

01:12:28,630 --> 01:12:27,280

fundamental questions that could have

1896

01:12:30,390 --> 01:12:28,640

profound implications in our

1897

01:12:31,430 --> 01:12:30,400

understanding of life and living systems

1898

01:12:33,590 --> 01:12:31,440

and also

1899

01:12:35,430 --> 01:12:33,600

in our fundamental understanding i

1900

01:12:37,189 --> 01:12:35,440

believe also in physics because most of

1901

01:12:40,630 --> 01:12:37,199

physics hasn't dealt with life and

1902

01:12:42,470 --> 01:12:40,640

living systems mostly inanimate systems

1903

01:12:44,229 --> 01:12:42,480

yes

1904

01:12:46,070 --> 01:12:44,239

i think when everyone hears like mrsa in

1905

01:12:48,870 --> 01:12:46,080

space everyone starts to sit up and pay

1906

01:12:51,189 --> 01:12:48,880

attention but outside of that that's

1907

01:12:53,270 --> 01:12:51,199

attentive audience right but outside of

1908

01:12:54,709 --> 01:12:53,280

that specifically um what sort of things

1909

01:12:55,750 --> 01:12:54,719

are you hoping that you might be able to

1910

01:12:57,990 --> 01:12:55,760

find out

1911

01:12:59,510 --> 01:12:58,000

um outside of even the super bug realm

1912

01:13:00,950 --> 01:12:59,520

since we're talking about genetics here

1913

01:13:03,270 --> 01:13:00,960

and this is something that you know

1914

01:13:06,229 --> 01:13:03,280

you're on the forefront of

1915

01:13:08,310 --> 01:13:06,239

i think mrsa is a model system uh

1916

01:13:10,310 --> 01:13:08,320

the fundamental question is

1917

01:13:12,470 --> 01:13:10,320

what's the stability of a genome or a

1918

01:13:14,310 --> 01:13:12,480

transcriptome and how is that affected

1919

01:13:15,750 --> 01:13:14,320

by the environment

1920

01:13:18,470 --> 01:13:15,760

specifically

1921

01:13:19,830 --> 01:13:18,480

space create the microgravity creates an

1922

01:13:21,830 --> 01:13:19,840

extreme environment that we wouldn't

1923

01:13:24,229 --> 01:13:21,840

normally experience on earth

1924

01:13:26,390 --> 01:13:24,239

uh but can we by pushing the limits on

1925

01:13:29,510 --> 01:13:26,400

that system can we drive

1926

01:13:31,990 --> 01:13:29,520

this system into a behavior pattern that

1927

01:13:35,510 --> 01:13:32,000

reveals new phenomena which then extends

1928

01:13:37,669 --> 01:13:35,520

our understanding of these systems so

1929

01:13:39,590 --> 01:13:37,679

if you wanted to expand it in terms of

1930

01:13:42,070 --> 01:13:39,600

biological or medical relevance i would

1931

01:13:43,750 --> 01:13:42,080

say that

1932

01:13:46,070 --> 01:13:43,760

there are a number of diseases

1933

01:13:47,750 --> 01:13:46,080

conditions that become resistant that

1934

01:13:50,390 --> 01:13:47,760

evolve to become resistant to our

1935

01:13:53,510 --> 01:13:50,400

current therapies

1936

01:13:56,470 --> 01:13:53,520

bacteria infections virus infections

1937

01:13:58,390 --> 01:13:56,480

viral infections cancers can become drug

1938

01:13:59,910 --> 01:13:58,400

resistance to various chemotherapy

1939

01:14:02,390 --> 01:13:59,920

because of an evolution that they're

1940

01:14:04,229 --> 01:14:02,400

undergoing so the knowledge that we

1941

01:14:06,630 --> 01:14:04,239

could gain at a very fundamental level

1942

01:14:08,229 --> 01:14:06,640

by understanding the role that the

1943

01:14:10,950 --> 01:14:08,239

environment or the microenvironment

1944

01:14:13,590 --> 01:14:10,960

plays in driving the arrow of evolution

1945

01:14:15,669 --> 01:14:13,600

of these systems and the understanding

1946

01:14:17,590 --> 01:14:15,679

more about the stability of the genome

1947

01:14:18,790 --> 01:14:17,600

the transcriptome the microbiome and how

1948

01:14:20,310 --> 01:14:18,800

they interact

1949

01:14:21,350 --> 01:14:20,320

would help to

1950

01:14:23,750 --> 01:14:21,360

um

1951

01:14:25,430 --> 01:14:23,760

inform uh

1952

01:14:28,070 --> 01:14:25,440

our own you know a our deeper

1953

01:14:29,990 --> 01:14:28,080

understanding but our how we develop

1954

01:14:31,750 --> 01:14:30,000

therapeutics to these and how do we

1955

01:14:35,430 --> 01:14:31,760

target these kinds of

1956

01:14:38,070 --> 01:14:35,440

uh rapidly evolving uh

1957

01:14:40,630 --> 01:14:38,080

systems so one of the reasons why some

1958

01:14:42,790 --> 01:14:40,640

of these bugs and superbugs are deadly

1959

01:14:45,030 --> 01:14:42,800

or viruses are deadly

1960

01:14:45,750 --> 01:14:45,040

is because they rapidly mutate

1961

01:14:47,110 --> 01:14:45,760

and

1962

01:14:51,510 --> 01:14:47,120

what's

1963

01:14:53,270 --> 01:14:51,520

one question but if we understand how

1964

01:14:55,430 --> 01:14:53,280

they mutated where they're going to go

1965

01:14:57,590 --> 01:14:55,440

and mutate to that would help us

1966

01:15:00,310 --> 01:14:57,600

anticipate that and build better drugs

1967

01:15:02,310 --> 01:15:00,320

ahead of schedule

1968

01:15:04,790 --> 01:15:02,320

yes

1969

01:15:06,390 --> 01:15:04,800

technology advancing the way it is and

1970

01:15:08,709 --> 01:15:06,400

all the different areas and fields that

1971

01:15:11,030 --> 01:15:08,719

they're they seem to be in right now

1972

01:15:12,950 --> 01:15:11,040

how often are you revisiting certain

1973

01:15:14,950 --> 01:15:12,960

research that you may have done

1974

01:15:16,229 --> 01:15:14,960

in taking the account what you found or

1975

01:15:20,149 --> 01:15:16,239

what they may have found in another

1976

01:15:26,550 --> 01:15:21,990

uh for me that's a

1977

01:15:29,350 --> 01:15:26,560

daily uh what you gonna call it uh

1978

01:15:31,110 --> 01:15:29,360

a daily passion because uh you know

1979

01:15:32,950 --> 01:15:31,120

somebody once said that it's not about

1980

01:15:34,630 --> 01:15:32,960

always discovering new lands but looking

1981

01:15:36,470 --> 01:15:34,640

at things with fresh eyes

1982

01:15:38,709 --> 01:15:36,480

and i think that

1983

01:15:41,270 --> 01:15:38,719

we always have to look at the data

1984

01:15:43,590 --> 01:15:41,280

before us with new eyes and as we

1985

01:15:44,550 --> 01:15:43,600

integrate information across different

1986

01:15:46,630 --> 01:15:44,560

uh

1987

01:15:49,590 --> 01:15:46,640

silos and backgrounds i think it gives

1988

01:15:50,950 --> 01:15:49,600

us fresh insight i think

1989

01:15:52,950 --> 01:15:50,960

the international space station

1990

01:15:56,709 --> 01:15:52,960

microgravity is an

1991

01:15:58,950 --> 01:15:56,719

excuse for us to re-look at our our

1992

01:16:01,590 --> 01:15:58,960

accepted paradigms and ways of thinking

1993

01:16:04,070 --> 01:16:01,600

from a fresh perspective

1994

01:16:05,910 --> 01:16:04,080

and once we do that we learn new things

1995

01:16:07,110 --> 01:16:05,920

we discover new ways of looking at old

1996

01:16:08,709 --> 01:16:07,120

things

1997

01:16:11,030 --> 01:16:08,719

so it's not just about the new data but

1998

01:16:13,830 --> 01:16:11,040

it's about looking at the old data in

1999

01:16:20,790 --> 01:16:16,709

and i think one should keep doing that

2000

01:16:23,990 --> 01:16:23,110

great okay thank you thank you dr gowell

2001

01:16:29,030 --> 01:16:24,000

and thank you for the wonderful

2002

01:16:32,070 --> 01:16:30,550

we look forward to hearing more about

2003

01:16:34,149 --> 01:16:32,080

these investigations as the work

2004

01:16:36,790 --> 01:16:34,159

progresses over the coming months thank

2005

01:16:38,470 --> 01:16:36,800

you for the wonderful questions we had a

2006

01:16:40,470 --> 01:16:38,480

rather engaged audience so thank you for

2007

01:16:42,630 --> 01:16:40,480

that and to our participants for their

2008

01:16:44,390 --> 01:16:42,640

groundbreaking work that's it for our

2009

01:16:46,709 --> 01:16:44,400

preview of what's on board from nasa's

2010

01:16:50,229 --> 01:16:46,719

kennedy space center in florida keep

2011

01:16:52,709 --> 01:16:50,239

following along via social media at nasa

2012

01:16:53,750 --> 01:16:52,719

on twitter on facebook and keep up with

2013

01:16:57,189 --> 01:16:53,760

everything that's happening on the