

# Gaylord Regional Airport

ELEVATION 1328.00

NASA

1  
00:00:09,230 --> 00:00:07,130  
regulating water use it every day just

2  
00:00:11,180 --> 00:00:09,240  
like a real crew member would we do a

3  
00:00:13,129 --> 00:00:11,190  
calm delay based on our mission scenario

4  
00:00:14,629 --> 00:00:13,139  
appropriate label phase it and starting

5  
00:00:16,519 --> 00:00:14,639  
with maybe a five minute compliment one

6  
00:00:18,590 --> 00:00:16,529  
weight on the leg up to 18 minute one

7  
00:00:21,830 --> 00:00:18,600  
way Conda lay with the Mission Control

8  
00:00:23,450 --> 00:00:21,840  
support personnel we observed them 24-7

9  
00:00:25,070 --> 00:00:23,460  
just like you would be if you were on a

10  
00:00:26,779 --> 00:00:25,080  
real mission so they're looking at the

11  
00:00:28,250 --> 00:00:26,789  
psychological effects of the isolation

12  
00:00:29,779 --> 00:00:28,260  
and confinement they're looking at the

13  
00:00:31,519 --> 00:00:29,789

heavenly what do they need in Saada

14

00:00:32,959 --> 00:00:31,529

module you're looking at the medical

15

00:00:34,729 --> 00:00:32,969

equipment that may be needed you're

16

00:00:35,810 --> 00:00:34,739

looking at annies have a physiological

17

00:00:37,780 --> 00:00:35,820

countermeasure that may need to be

18

00:00:39,680 --> 00:00:37,790

introduced to keep the crew healthy and

19

00:00:40,910 --> 00:00:39,690

psychologically sound so that when they

20

00:00:42,889 --> 00:00:40,920

arrive at their destination they're able

21

00:00:43,970 --> 00:00:42,899

to perform the tasks at hand right so we

22

00:01:00,970 --> 00:00:43,980

need to answer all those questions to

23

00:01:05,280 --> 00:01:03,549

we're on a journey a journey that

24

00:01:09,010 --> 00:01:05,290

started with the dreams and

25

00:01:11,440 --> 00:01:09,020

determination of men and women around

26

00:01:14,140 --> 00:01:11,450

this nation a journey that set course

27

00:01:16,300 --> 00:01:14,150

from Florida's Space Coast a journey of

28

00:01:18,550 --> 00:01:16,310

real innovators from California's

29

00:01:20,590 --> 00:01:18,560

Silicon Valley a voyage of

30

00:01:22,990 --> 00:01:20,600

experimentation soaring above the

31

00:01:26,910 --> 00:01:23,000

Tidewater region and the high southern

32

00:01:30,160 --> 00:01:26,920

desert of California one of humankind's

33

00:01:32,440 --> 00:01:30,170

greatest adventures a magnificent

34

00:01:35,859 --> 00:01:32,450

journey that took vision from Texas to

35

00:01:40,300 --> 00:01:35,869

Ohio from Louisiana to Alabama and from

36

00:01:42,790 --> 00:01:40,310

all around this great nation the start

37

00:01:47,410 --> 00:01:42,800

of anything substantial begins with a

38

00:01:53,219 --> 00:01:47,420

dream from dreamers come documents and

39

00:01:59,770 --> 00:01:56,350

that moment of execution comes as the

40

00:02:03,389 --> 00:01:59,780

dream lights up and literally burst into

41

00:02:08,499 --> 00:02:06,550

welcome to NASA where every day at every

42

00:02:12,040 --> 00:02:08,509

NASA Center these dreams come true in

43

00:02:14,320 --> 00:02:12,050

offices cubicles hallways hangars and

44

00:02:17,589 --> 00:02:14,330

clean rooms on launch pads and cockpits

45

00:02:19,600 --> 00:02:17,599

at desktop observatories and continually

46

00:02:25,000 --> 00:02:19,610

for more than 15 years aboard the

47

00:02:29,990 --> 00:02:25,010

International Space Station investments

48

00:03:42,740 --> 00:02:38,010

you

49

00:03:47,180 --> 00:03:44,660

from the Baikonur cosmodrome in

50

00:03:50,600 --> 00:03:47,190

Kazakhstan the trio will spend six

51  
00:03:52,040 --> 00:03:50,610  
months on the space station NASA's

52  
00:03:54,620 --> 00:03:52,050  
associate administrator for Space

53  
00:03:57,050 --> 00:03:54,630  
Technology Steve Jurich was on hand for

54  
00:03:59,600 --> 00:03:57,060  
a recent media day at made and space

55  
00:04:02,030 --> 00:03:59,610  
incorporated an American based startup

56  
00:04:04,880 --> 00:04:02,040  
company located at NASA's research park

57  
00:04:14,080 --> 00:04:04,890  
at Moffett Field California a made in

58  
00:05:14,820 --> 00:04:35,340  
you

59  
00:05:20,580 --> 00:05:18,330  
coffee I went to that Marvel movie

60  
00:05:23,010 --> 00:05:20,590  
marathon where you literally sit in the

61  
00:05:25,200 --> 00:05:23,020  
theater and watch everything leading up

62  
00:05:27,630 --> 00:05:25,210  
to the Avengers yes age of Ultron like

63  
00:05:31,170 --> 00:05:27,640

the there's like 400 hours of footage

64

00:05:32,160 --> 00:05:31,180

and popcorn and I'm sorry I'm I'll we'll

65

00:05:33,750 --> 00:05:32,170

get it together because we have a

66

00:05:35,130 --> 00:05:33,760

jam-packed show Franklin we're gonna be

67

00:05:37,290 --> 00:05:35,140

talking about advanced exploration

68

00:05:39,690 --> 00:05:37,300

systems or eight yes yeah and one of

69

00:05:41,010 --> 00:05:39,700

those technologies is 3d printing that

70

00:05:43,260 --> 00:05:41,020

is actually up on the International

71

00:05:44,730 --> 00:05:43,270

Space Station Blair yes hey sport to go

72

00:05:46,170 --> 00:05:44,740

later and show you're gonna be talking

73

00:05:49,890 --> 00:05:46,180

with the in bell with the future

74

00:05:52,110 --> 00:05:49,900

engineers I am gonna be talking and in

75

00:05:53,880 --> 00:05:52,120

the meantime I had a chance to sit down

76  
00:05:56,460 --> 00:05:53,890  
with Jason cruise on who is the head of

77  
00:05:57,720 --> 00:05:56,470  
AES and he's gonna tell us all about the

78  
00:06:02,030 --> 00:05:57,730  
cool technologies coming out of his

79  
00:06:05,180 --> 00:06:02,040  
office let's check it out so Jason I

80  
00:06:07,740 --> 00:06:05,190  
understand that you're the q of NASA

81  
00:06:10,020 --> 00:06:07,750  
well that's an interesting reference in

82  
00:06:12,090 --> 00:06:10,030  
itself but it's a nice analogy if you

83  
00:06:14,580 --> 00:06:12,100  
think about Hugh was getting ready for

84  
00:06:16,650 --> 00:06:14,590  
bond to go up and do whatever mission he

85  
00:06:18,810 --> 00:06:16,660  
was being charged to do our group is

86  
00:06:20,880 --> 00:06:18,820  
much like that we're designing all the

87  
00:06:23,670 --> 00:06:20,890  
systems to send our crews off to explore

88  
00:06:25,620 --> 00:06:23,680

deep space now within your portfolio or

89

00:06:28,170 --> 00:06:25,630

your technologies what are you trying to

90

00:06:29,370 --> 00:06:28,180

develop so a couple fundamental things

91

00:06:31,050 --> 00:06:29,380

you need to be able to get into space

92

00:06:32,970 --> 00:06:31,060

you need to be able to live in space and

93

00:06:34,710 --> 00:06:32,980

be productive when you're there so we're

94

00:06:36,780 --> 00:06:34,720

building a lot of the stuff that allows

95

00:06:38,310 --> 00:06:36,790

you to live in space so we are

96

00:06:40,500 --> 00:06:38,320

developing some of the next generation

97

00:06:41,940 --> 00:06:40,510

habitation system so where's the home

98

00:06:44,340 --> 00:06:41,950

how people are going to live in that

99

00:06:47,130 --> 00:06:44,350

life support systems for it how are you

100

00:06:48,870 --> 00:06:47,140

going to handle logistics and management

101  
00:06:50,700 --> 00:06:48,880  
of that overall being able to live in

102  
00:06:51,870 --> 00:06:50,710  
space now i guess like let's say when we

103  
00:06:54,090 --> 00:06:51,880  
go to Mars one day we had the first

104  
00:06:55,230 --> 00:06:54,100  
humans on Mars the first thing that

105  
00:06:57,210 --> 00:06:55,240  
comes to my mind is going to be

106  
00:06:58,950 --> 00:06:57,220  
spacesuits absolutely so we're also

107  
00:07:00,960 --> 00:06:58,960  
advancing the new space suits

108  
00:07:02,520 --> 00:07:00,970  
technologies and spaces we see the other

109  
00:07:04,740 --> 00:07:02,530  
what you see on the space station today

110  
00:07:07,170 --> 00:07:04,750  
they go out they repair something they

111  
00:07:08,760 --> 00:07:07,180  
fix something to come back in on a trip

112  
00:07:10,560 --> 00:07:08,770  
to save Mars you're going to have

113  
00:07:12,480 --> 00:07:10,570

potentially at the glau fix things along

114

00:07:13,830 --> 00:07:12,490

the way long duration there then when

115

00:07:16,350 --> 00:07:13,840

you get to the surface you want to go

116

00:07:17,790 --> 00:07:16,360

outside right now one of the cool apps

117

00:07:19,050 --> 00:07:17,800

we have here at NASA Johnson Space

118

00:07:21,450 --> 00:07:19,060

Center is the portable life-support

119

00:07:22,710 --> 00:07:21,460

system ventilation laboratory and that's

120

00:07:24,480 --> 00:07:22,720

where they are working on the spacesuits

121

00:07:26,760 --> 00:07:24,490

of the next generation correct yeah so

122

00:07:28,260 --> 00:07:26,770

the suit is made up of two parts the

123

00:07:28,530 --> 00:07:28,270

actual garment that you wear and then

124

00:07:34,650 --> 00:07:28,540

the

125

00:07:36,210 --> 00:07:34,660

we have has been very reliable however

126

00:07:38,490 --> 00:07:36,220

it's getting pretty old at this point

127

00:07:39,810 --> 00:07:38,500

there's a lot of new technologies that

128

00:07:42,210 --> 00:07:39,820

we want to actually incorporate in the

129

00:07:43,470 --> 00:07:42,220

backpack of the future for assembly in

130

00:07:45,330 --> 00:07:43,480

the space station or what we did on a

131

00:07:47,550 --> 00:07:45,340

shuttle you're working in zero gravity

132

00:07:48,870 --> 00:07:47,560

and near zero gravity so the weight of

133

00:07:50,460 --> 00:07:48,880

the suit didn't really matter as much

134

00:07:52,260 --> 00:07:50,470

the mass of the soup but when you get to

135

00:07:53,520 --> 00:07:52,270

a surface even though we're the reduced

136

00:07:54,780 --> 00:07:53,530

gravity of Mars you're still gonna have

137

00:07:56,100 --> 00:07:54,790

to carry around that wait so you're

138

00:07:58,230 --> 00:07:56,110

gonna need a lighter weight suit and

139

00:08:00,540 --> 00:07:58,240

also one that you can use more

140

00:08:02,190 --> 00:08:00,550

frequently and also the one that puts up

141

00:08:04,320 --> 00:08:02,200

with the environment the dust the rocks

142

00:08:07,680 --> 00:08:04,330

and all those kind of things when we did

143

00:08:09,750 --> 00:08:07,690

those short duration ebas during Apollo

144

00:08:11,580 --> 00:08:09,760

we only did a very few number of them

145

00:08:13,710 --> 00:08:11,590

and we were there on the surface of the

146

00:08:15,390 --> 00:08:13,720

Moon for a very short time Mars we're

147

00:08:16,590 --> 00:08:15,400

gonna be there for a long time mobility

148

00:08:18,360 --> 00:08:16,600

will probably be an issue you said

149

00:08:19,740 --> 00:08:18,370

weights an issue the flexibility of

150

00:08:22,260 --> 00:08:19,750

actually working in that environment

151  
00:08:24,150 --> 00:08:22,270  
would be a key factor correct yeah so a

152  
00:08:26,160 --> 00:08:24,160  
lot of the station assembly they

153  
00:08:28,020 --> 00:08:26,170  
optimized the suit to working on the

154  
00:08:29,580 --> 00:08:28,030  
space station so your work zones and

155  
00:08:30,990 --> 00:08:29,590  
such you're not picking up things off

156  
00:08:33,030 --> 00:08:31,000  
the ground you're not using hand tools

157  
00:08:34,380 --> 00:08:33,040  
and those kind of things instead you're

158  
00:08:35,460 --> 00:08:34,390  
turning bolts and all that so you have a

159  
00:08:37,980 --> 00:08:35,470  
different type of work that you're gonna

160  
00:08:39,420 --> 00:08:37,990  
be doing now is it something with that

161  
00:08:41,159 --> 00:08:39,430  
backpack is it something that you want

162  
00:08:42,690 --> 00:08:41,169  
to try to to miniaturize it they make it

163  
00:08:44,910 --> 00:08:42,700

as small as possible but on the flip

164

00:08:46,440 --> 00:08:44,920

side you want as much oxygen the

165

00:08:47,910 --> 00:08:46,450

astronauts to breathe that this day out

166

00:08:50,070 --> 00:08:47,920

there for extended periods of time I'm

167

00:08:52,140 --> 00:08:50,080

sir yeah so you have this hard challenge

168

00:08:54,990 --> 00:08:52,150

of wanting to be out there as long as

169

00:08:56,970 --> 00:08:55,000

you can be out there and making it as

170

00:08:58,530 --> 00:08:56,980

lightweight as possible which is what

171

00:08:59,880 --> 00:08:58,540

most people can relate to if anybody's

172

00:09:01,290 --> 00:08:59,890

ever traveled you don't want to be

173

00:09:03,270 --> 00:09:01,300

carrying around a big heavy bag all the

174

00:09:04,470 --> 00:09:03,280

time either that's right it's true now

175

00:09:06,450 --> 00:09:04,480

where are some other cool technologies

176

00:09:08,130 --> 00:09:06,460

going on one of the problems we have is

177

00:09:09,780 --> 00:09:08,140

managing all the logistics if you're

178

00:09:11,820 --> 00:09:09,790

going to be gone on a trip and you pack

179

00:09:13,410 --> 00:09:11,830

your car and you need to figure out

180

00:09:15,390 --> 00:09:13,420

where everything is going to be in say

181

00:09:16,980 --> 00:09:15,400

your motorhome over the course of a

182

00:09:18,930 --> 00:09:16,990

couple years how are you gonna find all

183

00:09:21,540 --> 00:09:18,940

that stuff so what we're going to do is

184

00:09:23,850 --> 00:09:21,550

use next generation RFID nor what we

185

00:09:25,980 --> 00:09:23,860

call radiofrequency ID tags and what

186

00:09:28,470 --> 00:09:25,990

those allow you to do is wirelessly

187

00:09:31,170 --> 00:09:28,480

track in inventory where everything is

188

00:09:33,360 --> 00:09:31,180

inside of your beer make I mean that's

189

00:09:34,470 --> 00:09:33,370

actually makes sense because especially

190

00:09:36,810 --> 00:09:34,480

would take a look something like it's

191

00:09:39,030 --> 00:09:36,820

ISS where you probably have thousands

192

00:09:40,680 --> 00:09:39,040

and thousands of pieces equipment yes

193

00:09:42,410 --> 00:09:40,690

station and how you keep track of all

194

00:09:44,509 --> 00:09:42,420

that in on Space Station

195

00:09:45,680 --> 00:09:44,519

don't sometimes there are a number of

196

00:09:47,449 --> 00:09:45,690

items that we've lost on the space

197

00:09:49,550 --> 00:09:47,459

station and we have to potentially fly

198

00:09:51,829 --> 00:09:49,560

anyone up on the space station you have

199

00:09:53,960 --> 00:09:51,839

the additive benefit of the crews

200

00:09:55,220 --> 00:09:53,970

changing every six months so imagine if

201

00:09:56,180 --> 00:09:55,230

you were living in your house for six

202

00:09:57,980 --> 00:09:56,190

months you put everything where you

203

00:09:59,480 --> 00:09:57,990

wanted it to go somebody else comes up

204

00:10:02,000 --> 00:09:59,490

six months later and moves it all on you

205

00:10:03,590 --> 00:10:02,010

and then you come back again and nobody

206

00:10:04,879 --> 00:10:03,600

knows where everything went right so

207

00:10:06,410 --> 00:10:04,889

everything will have the equivalent of

208

00:10:08,360 --> 00:10:06,420

almost like a high-tech sticker that

209

00:10:09,980 --> 00:10:08,370

actually tracks every piece and you'll

210

00:10:11,360 --> 00:10:09,990

have different types of readers so you

211

00:10:13,160 --> 00:10:11,370

have readers that are in between modules

212

00:10:15,199 --> 00:10:13,170

so you can track when something moves

213

00:10:16,970 --> 00:10:15,209

from one module to another and you'll

214

00:10:19,550 --> 00:10:16,980

have other readers that may be handheld

215

00:10:21,829 --> 00:10:19,560

so you can scan your storage bags and

216

00:10:23,900 --> 00:10:21,839

figure out which bag and have folks here

217

00:10:25,400 --> 00:10:23,910

on the ground design it digitally right

218

00:10:26,689 --> 00:10:25,410

email the file up and then print out the

219

00:10:28,790 --> 00:10:26,699

part on orbit and how long is that

220

00:10:30,800 --> 00:10:28,800

process in terms of making a tool making

221

00:10:32,389 --> 00:10:30,810

a piece of technology so on station

222

00:10:34,280 --> 00:10:32,399

we've already printed over 20 some parts

223

00:10:36,139 --> 00:10:34,290

in fact you can print several parts per

224

00:10:52,400 --> 00:10:36,149

day whatever you want just on a single

225

00:10:55,130 --> 00:10:52,410

printer hey Frank Franklin what's the

226

00:10:57,710 --> 00:10:55,140

code for Q's lab you know I'm not quite

227

00:11:03,319 --> 00:10:57,720

sure but Travis he usually works for me

228

00:11:44,380 --> 00:11:03,329

hung up not really directions left right

229

00:11:48,170 --> 00:11:46,280

today we're at the additive

230

00:11:50,780 --> 00:11:48,180

manufacturing lab at the Marshall Space

231

00:11:53,450 --> 00:11:50,790

Flight Center and I'm talking with the

232

00:11:55,639 --> 00:11:53,460

3d printing and space project manager

233

00:11:58,360 --> 00:11:55,649

Nickey Werkheiser hey don't Nicki I am

234

00:12:00,949 --> 00:11:58,370

doing well thanks additive manufacturing

235

00:12:02,780 --> 00:12:00,959

exactly what is it so I did

236

00:12:05,510 --> 00:12:02,790

manufacturing is actually the kind of

237

00:12:07,460 --> 00:12:05,520

formal term for 3d printing traditional

238

00:12:08,810 --> 00:12:07,470

manufacturing is subtractive you have a

239

00:12:11,600 --> 00:12:08,820

material and you take away from it

240

00:12:13,490 --> 00:12:11,610

additive is any process really where you

241

00:12:15,949 --> 00:12:13,500

actually build the part that you're

242

00:12:18,410 --> 00:12:15,959

trying to create layer by layer so it's

243

00:12:20,540 --> 00:12:18,420

additive instead of subtractive 3d

244

00:12:21,949 --> 00:12:20,550

printing has been around for a low-fat

245

00:12:24,380 --> 00:12:21,959

that right now we're completely

246

00:12:27,620 --> 00:12:24,390

dependent upon launching from the ground

247

00:12:29,449 --> 00:12:27,630

to Space Station so being able to create

248

00:12:31,250 --> 00:12:29,459

what you need when you need it on these

249

00:12:33,699 --> 00:12:31,260

type of missions is really a critical

250

00:12:37,310 --> 00:12:33,709

enabler to sustainable affordable

251  
00:12:40,490 --> 00:12:37,320  
exploration missions well I've seen 3d

252  
00:12:42,889 --> 00:12:40,500  
printing work here on the ground but to

253  
00:12:45,500 --> 00:12:42,899  
get it in space what are the you know

254  
00:12:47,240 --> 00:12:45,510  
the technology hurdles that you have to

255  
00:12:49,670 --> 00:12:47,250  
get over to make sure it works the same

256  
00:12:51,710 --> 00:12:49,680  
way in space as it does here on earth

257  
00:12:53,960 --> 00:12:51,720  
right so those were actually our exact

258  
00:12:55,640 --> 00:12:53,970  
questions as a matter of fact it was

259  
00:12:57,530 --> 00:12:55,650  
back in night that we just launched it

260  
00:12:59,240 --> 00:12:57,540  
is the first 3d printer ever in space

261  
00:13:01,430 --> 00:12:59,250  
and we launched it on SpaceX for

262  
00:13:03,620 --> 00:13:01,440  
recently that's why it's called a

263  
00:13:06,290 --> 00:13:03,630

technology demonstration now on the

264

00:13:08,560 --> 00:13:06,300

table right over here we have a replica

265

00:13:12,500 --> 00:13:08,570

of what is playing on the ISS right now

266

00:13:13,940 --> 00:13:12,510

exactly how does this 3d printer work so

267

00:13:15,260 --> 00:13:13,950

this first printer that we're flying

268

00:13:17,630 --> 00:13:15,270

we're actually operating in the

269

00:13:19,130 --> 00:13:17,640

microgravity science glovebox and that

270

00:13:21,829 --> 00:13:19,140

is because since this had never been

271

00:13:23,780 --> 00:13:21,839

done in space before we did not have all

272

00:13:26,840 --> 00:13:23,790

of the data for things like flammability

273

00:13:28,940 --> 00:13:26,850

and off gassing of the heated extruded

274

00:13:30,199 --> 00:13:28,950

material that we're printing with since

275

00:13:32,120 --> 00:13:30,209

then we've collected all that ground

276

00:13:35,360 --> 00:13:32,130

data and found that it's not it's going

277

00:13:42,230 --> 00:13:35,370

to be science back very soon te o Great

278

00:13:47,760 --> 00:13:45,600

what material is being used in the

279

00:13:49,500 --> 00:13:47,770

production of the parts that are going

280

00:13:50,760 --> 00:13:49,510

to be made on the ISS sure so for our

281

00:13:53,160 --> 00:13:50,770

first printer the technology

282

00:13:55,710 --> 00:13:53,170

demonstration we're actually using ABS

283

00:13:57,210 --> 00:13:55,720

plastic which is the same plastic if you

284

00:13:59,520 --> 00:13:57,220

see here this is a little piece of the

285

00:14:01,050 --> 00:13:59,530

filament and this is the same plastic

286

00:14:03,450 --> 00:14:01,060

that Legos are made out of for example

287

00:14:06,150 --> 00:14:03,460

the filament that we use is just like

288

00:14:08,070 --> 00:14:06,160

this in to be proposal for a recycler on

289

00:14:11,250 --> 00:14:08,080

how to take that 3d printed part and

290

00:14:13,070 --> 00:14:11,260

turn it back into usable feedstock Ricky

291

00:14:16,080 --> 00:14:13,080

what are the goals of this technology

292

00:14:18,210 --> 00:14:16,090

demonstration on the ISS so for the

293

00:14:20,580 --> 00:14:18,220

technology demonstration it really has

294

00:14:22,590 --> 00:14:20,590

two phases in the very first phase is

295

00:14:25,320 --> 00:14:22,600

specifically just to answer the question

296

00:14:27,150 --> 00:14:25,330

does the additive manufacturing or 3d

297

00:14:29,670 --> 00:14:27,160

printing process work in microgravity

298

00:14:31,500 --> 00:14:29,680

the same way it does on the ground so

299

00:14:35,730 --> 00:14:31,510

for the first phase will actually be

300

00:14:37,650 --> 00:14:35,740

printing utilization parts and a broad

301  
00:14:40,170 --> 00:14:37,660  
range and we're developing a utilization

302  
00:14:43,260 --> 00:14:40,180  
catalog you can have things like sample

303  
00:14:45,240 --> 00:14:43,270  
containers small hand tools replacement

304  
00:14:47,250 --> 00:14:45,250  
parts for exercise equipment or medical

305  
00:14:49,170 --> 00:14:47,260  
tools there's just a plethora of

306  
00:14:51,120 --> 00:14:49,180  
different areas and categories we're

307  
00:14:54,150 --> 00:14:51,130  
looking into but the thing there is to

308  
00:14:56,820 --> 00:14:54,160  
learn how to design these parts and

309  
00:15:00,120 --> 00:14:56,830  
build them in microgravity and to create

310  
00:15:01,740 --> 00:15:00,130  
kind of a certification process on Space

311  
00:15:04,050 --> 00:15:01,750  
Station what's going to happen in the

312  
00:15:06,480 --> 00:15:04,060  
next generation of 3d printing in space

313  
00:15:08,250 --> 00:15:06,490

yes so so we're already working that and

314

00:15:10,200 --> 00:15:08,260

everything that we learn from this

315

00:15:11,940 --> 00:15:10,210

technology demonstration including what

316

00:15:14,160 --> 00:15:11,950

we've already learned from the design

317

00:15:15,960 --> 00:15:14,170

and the operations getting it ready for

318

00:15:17,940 --> 00:15:15,970

flight will feed into the next

319

00:15:20,190 --> 00:15:17,950

generation printer the really exciting

320

00:15:22,110 --> 00:15:20,200

thing about the next generation is that

321

00:15:23,420 --> 00:15:22,120

it's going to be a commercial printer

322

00:15:25,860 --> 00:15:23,430

it's called the additive manufacturing

323

00:15:27,630 --> 00:15:25,870

facility and it's being developed by the

324

00:15:30,540 --> 00:15:27,640

company made in space and they're out in

325

00:15:33,150 --> 00:15:30,550

Silicon Valley so it won't just be NASA

326

00:15:35,430 --> 00:15:33,160

or the government that has access to 3d

327

00:15:38,160 --> 00:15:35,440

printing parts in space it will be

328

00:15:38,550 --> 00:15:38,170

available for use by industry and a

329

00:15:40,870 --> 00:15:38,560

cadet

330

00:15:43,150 --> 00:15:40,880

small businesses large businesses that

331

00:15:45,220 --> 00:15:43,160

are interested in making something in

332

00:15:46,509 --> 00:15:45,230

space so I think it's very exciting to

333

00:15:49,240 --> 00:15:46,519

think about kind of opening that door

334

00:15:51,759 --> 00:15:49,250

and opening the door to the space

335

00:15:54,490 --> 00:15:51,769

station and able to manufacture parts in

336

00:16:01,900 --> 00:15:54,500

space to more people than just directly

337

00:16:03,519 --> 00:16:01,910

NASA this technology is awesome and I

338

00:16:05,110 --> 00:16:03,529

got to tell you guys in light of all the

339

00:16:06,670 --> 00:16:05,120

technology that we've seen in the show

340

00:16:08,079 --> 00:16:06,680

today I've got something a little

341

00:16:09,879 --> 00:16:08,089

special that I've worked up with the

342

00:16:15,400 --> 00:16:09,889

help of our good friend Jarvis we're

343

00:16:17,710 --> 00:16:15,410

going to talk to Deanne Bell hi Deann

344

00:16:20,230 --> 00:16:17,720

thanks for being on the show okay well

345

00:16:21,850 --> 00:16:20,240

we're rolling and we're good to go let's

346

00:16:24,280 --> 00:16:21,860

get started with a very important

347

00:16:27,310 --> 00:16:24,290

foundational question what exactly is

348

00:16:29,230 --> 00:16:27,320

the future engineers program great so

349

00:16:31,600 --> 00:16:29,240

future engineers is a program that was

350

00:16:33,759 --> 00:16:31,610

started to really inspire the next

351  
00:16:35,590 --> 00:16:33,769  
generation of innovators and explorers

352  
00:16:38,230 --> 00:16:35,600  
it's a website you go to future

353  
00:16:40,629 --> 00:16:38,240  
engineers org and there's all kinds of

354  
00:16:44,019 --> 00:16:40,639  
education resources and our website

355  
00:16:47,530 --> 00:16:44,029  
challenges students to create 3d model

356  
00:16:49,509 --> 00:16:47,540  
inventions for space the program is an

357  
00:16:51,490 --> 00:16:49,519  
American Society of Mechanical Engineers

358  
00:16:53,680 --> 00:16:51,500  
foundation program in technical

359  
00:16:55,660 --> 00:16:53,690  
partnership with NASA and it's really

360  
00:16:58,059 --> 00:16:55,670  
exciting our first challenge launched

361  
00:17:00,280 --> 00:16:58,069  
with the first zero gravity 3d printer

362  
00:17:02,740 --> 00:17:00,290  
that went to space and you know that's

363  
00:17:04,480 --> 00:17:02,750

not the first and only challenge we have

364

00:17:05,829 --> 00:17:04,490

many more challenges in the pipe and

365

00:17:08,500 --> 00:17:05,839

we're constantly developing new

366

00:17:10,360 --> 00:17:08,510

challenges and new curriculum to really

367

00:17:12,640 --> 00:17:10,370

connect the excitement of space

368

00:17:14,620 --> 00:17:12,650

exploration and Space Research with the

369

00:17:16,809 --> 00:17:14,630

excitement of creating a 3d model and

370

00:17:19,809 --> 00:17:16,819

turning your idea into a 3d model

371

00:17:21,460 --> 00:17:19,819

reality recently you announce the winner

372

00:17:23,890 --> 00:17:21,470

for your first future engineers

373

00:17:26,079 --> 00:17:23,900

challenge what did that first challenge

374

00:17:27,819 --> 00:17:26,089

involve the first challenge we challenge

375

00:17:29,980 --> 00:17:27,829

students to create a space tool for

376

00:17:31,780 --> 00:17:29,990

astronauts and we had so many different

377

00:17:34,720 --> 00:17:31,790

submissions from all corners of the

378

00:17:37,240 --> 00:17:34,730

country and ultimately we chose ten

379

00:17:40,570 --> 00:17:37,250

semi-finalists in each age group we had

380

00:17:42,130 --> 00:17:40,580

two age groups under 13 and over 13 that

381

00:17:44,260 --> 00:17:42,140

are enrolled in a k through 12 school

382

00:17:45,760 --> 00:17:44,270

and our winner in the

383

00:17:48,430 --> 00:17:45,770

juniors age group his name's Sydney

384

00:17:51,550 --> 00:17:48,440

Vernon and she designed a space planter

385

00:17:53,320 --> 00:17:51,560

to grow a seedling in space our winner

386

00:17:55,720 --> 00:17:53,330

of our teen division his name is Robert

387

00:17:58,060 --> 00:17:55,730

hylan based in enterprise Alabama and he

388

00:18:00,190 --> 00:17:58,070

designed something called the MPN tea

389

00:18:02,080 --> 00:18:00,200

it's the multipurpose precision

390

00:18:04,210 --> 00:18:02,090

maintenance tool and he basically took

391

00:18:06,130 --> 00:18:04,220

like a gajillion different tools and put

392

00:18:08,620 --> 00:18:06,140

it all into one to be 3d printed on

393

00:18:10,390 --> 00:18:08,630

station and the excitement is that one

394

00:18:13,090 --> 00:18:10,400

actually is getting 3d printed on

395

00:18:15,460 --> 00:18:13,100

station what's next for future engineers

396

00:18:17,500 --> 00:18:15,470

there is so much excitement going on

397

00:18:20,500 --> 00:18:17,510

with the future engineers program we are

398

00:18:23,050 --> 00:18:20,510

growing we are always in the process of

399

00:18:24,700 --> 00:18:23,060

developing new challenges this program

400

00:18:26,710 --> 00:18:24,710

wasn't just one challenge with that

401

00:18:28,420 --> 00:18:26,720

first printer that went up we're really

402

00:18:30,190 --> 00:18:28,430

focused on a multi-year endeavor of

403

00:18:32,020 --> 00:18:30,200

getting students creating their

404

00:18:35,080 --> 00:18:32,030

inventions and 3d model like them in the

405

00:18:37,030 --> 00:18:35,090

computer every challenge that future

406

00:18:38,650 --> 00:18:37,040

engineers issues in partnership with

407

00:18:41,500 --> 00:18:38,660

NASA is going to be centered around

408

00:18:44,020 --> 00:18:41,510

research that's going on at NASA so it's

409

00:18:45,460 --> 00:18:44,030

a really great opportunity to pair all

410

00:18:47,920 --> 00:18:45,470

the excitement and all the different

411

00:18:50,110 --> 00:18:47,930

areas of natural research with k12

412

00:18:52,780 --> 00:18:50,120

programs to connect it with students in

413

00:18:54,340 --> 00:18:52,790

the classrooms how can students and

414

00:18:57,130 --> 00:18:54,350

future engineers get involved with the

415

00:18:59,890 --> 00:18:57,140

Avengers initiative but future

416

00:19:01,410 --> 00:18:59,900

challenges its future challenges how can

417

00:19:04,120 --> 00:19:01,420

they get involved in future challenges

418

00:19:06,850 --> 00:19:04,130

right so you can get involved just by

419

00:19:08,590 --> 00:19:06,860

going to future engineers org the site's

420

00:19:10,960 --> 00:19:08,600

more than just a place to register and

421

00:19:13,000 --> 00:19:10,970

submit a model there's all kinds of cool

422

00:19:15,160 --> 00:19:13,010

fun goodies to explore there's videos

423

00:19:17,460 --> 00:19:15,170

about how to get started in 3d modeling

424

00:19:20,680 --> 00:19:17,470

how to learn about 3d modeling concepts

425

00:19:23,320 --> 00:19:20,690

there's also all kinds of space science

426

00:19:24,640 --> 00:19:23,330

videos there's different animated

427

00:19:27,850 --> 00:19:24,650

science lessons that you can learn about

428

00:19:30,760 --> 00:19:27,860

microgravity about how Rockets resupply

429

00:19:32,320 --> 00:19:30,770

the ISS there's all kinds of content

430

00:19:35,020 --> 00:19:32,330

there to explore so I strongly encourage

431

00:19:36,580 --> 00:19:35,030

students to go there to just just dive

432

00:19:39,620 --> 00:19:36,590

into the site and look at all the

433

00:19:41,660 --> 00:19:39,630

resources that we've curated for them

434

00:19:47,180 --> 00:19:41,670

thanks Deanne and thanks future

435

00:19:49,460 --> 00:19:47,190

engineers thank you you guys think dude

436

00:19:52,160 --> 00:19:49,470

that might very well have been the best

437

00:19:54,260 --> 00:19:52,170

interview you've ever done Franklin I

438

00:19:57,860 --> 00:19:54,270

really appreciate that thanks so much as

439

00:20:12,359 --> 00:19:57,870

good as an Asgardian God or that's

440

00:20:19,419 --> 00:20:15,609

what's up come on man and outside look

441

00:20:22,239 --> 00:20:19,429

at all things NASA we lost a whole day

442

00:20:25,749 --> 00:20:22,249

because you were sleep next time just

443

00:20:27,820 --> 00:20:25,759

see one film and one film does this to

444

00:20:29,259 --> 00:20:27,830

us all the time all the time we have to

445

00:20:31,749 --> 00:20:29,269

shoot the wrong morning it was good not

446

00:20:34,690 --> 00:20:31,759

are you okay not a me right dude next

447

00:20:36,879 --> 00:20:34,700

time bring you a game get some sleep and

448

00:20:40,450 --> 00:20:36,889

by the way you blew it with the

449

00:21:33,830 --> 00:20:40,460

adventures question here's question and

450

00:21:38,940 --> 00:21:36,660

hi I'm Jenny davao lights and i am the

451  
00:21:51,080 --> 00:21:38,950  
Morpheus Lander test conductor and

452  
00:21:56,340 --> 00:21:53,940  
Morpheus is the world's first prototype

453  
00:21:58,560 --> 00:21:56,350  
Lander with liquid oxygen liquid methane

454  
00:22:00,510 --> 00:21:58,570  
propulsion one of the really exciting

455  
00:22:02,370 --> 00:22:00,520  
aspects of this project is that it's a

456  
00:22:07,790 --> 00:22:02,380  
rocket and it flies and we get to light

457  
00:22:12,780 --> 00:22:10,560  
from a team development perspective

458  
00:22:15,240 --> 00:22:12,790  
there's a group of us that designed

459  
00:22:16,620 --> 00:22:15,250  
built and flew this vehicle that's not

460  
00:22:19,020 --> 00:22:16,630  
an opportunity that you get every day so

461  
00:22:20,280 --> 00:22:19,030  
that was always a very exciting thing to

462  
00:22:22,200 --> 00:22:20,290  
be able to do but the long-term

463  
00:22:24,030 --> 00:22:22,210

implications of it for the journey to

464

00:22:25,500 --> 00:22:24,040

Mars are even more important the

465

00:22:26,820 --> 00:22:25,510

technologies that we're testing we're

466

00:22:28,830 --> 00:22:26,830

trying to enable the types of

467

00:22:30,570 --> 00:22:28,840

capabilities that were going to need

468

00:22:32,790 --> 00:22:30,580

down the road in order to get humans to

469

00:22:34,580 --> 00:22:32,800

Mars and back safely and one of the

470

00:22:37,140 --> 00:22:34,590

important things is the integration of

471

00:22:38,820 --> 00:22:37,150

oxygen and methane with the rest of the

472

00:22:40,620 --> 00:22:38,830

system something very important about

473

00:22:42,420 --> 00:22:40,630

going to Mars is that you only have what

474

00:22:44,220 --> 00:22:42,430

you can take with you or what you can

475

00:22:46,920 --> 00:22:44,230

make on the surface you look at Mars

476

00:22:49,110 --> 00:22:46,930

it's very dry but you can extract water

477

00:22:51,540 --> 00:22:49,120

from the Martian soil you can also

478

00:22:53,370 --> 00:22:51,550

create methane to fill the tanks of your

479

00:22:54,570 --> 00:22:53,380

asset and vehicle and that's why part of

480

00:24:04,730 --> 00:22:54,580

what we did that Morpheus was so

481

00:24:12,490 --> 00:24:08,010

it is often said that the only thing

482

00:24:12,500 --> 00:24:18,300

that is as true at NASA as anywhere else

483

00:24:23,170 --> 00:24:21,550

but the men and women of NASA generally

484

00:24:26,170 --> 00:24:23,180

see changed differently than others

485

00:24:30,470 --> 00:24:26,180

because their life's work is all about

486

00:24:35,390 --> 00:24:32,960

through their tireless efforts these

487

00:24:38,060 --> 00:24:35,400

talented professionals move past the

488

00:24:40,760 --> 00:24:38,070

status quo every day and help us

489

00:24:43,370 --> 00:24:40,770

understand and change our world for the

490

00:24:45,799 --> 00:24:43,380

better but even though changes part of

491

00:24:48,830 --> 00:24:45,809

their job requirement the people of NASA

492

00:24:51,320 --> 00:24:48,840

understand that all projects eventually

493

00:24:53,539 --> 00:24:51,330

come to an end and they will have to

494

00:24:56,510 --> 00:24:53,549

transition from one assignment and get

495

00:24:58,850 --> 00:24:56,520

ready for their next challenge that

496

00:25:01,130 --> 00:24:58,860

transition is beginning to happen now

497

00:25:04,490 --> 00:25:01,140

for the members of the environmentally

498

00:25:06,680 --> 00:25:04,500

responsible aviation project after six

499

00:25:09,260 --> 00:25:06,690

long years of study team members are

500

00:25:11,480 --> 00:25:09,270

closing the books on the ER a research

501  
00:25:13,190 --> 00:25:11,490  
project that has provided so much new

502  
00:25:16,549 --> 00:25:13,200  
information about how future aircraft

503  
00:25:19,340 --> 00:25:16,559  
will fly this team has worked diligently

504  
00:25:22,010 --> 00:25:19,350  
over the past half decade to reduce

505  
00:25:24,890 --> 00:25:22,020  
aircraft drag by eight percent reduce

506  
00:25:27,080 --> 00:25:24,900  
aircraft weight by ten percent reduce

507  
00:25:29,690 --> 00:25:27,090  
engine specific fuel consumption by

508  
00:25:32,299 --> 00:25:29,700  
fifteen percent produce oxides of

509  
00:25:35,840 --> 00:25:32,309  
nitrogen emissions of the engine by 75

510  
00:25:38,600 --> 00:25:35,850  
percent and to reduce aircraft noise by

511  
00:25:41,450 --> 00:25:38,610  
18 compared with current standards all

512  
00:25:43,789 --> 00:25:41,460  
by the year twenty twenty-five these

513  
00:25:46,340 --> 00:25:43,799

were stretch goals to be sure but not

514

00:25:50,900 --> 00:25:46,350

surprisingly their efforts have paid off

515

00:25:52,850 --> 00:25:50,910

for all of us today on nasa x we will

516

00:25:55,190 --> 00:25:52,860

look at part two of this two-part

517

00:25:58,159 --> 00:25:55,200

program that has explored the work done

518

00:26:00,409 --> 00:25:58,169

by the ER 18 we will look back at some

519

00:26:02,240 --> 00:26:00,419

of their early work while also looking

520

00:26:04,880 --> 00:26:02,250

at what some of the finished products

521

00:26:06,950 --> 00:26:04,890

look like we will see how nasa and

522

00:26:09,409 --> 00:26:06,960

industry have worked together to improve

523

00:26:11,990 --> 00:26:09,419

the state of the art for aircraft design

524

00:26:15,060 --> 00:26:12,000

and we'll find out about promising new

525

00:26:17,919 --> 00:26:15,070

ideas that have come out of this work

526  
00:26:40,649 --> 00:26:17,929  
finally we will bid farewell to the team

527  
00:26:45,850 --> 00:26:44,110  
created in 2009 as part of NASA's

528  
00:26:48,130 --> 00:26:45,860  
Aeronautics research mission

529  
00:26:50,860 --> 00:26:48,140  
directorates integrated systems research

530  
00:26:53,409 --> 00:26:50,870  
program the environmentally responsible

531  
00:26:55,720 --> 00:26:53,419  
aviation project was tasked with

532  
00:26:58,049 --> 00:26:55,730  
exploring and documenting the

533  
00:27:00,539 --> 00:26:58,059  
feasibility of vehicle concepts and

534  
00:27:03,539 --> 00:27:00,549  
enabling technologies to reduce

535  
00:27:06,159 --> 00:27:03,549  
Aviation's impact on the environment

536  
00:27:08,289 --> 00:27:06,169  
aircraft have benefited greatly by the

537  
00:27:10,620 --> 00:27:08,299  
work done by NASA engineers over the

538  
00:27:13,870 --> 00:27:10,630

decades but with changes in technology

539

00:27:18,840 --> 00:27:13,880

NASA knew that much more could still be

540

00:27:22,120 --> 00:27:18,850

done the ER a project was organized to

541

00:27:24,460 --> 00:27:22,130

mature promising technology and advanced

542

00:27:27,399 --> 00:27:24,470

aircraft configurations that meet mid

543

00:27:30,130 --> 00:27:27,409

term goals for community noise reduce

544

00:27:33,519 --> 00:27:30,140

fuel burn and nitrogen oxide or NOx

545

00:27:35,500 --> 00:27:33,529

emissions they were also tasked with

546

00:27:37,539 --> 00:27:35,510

determining the potential impact of

547

00:27:39,519 --> 00:27:37,549

these advanced aircraft designs and

548

00:27:43,860 --> 00:27:39,529

technologies into the air transportation

549

00:27:46,150 --> 00:27:43,870

system they have done all this and more

550

00:27:48,670 --> 00:27:46,160

the solutions that they have achieved

551  
00:27:50,980 --> 00:27:48,680  
will undoubtedly reduce fuel consumption

552  
00:27:53,680 --> 00:27:50,990  
by up to several percentage points for

553  
00:27:56,680 --> 00:27:53,690  
the aircraft community that may not

554  
00:27:59,230 --> 00:27:56,690  
sound like much but shaving aircraft

555  
00:28:02,080 --> 00:27:59,240  
fuel consumption even a few percentage

556  
00:28:04,240 --> 00:28:02,090  
points can save millions of dollars and

557  
00:28:07,390 --> 00:28:04,250  
help protect the environment from

558  
00:28:09,430 --> 00:28:07,400  
harmful emissions one area that the team

559  
00:28:11,890 --> 00:28:09,440  
focused on heavily to meet these goals

560  
00:28:14,140 --> 00:28:11,900  
was to develop in collaboration with

561  
00:28:16,690 --> 00:28:14,150  
their industry partners a new type of

562  
00:28:19,810 --> 00:28:16,700  
aircraft call the hybrid wing body

563  
00:28:22,210 --> 00:28:19,820

concept NASA planners did early wind

564

00:28:24,850 --> 00:28:22,220

tunnel tests and scale model tests with

565

00:28:27,430 --> 00:28:24,860

great success the final phase of this

566

00:28:29,980 --> 00:28:27,440

testing is being done here at NASA Ames

567

00:28:33,130 --> 00:28:29,990

Research Center's 40 x 80 tunnel in

568

00:28:35,830 --> 00:28:33,140

California the in fact is actually home

569

00:28:37,300 --> 00:28:35,840

to two interconnected wind tunnels one

570

00:28:41,260 --> 00:28:37,310

Test section the world's largest

571

00:28:43,510 --> 00:28:41,270

measures 80 feet tall by 120 feet wide

572

00:28:46,510 --> 00:28:43,520

the other one the world's second largest

573

00:28:49,780 --> 00:28:46,520

has a test section that measures 40 feet

574

00:28:52,090 --> 00:28:49,790

tall by 80 feet wide this full-scale

575

00:28:54,820 --> 00:28:52,100

tunnel has been used since world war two

576

00:28:57,190 --> 00:28:54,830

and has helped perfect numerous aircraft

577

00:28:59,980 --> 00:28:57,200

designs and is now being used to help

578

00:29:03,610 --> 00:28:59,990

with this unique aircraft here is Kevin

579

00:29:08,050 --> 00:29:03,620

James from NASA Ames to explain if you

580

00:29:10,480 --> 00:29:08,060

take an airplane from say 1950 1952 an

581

00:29:12,430 --> 00:29:10,490

airplane from say today and you lay them

582

00:29:14,800 --> 00:29:12,440

on top of each other they have almost

583

00:29:17,950 --> 00:29:14,810

exactly the same outline there's been a

584

00:29:18,730 --> 00:29:17,960

lot of improvements but as we start

585

00:29:20,320 --> 00:29:18,740

looking for something that's

586

00:29:22,000 --> 00:29:20,330

dramatically different where you're

587

00:29:26,290 --> 00:29:22,010

really going to make improvements in

588

00:29:28,549 --> 00:29:26,300

fuel economy fuel emissions and

589

00:29:30,710 --> 00:29:28,559

acoustics a community

590

00:29:33,139 --> 00:29:30,720

and the impact we have on how people

591

00:29:34,930 --> 00:29:33,149

live their lives we have to keep looking

592

00:29:38,869 --> 00:29:34,940

and sometimes think outside of the box

593

00:29:42,649 --> 00:29:38,879

so this is this is a hybrid blended wing

594

00:29:45,529 --> 00:29:42,659

body we call the generic airplanes of

595

00:29:46,820 --> 00:29:45,539

today tuvan wings and it sort of makes

596

00:29:48,560 --> 00:29:46,830

sense because there's just a big ol tube

597

00:29:50,600 --> 00:29:48,570

with a bling on it and we all just go

598

00:29:52,039 --> 00:29:50,610

along for the ride what we've done here

599

00:29:56,350 --> 00:29:52,049

is we've actually taken that too and

600

00:29:59,919 --> 00:29:56,360

with the abilities that we've had in

601  
00:30:02,690 --> 00:29:59,929  
improvements in structures and materials

602  
00:30:04,700 --> 00:30:02,700  
specifically composites we can now go

603  
00:30:06,440 --> 00:30:04,710  
from a tube shape to more of an

604  
00:30:08,480 --> 00:30:06,450  
elongated shape because the pressure

605  
00:30:10,340 --> 00:30:08,490  
vessel wants to be tube and we want to

606  
00:30:11,810 --> 00:30:10,350  
kind of stretch it a little well when we

607  
00:30:14,239 --> 00:30:11,820  
stretch it and then we blend the wings

608  
00:30:17,060 --> 00:30:14,249  
into it we get this hybrid blended wing

609  
00:30:19,249 --> 00:30:17,070  
body airplane and through very careful

610  
00:30:21,230 --> 00:30:19,259  
control of weight and very careful

611  
00:30:23,480 --> 00:30:21,240  
configuration control including how you

612  
00:30:25,159 --> 00:30:23,490  
put the engines on it we have

613  
00:30:27,350 --> 00:30:25,169

significant improvements in fuel burn

614

00:30:31,129 --> 00:30:27,360

and also very significant improvements

615

00:30:33,379 --> 00:30:31,139

in noise arm was a fifty percent

616

00:30:38,869 --> 00:30:33,389

reduction in fuel burn gate to gate and

617

00:30:41,930 --> 00:30:38,879

a 42 DB decibel or reduction noise in

618

00:30:45,710 --> 00:30:41,940

accumulative fashioned from a 1999

619

00:30:49,820 --> 00:30:45,720

target airplane where we ended up was

620

00:30:51,259 --> 00:30:49,830

really really close we made over

621

00:30:54,489 --> 00:30:51,269

forty-eight percent improvement in fuel

622

00:30:57,169 --> 00:30:54,499

burn so missed it by just that much and

623

00:30:58,520 --> 00:30:57,179

really close to the four it were at work

624

00:31:00,980 --> 00:30:58,530

40 DB down

625

00:31:03,530 --> 00:31:00,990

phew motive but a good way to keep in

626

00:31:06,650 --> 00:31:03,540

mind what it really means is every 6

627

00:31:10,010 --> 00:31:06,660

decibels of change is a doubling of the

628

00:31:12,110 --> 00:31:10,020

noise our perception of the noise so

629

00:31:15,380 --> 00:31:12,120

when we start talking about numbers like

630

00:31:17,840 --> 00:31:15,390

42 DB down even if it's cumulative that

631

00:31:19,670 --> 00:31:17,850

is a huge improvement what that really

632

00:31:21,620 --> 00:31:19,680

is in terms of quality of life for

633

00:31:24,140 --> 00:31:21,630

people in the cities especially around

634

00:31:26,300 --> 00:31:24,150

airports is a is a significant

635

00:31:29,710 --> 00:31:26,310

improvement to what they've come to

636

00:31:32,270 --> 00:31:29,720

expect it's been a lot of hard work

637

00:31:35,200 --> 00:31:32,280

there's always frustrations but that's

638

00:31:38,480 --> 00:31:35,210

kind of what makes the job fun sometimes

639

00:31:41,000 --> 00:31:38,490

in solving the challenges we have worked

640

00:31:43,460 --> 00:31:41,010

with some phenomenally good people it is

641

00:31:46,610 --> 00:31:43,470

just it is we were really truly blessed

642

00:31:52,870 --> 00:31:46,620

nASA has hands down the best people on

643

00:31:57,650 --> 00:31:52,880

the planet just really good people smart

644

00:32:00,620 --> 00:31:57,660

interactive social full of good ideas

645

00:32:02,630 --> 00:32:00,630

and wanting to solve problems it has

646

00:32:06,350 --> 00:32:02,640

been a lot of fun seeing the pieces all

647

00:32:08,600 --> 00:32:06,360

come together and ER a was laid out in a

648

00:32:10,400 --> 00:32:08,610

really kind of a very slick way you've

649

00:32:11,750 --> 00:32:10,410

got the vehicle in the systems

650

00:32:13,820 --> 00:32:11,760

integration you've got you know

651  
00:32:16,820 --> 00:32:13,830  
structures and got the end engine and

652  
00:32:19,910 --> 00:32:16,830  
propulsion and again to meet the stated

653  
00:32:22,340 --> 00:32:19,920  
goals all three legs had to deliver and

654  
00:32:26,210 --> 00:32:22,350  
as we get to the end of the program it

655  
00:32:28,100 --> 00:32:26,220  
is just incredible seeing the progress

656  
00:32:30,290 --> 00:32:28,110  
that was made and the deliverables that

657  
00:32:33,140 --> 00:32:30,300  
we're getting from all of the components

658  
00:32:35,330 --> 00:32:33,150  
and as they come together you see that

659  
00:32:36,590 --> 00:32:35,340  
we are actually going to be able to be

660  
00:32:38,840 --> 00:32:36,600  
in a position to say something like this

661  
00:32:41,960 --> 00:32:38,850  
works and this is where we should be

662  
00:32:45,020 --> 00:32:41,970  
headed the research from the hybrid wing

663  
00:32:47,570 --> 00:32:45,030

body aircraft will continue and one day

664

00:32:50,240 --> 00:32:47,580

in the near future we may all see these

665

00:33:09,860 --> 00:32:50,250

types of revolutionary aircraft flying

666

00:33:15,120 --> 00:33:12,720

another concept the ER a team has been

667

00:33:17,700 --> 00:33:15,130

working on called active flow control

668

00:33:20,610 --> 00:33:17,710

enhanced vertical tail flight experiment

669

00:33:23,310 --> 00:33:20,620

has shown much promise as well the ER a

670

00:33:25,590 --> 00:33:23,320

team worked in cooperation with Boeing

671

00:33:27,930 --> 00:33:25,600

to develop a plan to test this

672

00:33:30,990 --> 00:33:27,940

innovative idea in the wind tunnel and

673

00:33:32,730 --> 00:33:31,000

on an actual aircraft in flight before

674

00:33:36,509 --> 00:33:32,740

flight tests were done the team

675

00:33:40,019 --> 00:33:36,519

installed 31 sweeping jet actuators onto

676

00:33:43,080 --> 00:33:40,029

a tail section of a 757 aircraft these

677

00:33:45,629 --> 00:33:43,090

Jets can manipulate on demand the air

678

00:33:48,749 --> 00:33:45,639

that flows over the vertical tail and

679

00:33:50,909 --> 00:33:48,759

rudder surfaces this test is important

680

00:33:53,190 --> 00:33:50,919

because it has the potential to reduce

681

00:33:56,490 --> 00:33:53,200

the weight associated with the tail

682

00:33:58,830 --> 00:33:56,500

section an aircraft's vertical tail is

683

00:34:01,499 --> 00:33:58,840

primarily used to add stability and

684

00:34:03,749 --> 00:34:01,509

directional control during takeoff and

685

00:34:06,629 --> 00:34:03,759

landing especially in the event of an

686

00:34:09,000 --> 00:34:06,639

engine failure but when the aircraft is

687

00:34:12,569 --> 00:34:09,010

cruising at altitude the same large

688

00:34:15,180 --> 00:34:12,579

heavy tail is not necessary Engineers

689

00:34:17,700 --> 00:34:15,190

theorized they could reduce the size of

690

00:34:20,040 --> 00:34:17,710

the vertical tail by using the sweeping

691

00:34:22,559 --> 00:34:20,050

Jets to generate the same side force

692

00:34:24,419 --> 00:34:22,569

during takeoff and landing that would

693

00:34:26,609 --> 00:34:24,429

reduce both the weight and drag of the

694

00:34:29,730 --> 00:34:26,619

airplane and decrease its fuel

695

00:34:31,980 --> 00:34:29,740

consumption in order to test this large

696

00:34:34,980 --> 00:34:31,990

tail section the team had to place it

697

00:34:37,349 --> 00:34:34,990

inside the NASA facility that is home to

698

00:34:40,589 --> 00:34:37,359

the world's largest wind tunnels the

699

00:34:42,730 --> 00:34:40,599

national full-scale aerodynamics complex

700

00:34:46,260 --> 00:34:42,740

or in fact

701  
00:34:48,850 --> 00:34:46,270  
ground studies by a team of NASA Boeing

702  
00:34:52,030 --> 00:34:48,860  
University of Arizona and Caltech

703  
00:34:54,730 --> 00:34:52,040  
researchers on this school scale 757

704  
00:34:57,190 --> 00:34:54,740  
vertical tail in the in fact did in fact

705  
00:35:00,190 --> 00:34:57,200  
show that the active flow control jets

706  
00:35:03,280 --> 00:35:00,200  
could potentially increase side force by

707  
00:35:05,560 --> 00:35:03,290  
as much as twenty to thirty percent that

708  
00:35:08,440 --> 00:35:05,570  
loan number of twenty percent increase

709  
00:35:11,170 --> 00:35:08,450  
in side force could allow designers to

710  
00:35:13,870 --> 00:35:11,180  
scale down the vertical tail by about

711  
00:35:16,420 --> 00:35:13,880  
seventeen percent and therefore reduce

712  
00:35:18,670 --> 00:35:16,430  
fuel usage by as much as one-half

713  
00:35:21,730 --> 00:35:18,680

percent but this is not the only

714

00:35:24,070 --> 00:35:21,740

potential benefit in addition to reduced

715

00:35:26,740 --> 00:35:24,080

weight and fuel economy this type of

716

00:35:32,109 --> 00:35:26,750

device could also allow for new aircraft

717

00:35:34,300 --> 00:35:32,119

to use shorter runways here is the man

718

00:35:37,630 --> 00:35:34,310

who is called the father of active flow

719

00:35:41,710 --> 00:35:37,640

control the University of Arizona's Iggy

720

00:35:44,200 --> 00:35:41,720

wig manski we and we can possibly take

721

00:35:51,220 --> 00:35:44,210

off from a football-field-sized with

722

00:35:54,880 --> 00:35:51,230

some sort of a rotor type airplane maybe

723

00:36:00,030 --> 00:35:54,890

partly tiltrotor partly tilt wing and we

724

00:36:03,880 --> 00:36:00,040

can fly possibly a 350 to 400 knots and

725

00:36:05,800 --> 00:36:03,890

do this very efficiently so since most

726

00:36:08,770 --> 00:36:05,810

of our flights are of the order of a

727

00:36:12,400 --> 00:36:08,780

thousand miles if you do it from

728

00:36:15,460 --> 00:36:12,410

downtown to downtown from a parking lot

729

00:36:19,090 --> 00:36:15,470

to another parking lot that's much more

730

00:36:23,170 --> 00:36:19,100

effective than to do it the way we do

731

00:36:27,790 --> 00:36:23,180

today because on the distance let's say

732

00:36:31,480 --> 00:36:27,800

from here to Tucson I spent about two

733

00:36:34,030 --> 00:36:31,490

hours at the airports and this is not

734

00:36:38,290 --> 00:36:34,040

really necessary and there are a lot of

735

00:36:41,680 --> 00:36:38,300

by the way small airport so far runways

736

00:36:44,890 --> 00:36:41,690

that are less than 5,000 feet are in a

737

00:36:47,500 --> 00:36:44,900

lot of city centers or close to citizens

738

00:36:50,770 --> 00:36:47,510

as it can be utilized it can be utilized

739

00:36:53,339 --> 00:36:50,780

effectively so some sort of short take

740

00:36:58,420 --> 00:36:53,349

of airplane

741

00:37:02,230 --> 00:36:58,430

that produced this technology could be

742

00:37:04,900 --> 00:37:02,240

very effective after testing on the tail

743

00:37:07,330 --> 00:37:04,910

was complete at the in fact NASA and

744

00:37:10,420 --> 00:37:07,340

Boeing place the tail on a boeing test

745

00:37:12,760 --> 00:37:10,430

aircraft call the eco demonstrator this

746

00:37:15,730 --> 00:37:12,770

aircraft is unique because it is being

747

00:37:17,500 --> 00:37:15,740

used as a flying testbed to evaluate

748

00:37:20,410 --> 00:37:17,510

different technologies that could

749

00:37:23,410 --> 00:37:20,420

increase efficiency with the active flow

750

00:37:25,510 --> 00:37:23,420

tail attached testing continued back at

751  
00:37:28,960 --> 00:37:25,520  
boeing field with much of the research

752  
00:37:31,240 --> 00:37:28,970  
data being validated in flight building

753  
00:37:33,070 --> 00:37:31,250  
on that 100 year collaboration we've had

754  
00:37:34,599 --> 00:37:33,080  
between NASA and Boeing the Eco

755  
00:37:37,450 --> 00:37:34,609  
demonstrator program really is about

756  
00:37:39,460 --> 00:37:37,460  
continuing that legacy and and and

757  
00:37:40,630 --> 00:37:39,470  
storing some more action to see that

758  
00:37:43,720 --> 00:37:40,640  
continued collaboration together

759  
00:37:45,870 --> 00:37:43,730  
successfully this collaboration and

760  
00:37:48,820 --> 00:37:45,880  
testing is important not only because

761  
00:37:50,859 --> 00:37:48,830  
technology must move forward but because

762  
00:37:52,990 --> 00:37:50,869  
of the significant savings this could

763  
00:37:58,570 --> 00:37:53,000

potentially afford aircraft operators

764

00:38:02,170 --> 00:38:00,430

when you think about the worldwide fleet

765

00:38:04,900 --> 00:38:02,180

of airplanes there are about 18,000

766

00:38:06,970 --> 00:38:04,910

airplanes that fly today and its

767

00:38:08,650 --> 00:38:06,980

projected to go to 36,000 airplane to

768

00:38:10,690 --> 00:38:08,660

the next 20 years so you can get a

769

00:38:12,610 --> 00:38:10,700

little bit of improvement on one

770

00:38:15,310 --> 00:38:12,620

airplane and it's multiplied times

771

00:38:16,690 --> 00:38:15,320

36,000 in the next 20 years so it's huge

772

00:38:20,410 --> 00:38:16,700

improvements with regard to reducing

773

00:38:22,780 --> 00:38:20,420

overall fuel burn having a relevant test

774

00:38:25,660 --> 00:38:22,790

bed like Boeing's eco demonstrator is

775

00:38:27,820 --> 00:38:25,670

helping to mature technology concepts

776

00:38:29,860 --> 00:38:27,830

that have been extremely important to

777

00:38:32,830 --> 00:38:29,870

NASA's environmentally responsible

778

00:38:35,290 --> 00:38:32,840

aviation project researchers have been

779

00:38:37,990 --> 00:38:35,300

working hard to develop technologies to

780

00:38:41,470 --> 00:38:38,000

reduce airplane fuel consumption noise

781

00:38:44,020 --> 00:38:41,480

and emissions being able to prove those

782

00:38:45,850 --> 00:38:44,030

concepts in flight tests gives them a

783

00:39:08,600 --> 00:38:45,860

better shot of getting into the

784

00:39:13,920 --> 00:39:11,160

because the Eco demonstrator was

785

00:39:17,160 --> 00:39:13,930

designed to test multiple experiments at

786

00:39:19,590 --> 00:39:17,170

once Boeing and the ER a team also

787

00:39:21,660 --> 00:39:19,600

decided to test special material

788

00:39:23,730 --> 00:39:21,670

coatings on the right wing of this

789

00:39:26,880 --> 00:39:23,740

aircraft that could reduce bug

790

00:39:28,650 --> 00:39:26,890

contamination this test was called the

791

00:39:31,560 --> 00:39:28,660

insect accretion and mitigation

792

00:39:34,050 --> 00:39:31,570

experiment which in layman's terms means

793

00:39:36,570 --> 00:39:34,060

that it is simply an experiment to test

794

00:39:39,600 --> 00:39:36,580

how to keep bug guts from reducing

795

00:39:41,880 --> 00:39:39,610

aircraft efficiency it might seem odd

796

00:39:44,340 --> 00:39:41,890

that NASA would spend its time worrying

797

00:39:46,860 --> 00:39:44,350

about seemingly innocuous bug strikes

798

00:39:49,800 --> 00:39:46,870

but believe it or not these small

799

00:39:53,460 --> 00:39:49,810

creatures can significantly reduce an

800

00:39:56,580 --> 00:39:53,470

aircraft's efficiency in a set of flight

801  
00:39:59,040 --> 00:39:56,590  
tests near shreveport louisiana the team

802  
00:40:01,800 --> 00:39:59,050  
assess how well five different coatings

803  
00:40:04,230 --> 00:40:01,810  
repel insect residue the studies have

804  
00:40:07,080 --> 00:40:04,240  
shown that keeping the flow smooth or

805  
00:40:10,200 --> 00:40:07,090  
laminar over a wing can reduce fuel

806  
00:40:12,630 --> 00:40:10,210  
consumption as much as six percent even

807  
00:40:15,120 --> 00:40:12,640  
something as small as a bug on a leading

808  
00:40:18,570 --> 00:40:15,130  
edge can cause turbulent wedges that

809  
00:40:21,620 --> 00:40:18,580  
interrupt laminar flow that results in

810  
00:40:25,020 --> 00:40:21,630  
an increase in drag and fuel consumption

811  
00:40:27,570 --> 00:40:25,030  
engineers at NASA developed and tested a

812  
00:40:30,210 --> 00:40:27,580  
number of nonstick coatings in a small

813  
00:40:32,460 --> 00:40:30,220

wind tunnel back at NASA Langley their

814

00:40:35,160 --> 00:40:32,470

initial findings allowed them to reduce

815

00:40:37,950 --> 00:40:35,170

the number of material from about 20

816

00:40:40,440 --> 00:40:37,960

test samples down to five with these

817

00:40:42,930 --> 00:40:40,450

five best candidates in hand the team

818

00:40:45,270 --> 00:40:42,940

was now ready to place the samples on

819

00:40:47,350 --> 00:40:45,280

the right wing of the Eco demonstrator

820

00:40:50,260 --> 00:40:47,360

for flight validation

821

00:40:52,570 --> 00:40:50,270

the next step was to find the best bug

822

00:40:55,120 --> 00:40:52,580

infested area in which to flight tests

823

00:40:58,780 --> 00:40:55,130

the surfaces after narrowing the list of

824

00:41:01,780 --> 00:40:58,790

90 airports 26 Shreveport Louisiana was

825

00:41:04,900 --> 00:41:01,790

chosen due to its temperature geology

826

00:41:08,680 --> 00:41:04,910

runway size and potential for large

827

00:41:11,440 --> 00:41:08,690

numbers of bugs during 15 planned

828

00:41:13,480 --> 00:41:11,450

flights researchers installed sections

829

00:41:17,620 --> 00:41:13,490

of coatings on to the leading edge slats

830

00:41:19,960 --> 00:41:17,630

of the Eco demonstrator 757 first they

831

00:41:22,720 --> 00:41:19,970

established a baseline using uncoated

832

00:41:25,390 --> 00:41:22,730

surfaces to capture insect accumulation

833

00:41:27,760 --> 00:41:25,400

rates then they remove those sections

834

00:41:30,280 --> 00:41:27,770

and installed samples of the five

835

00:41:32,860 --> 00:41:30,290

treated panels one of the things

836

00:41:35,830 --> 00:41:32,870

engineers were to test is how durable

837

00:41:37,990 --> 00:41:35,840

the coatings are treated surfaces will

838

00:41:40,360 --> 00:41:38,000

only be effective as drag reducers if

839

00:41:43,200 --> 00:41:40,370

they can withstand the harsh flying

840

00:41:46,060 --> 00:41:43,210

environment so what we're doing here is

841

00:41:47,650 --> 00:41:46,070

testing some of the coatings that we

842

00:41:52,180 --> 00:41:47,660

develop to prevent bugs from sticky

843

00:41:54,670 --> 00:41:52,190

craft wings this has been about a five

844

00:41:57,220 --> 00:41:54,680

year effort and we started in the lab

845

00:41:59,200 --> 00:41:57,230

knowing that the problem is that if bugs

846

00:42:02,020 --> 00:41:59,210

stick to aircraft wings you affect the

847

00:42:04,900 --> 00:42:02,030

laminar flow and therefore fuel

848

00:42:07,570 --> 00:42:04,910

efficiency so we've taken samples you

849

00:42:10,540 --> 00:42:07,580

know designs of material coatings from

850

00:42:11,980 --> 00:42:10,550

the lab to wind tunnel tests and we

851  
00:42:14,230 --> 00:42:11,990  
finally have the big test which is

852  
00:42:15,549 --> 00:42:14,240  
testing it on an actual aircraft and so

853  
00:42:18,219 --> 00:42:15,559  
that's what we are here to

854  
00:42:21,209 --> 00:42:18,229  
what we do is we mount our samples onto

855  
00:42:24,880 --> 00:42:21,219  
the wing of one side of the aircraft and

856  
00:42:27,429 --> 00:42:24,890  
we designed the test so that half of the

857  
00:42:29,620 --> 00:42:27,439  
panels are untreated that are mounted

858  
00:42:33,759 --> 00:42:29,630  
and half of them have the surfaces that

859  
00:42:36,489 --> 00:42:33,769  
we are flying and so what we do is have

860  
00:42:38,920 --> 00:42:36,499  
several takeoffs and landings because

861  
00:42:41,170 --> 00:42:38,930  
those sort of parts of the flight

862  
00:42:45,849 --> 00:42:41,180  
profile where you actually accumulate

863  
00:42:49,299 --> 00:42:45,859

bugs and so what we want to do is test

864

00:42:50,829 --> 00:42:49,309

to see if the coatings that we developed

865

00:42:53,229 --> 00:42:50,839

actually reduce the number of bug

866

00:42:54,789 --> 00:42:53,239

strikes that you get and we that's why

867

00:42:56,769 --> 00:42:54,799

we fly together with the untreated

868

00:42:59,799 --> 00:42:56,779

coatings and the reason we're interested

869

00:43:03,069 --> 00:42:59,809

in that is because aircraft is designed

870

00:43:05,529 --> 00:43:03,079

for crews but in order to get the crews

871

00:43:07,900 --> 00:43:05,539

you gotta pass by takeoff and landing

872

00:43:10,059 --> 00:43:07,910

which is when the bugs are going to

873

00:43:12,779 --> 00:43:10,069

accumulate and so you basically negate

874

00:43:16,239 --> 00:43:12,789

the effect of designing the aircraft to

875

00:43:18,309 --> 00:43:16,249

benefit from being in cruise because you

876

00:43:20,319 --> 00:43:18,319

already have the bugs by the time you

877

00:43:22,749 --> 00:43:20,329

get to clean that's why we have to do a

878

00:43:24,459 --> 00:43:22,759

lot of takeoffs and landings because

879

00:43:27,189 --> 00:43:24,469

those are the parts of the flight were

880

00:43:28,959 --> 00:43:27,199

but we actually have the problem what we

881

00:43:30,669 --> 00:43:28,969

hope to accomplish is that the flight

882

00:43:34,719 --> 00:43:30,679

test confirms what we actually saw in

883

00:43:38,859 --> 00:43:34,729

the lab right so we tested over 200

884

00:43:40,749 --> 00:43:38,869

different compositions in the lab in a

885

00:43:42,779 --> 00:43:40,759

small-scale bug gun in the wind tunnel

886

00:43:45,789 --> 00:43:42,789

and actually even in the small aircraft

887

00:43:47,679 --> 00:43:45,799

we've down selected 25 compositions if

888

00:43:50,349 --> 00:43:47,689

any one of those or at least one of

889

00:43:52,359 --> 00:43:50,359

those actually works in practical

890

00:43:54,640 --> 00:43:52,369

application on the aircraft which means

891

00:43:56,739 --> 00:43:54,650

that we've reduced significantly reduce

892

00:43:59,279 --> 00:43:56,749

the number of bugs sticking to the

893

00:44:02,289 --> 00:43:59,289

surface and where they stick is not a

894

00:44:04,870 --> 00:44:02,299

critical location the trip the flow then

895

00:44:07,059 --> 00:44:04,880

it would be a success right this is

896

00:44:08,769 --> 00:44:07,069

actually a long-standing problem we've

897

00:44:09,240 --> 00:44:08,779

seen literature all the way back to the

898

00:44:11,610 --> 00:44:09,250

50

899

00:44:15,600 --> 00:44:11,620

he's trying to solve this problem and so

900

00:44:18,210 --> 00:44:15,610

if we're able to have a solution based

901  
00:44:19,890 --> 00:44:18,220  
on current understanding of what makes

902  
00:44:23,430 --> 00:44:19,900  
things stick and not stick they'll be

903  
00:44:26,370 --> 00:44:23,440  
that the huge success testing also

904  
00:44:29,490 --> 00:44:26,380  
continues on this unique application and

905  
00:44:31,590 --> 00:44:29,500  
early results have shown that the ideas

906  
00:44:34,410 --> 00:44:31,600  
that have been generated may possibly

907  
00:44:37,650 --> 00:44:34,420  
work to reduce bug strikes on future

908  
00:45:05,300 --> 00:44:37,660  
aircraft these are just a few of the

909  
00:45:05,310 --> 00:45:24,830  
you

910  
00:45:31,110 --> 00:45:28,170  
hi I'm Jim Green director of planetary

911  
00:45:33,000 --> 00:45:31,120  
science at NASA you know NASA works with

912  
00:45:36,210 --> 00:45:33,010  
the international science community to

913  
00:45:38,400 --> 00:45:36,220

explore our solar system and beyond we

914

00:45:40,650 --> 00:45:38,410

look to unravel the mysteries that

915

00:45:43,260 --> 00:45:40,660

intrigued us all as we explore and

916

00:45:45,600 --> 00:45:43,270

answer the big questions questions like

917

00:45:49,080 --> 00:45:45,610

how did the earth originated and change

918

00:45:51,780 --> 00:45:49,090

over time how did the solar system begin

919

00:45:54,900 --> 00:45:51,790

and evolve and what will be its destiny

920

00:45:56,700 --> 00:45:54,910

what will be our destiny last July

921

00:46:00,390 --> 00:45:56,710

fourteenth NASA's new Horizons

922

00:46:02,400 --> 00:46:00,400

spacecraft flew past Pluto capping a

923

00:46:06,150 --> 00:46:02,410

half-century of exploration of our solar

924

00:46:08,760 --> 00:46:06,160

system it piqued our interest about what

925

00:46:11,130 --> 00:46:08,770

lies beyond Pluto and what can we learn

926

00:46:15,000 --> 00:46:11,140

about ourselves in the origins of our

927

00:46:17,340 --> 00:46:15,010

solar system the idea of a new planet is

928

00:46:19,770 --> 00:46:17,350

certainly an exciting one for me as a

929

00:46:23,460 --> 00:46:19,780

planetary scientist and I think for all

930

00:46:25,620 --> 00:46:23,470

of us the january twentieth paper in the

931

00:46:28,190 --> 00:46:25,630

astronomical journal is fueling our

932

00:46:31,530 --> 00:46:28,200

interest in planetary exploration and

933

00:46:34,560 --> 00:46:31,540

stimulating a healthy debate that's part

934

00:46:37,410 --> 00:46:34,570

of the scientific process I couldn't be

935

00:46:39,480 --> 00:46:37,420

more pleased about what's happening you

936

00:46:43,040 --> 00:46:39,490

know it's all about starting the process

937

00:46:46,710 --> 00:46:43,050

that could lead to an exciting result it

938

00:46:49,290 --> 00:46:46,720

is not however the detection of a new

939

00:46:51,480 --> 00:46:49,300

planet it's too early to say with

940

00:46:54,780 --> 00:46:51,490

certainty that there's a so called

941

00:46:57,480 --> 00:46:54,790

Planet X out there what we're really

942

00:46:59,720 --> 00:46:57,490

seeing is an early prediction based on

943

00:47:02,880 --> 00:46:59,730

modeling from limited observations

944

00:47:05,850 --> 00:47:02,890

what's exciting is that black NASA's

945

00:47:08,880 --> 00:47:05,860

journey to Mars or New Horizons flyby of

946

00:47:12,260 --> 00:47:08,890

Pluto you will have a front-row seat to

947

00:47:14,940 --> 00:47:12,270

see how the scientific process unfolds

948

00:47:18,540 --> 00:47:14,950

theories like this serve to stimulate

949

00:47:21,870 --> 00:47:18,550

ideas and conversation they tap into our

950

00:47:26,610 --> 00:47:21,880

innate curiosity it's important for us

951  
00:47:29,019 --> 00:47:26,620  
to continue to work and we will anytime

952  
00:47:31,749 --> 00:47:29,029  
we have an interesting idea like

953  
00:47:34,829 --> 00:47:31,759  
this we always apply Carl Sagan's rules

954  
00:47:37,620 --> 00:47:34,839  
for critical thinking which include

955  
00:47:40,799 --> 00:47:37,630  
independent confirmation of the fax

956  
00:47:44,979 --> 00:47:40,809  
looking for alternate explanations and

957  
00:47:48,579 --> 00:47:44,989  
encouraging scientific debate if Planet

958  
00:47:51,519 --> 00:47:48,589  
X is out there we'll find it together or

959  
00:47:55,689 --> 00:47:51,529  
we'll determine an alternate explanation

960  
00:48:29,829 --> 00:47:55,699  
for the data that we've so far now let's

961  
00:48:32,649 --> 00:48:29,839  
go explore samos mrt fisicamente no no

962  
00:48:41,849 --> 00:48:32,659  
Lola pero si tenemos robust an en marte

963  
00:49:16,190 --> 00:48:47,349

aqui mismo en nasa TV lola yo y lola

964

00:49:22,730 --> 00:49:19,630

and determination of men and women

965

00:49:24,920 --> 00:49:22,740

around this nation a journey that set

966

00:49:26,960 --> 00:49:24,930

course from Florida's Space Coast a

967

00:49:32,180 --> 00:49:26,970

journey of real innovators from

968

00:50:54,589 --> 00:49:34,560

hi I'm Neil deGrasse Tyson and you're

969

00:51:01,190 --> 00:50:58,069

this is Mission Control Houston 14 hours

970

00:51:03,259 --> 00:51:01,200

and 58 minutes into the 47th expedition

971

00:51:05,479 --> 00:51:03,269

to the International Space Station new

972

00:51:07,999 --> 00:51:05,489

expedition extending the world's work in

973

00:51:10,339 --> 00:51:08,009

space is underway as the on-orbit

974

00:51:12,769 --> 00:51:10,349

portion of the one-year mission goes

975

00:51:14,870 --> 00:51:12,779

into the record books right now the

976

00:51:18,829 --> 00:51:14,880

International Space Station is flying in

977

00:51:21,440 --> 00:51:18,839

good shape and orbital darkness but 249

978

00:51:24,140 --> 00:51:21,450

miles above the Tasman Sea east of

979

00:51:26,509 --> 00:51:24,150

Sydney Australia it's currently headed

980

00:51:29,779 --> 00:51:26,519

to the northeast for transit across the

981

00:51:32,059 --> 00:51:29,789

Pacific Ocean and should be west of the

982

00:51:35,420 --> 00:51:32,069

coast of Oregon about half an hour from

983

00:51:37,969 --> 00:51:35,430

right now on board the space station the

984

00:51:41,269 --> 00:51:37,979

three crew members are all either off

985

00:51:43,759 --> 00:51:41,279

duty or still asleep they are shifting

986

00:51:46,640 --> 00:51:43,769

their wake sleep cycle back to normal

987

00:51:49,609 --> 00:51:46,650

following the Soyuz undocking operations

988

00:51:51,739 --> 00:51:49,619

that took place on Tuesday the next wake

989

00:51:53,390 --> 00:51:51,749

up alarm it's not actually set to go off

990

00:51:56,870 --> 00:51:53,400

on board the space station until

991

00:52:00,410 --> 00:51:56,880

Thursday morning midnight Houston time

992

00:52:02,839 --> 00:52:00,420

today is the 79th day in space for the

993

00:52:05,299 --> 00:52:02,849

expedition forty seven crew members nasa

994

00:52:07,489 --> 00:52:05,309

astronaut tim kopra now the commander of

995

00:52:09,620 --> 00:52:07,499

the space station joined by flight

996

00:52:12,289 --> 00:52:09,630

engineers a yuri malenchenko of ros

997

00:52:15,170 --> 00:52:12,299

cosmos and tim peake of the european

998

00:52:16,370 --> 00:52:15,180

space agency they've been in space since

999

00:52:18,999 --> 00:52:16,380

their launch from the Baikonur

1000

00:52:23,120 --> 00:52:19,009

cosmodrome on back on December 15th

1001  
00:52:28,370 --> 00:52:23,130  
expedition 47 will extend into early

1002  
00:52:30,680 --> 00:52:28,380  
June right now the International Space

1003  
00:52:33,440 --> 00:52:30,690  
Station flight control room is the home

1004  
00:52:36,039 --> 00:52:33,450  
for operations of the orbit 2 team of

1005  
00:52:38,120 --> 00:52:36,049  
flight controllers a team that is

1006  
00:52:40,729 --> 00:52:38,130  
standing by keeping track of the

1007  
00:52:42,499 --> 00:52:40,739  
operation of stations systems and will

1008  
00:52:45,039 --> 00:52:42,509  
be ready to work with the crew members

1009  
00:52:47,900 --> 00:52:45,049  
if anything comes up for them today

1010  
00:52:50,779 --> 00:52:47,910  
flight director Zeb Scoville is in

1011  
00:52:53,479 --> 00:52:50,789  
charge of the team today no spacecraft

1012  
00:52:56,630 --> 00:52:53,489  
communicator is currently at the console

1013  
00:53:01,190 --> 00:52:56,640

since the crew members are technically

1014

00:53:04,609 --> 00:53:01,200

are asleep it has been a quiet day in

1015

00:53:05,809 --> 00:53:04,619

flight control room 1 today after a very

1016

00:53:08,449 --> 00:53:05,819

busy day and

1017

00:53:11,539 --> 00:53:08,459

evening yesterday that saw the end of

1018

00:53:13,430 --> 00:53:11,549

expedition 46 the safe landing of the

1019

00:53:16,579 --> 00:53:13,440

Soyuz spacecraft with three crew members

1020

00:53:20,269 --> 00:53:16,589

on board and the final hours on orbit of

1021

00:53:22,910 --> 00:53:20,279

a 340 day flight by nasa astronaut scott

1022

00:53:25,459 --> 00:53:22,920

kelly and Roscosmos cosmonaut mikhail

1023

00:53:27,859 --> 00:53:25,469

kornienko it's the longest flight ever

1024

00:53:30,259 --> 00:53:27,869

by crew members on the International

1025

00:53:43,920 --> 00:53:30,269

Space Station we pick up the story on

1026  
00:53:48,930 --> 00:53:46,800  
and some quick words from the soyuz

1027  
00:53:50,970 --> 00:53:48,940  
commander Sergei Volkov who's bringing

1028  
00:53:52,800 --> 00:53:50,980  
the 21 year crewmembers home first and

1029  
00:53:55,050 --> 00:53:52,810  
then you're a Melungeon code there on

1030  
00:53:57,690 --> 00:53:55,060  
the left just also offering his

1031  
00:53:59,550 --> 00:53:57,700  
congratulations in his thanks to the

1032  
00:54:01,650 --> 00:53:59,560  
three getting ready to depart the

1033  
00:54:05,820 --> 00:54:01,660  
International Space Station again Scott

1034  
00:54:08,310 --> 00:54:05,830  
Kelly Mikhail Kornienko wrapping up 340

1035  
00:54:11,160 --> 00:54:08,320  
days onboard the orbiting laboratory for

1036  
00:54:13,650 --> 00:54:11,170  
Sergei Volkov 181 he's going to be

1037  
00:54:15,630 --> 00:54:13,660  
commanding the Soyuz craft through

1038  
00:54:19,410 --> 00:54:15,640

tonight's activities and the descent

1039

00:54:21,330 --> 00:54:19,420

back down to earth but I definitely a

1040

00:54:23,310 --> 00:54:21,340

pretty significant moment for the

1041

00:54:24,240 --> 00:54:23,320

departing year-long crew members who

1042

00:54:27,090 --> 00:54:24,250

have been on board the International

1043

00:54:30,480 --> 00:54:27,100

Space Station since March 27th of last

1044

00:54:31,860 --> 00:54:30,490

year so obviously very big steps for

1045

00:54:35,190 --> 00:54:31,870

them to now depart what's been their

1046

00:54:37,650 --> 00:54:35,200

home for the last roughly 12 months and

1047

00:54:40,410 --> 00:54:37,660

I get ready to make their way back down

1048

00:54:59,420 --> 00:54:40,420

to earth its gravity their families and

1049

00:55:06,380 --> 00:55:02,569

sergey volkov doing one final wipe down

1050

00:55:40,870 --> 00:55:06,390

of the sealing ring around the soyuz

1051  
00:55:50,749 --> 00:55:46,099  
to do with you to 40 60 and undocking

1052  
00:55:54,890 --> 00:55:50,759  
has occurred 702 p.m. central time say

1053  
00:55:57,079 --> 00:55:54,900  
80 2 p.m. eastern time while the station

1054  
00:56:03,170 --> 00:55:57,089  
is flying just over the eastern part of

1055  
00:56:05,120 --> 00:56:03,180  
Mongolia so so use tm2f and I'm the

1056  
00:56:07,759 --> 00:56:05,130  
International Space Station the

1057  
00:56:15,459 --> 00:56:07,769  
California coast kelly sergei volkov on

1058  
00:56:17,420 --> 00:56:15,469  
their way home c7 is illuminated copy

1059  
00:56:18,979 --> 00:56:17,430  
quarterly the visiting vehicle officer

1060  
00:56:21,439 --> 00:56:18,989  
here in Houston getting confirmation

1061  
00:56:24,410 --> 00:56:21,449  
everything went well with that second

1062  
00:56:26,630 --> 00:56:24,420  
separation burn soyuz tma etm with a

1063  
00:56:28,759 --> 00:56:26,640

one-year crew on board now departing the

1064

00:56:31,519 --> 00:56:28,769

area of the International Space Station

1065

00:56:34,309 --> 00:56:31,529

ok ok you can see the orbiting

1066

00:56:36,920 --> 00:56:34,319

laboratory in full view from the camera

1067

00:56:38,809 --> 00:56:36,930

on board the Soyuz craft which again

1068

00:56:40,640 --> 00:56:38,819

undock from the space facing side so

1069

00:56:45,439 --> 00:56:40,650

getting a great look straight down at

1070

00:56:48,829 --> 00:56:45,449

the station in the earth below both

1071

00:56:52,209 --> 00:56:48,839

spacecraft right now just over the very

1072

00:56:57,529 --> 00:56:52,219

far eastern part of Russia about the

1073

00:57:02,070 --> 00:56:57,539

well north of the Sea of Japan s 18 is

1074

00:57:08,920 --> 00:57:06,100

and this was what we were waiting for we

1075

00:57:12,010 --> 00:57:08,930

actually have replays now of the Soyuz

1076  
00:57:14,650 --> 00:57:12,020  
spacecraft as it was under parachute

1077  
00:57:16,810 --> 00:57:14,660  
these this view coming from one of the

1078  
00:57:18,880 --> 00:57:16,820  
Russian mi-8 helicopters which was

1079  
00:57:21,070 --> 00:57:18,890  
circling the landing zone waiting for

1080  
00:57:23,859 --> 00:57:21,080  
the Soyuz craft to descend and here you

1081  
00:57:26,710 --> 00:57:23,869  
can see it this a replay from just under

1082  
00:57:29,109 --> 00:57:26,720  
an hour ago as the Soyuz spacecraft was

1083  
00:57:31,090 --> 00:57:29,119  
descending under parachute you can see

1084  
00:57:34,030 --> 00:57:31,100  
the thick cloud cover in the overcast

1085  
00:57:36,580 --> 00:57:34,040  
sky but a beautiful light the Soyuz

1086  
00:57:42,190 --> 00:57:36,590  
landing just a few hours after sunrise

1087  
00:57:44,200 --> 00:57:42,200  
in Kazakhstan this again a recorded view

1088  
00:58:01,070 --> 00:57:44,210

from one of the Russian search and

1089

00:58:06,890 --> 00:58:04,400

and so at this stage the Soyuz capsule

1090

00:58:09,350 --> 00:58:06,900

was well under its main parachute a

1091

00:58:11,480 --> 00:58:09,360

massive parachute designed to slow the

1092

00:58:14,810 --> 00:58:11,490

Soyuz down from the descent rate of 80

1093

00:58:17,690 --> 00:58:14,820

meters per second to just 7.2 the

1094

00:58:21,770 --> 00:58:17,700

parachutes being initially opened at an

1095

00:58:24,130 --> 00:58:21,780

altitude of about 6.6 miles you can see

1096

00:58:26,450 --> 00:58:24,140

the capsule descends upright

1097

00:58:28,250 --> 00:58:26,460

occasionally we'll land and roll over on

1098

00:58:31,250 --> 00:58:28,260

its side but in this case the capsule

1099

00:58:36,770 --> 00:58:31,260

landed upright so made things easy for

1100

00:58:43,250 --> 00:58:38,840

and then they're helping them down this

1101

00:58:46,070 --> 00:58:43,260

little slide a ladder if you will he'll

1102

00:58:48,260 --> 00:58:46,080

be carried into the center seat of the

1103

00:58:50,390 --> 00:58:48,270

three comfortable chairs that are set up

1104

00:58:58,290 --> 00:58:50,400

in front of the cameras you'll be

1105

00:59:03,430 --> 00:59:01,630

and the recovery person held now

1106

00:59:05,560 --> 00:59:03,440

bringing sergei volkov to the center

1107

00:59:08,440 --> 00:59:05,570

seat as you know he was launched back in

1108

00:59:11,650 --> 00:59:08,450

September with a visiting crew cause a

1109

00:59:13,720 --> 00:59:11,660

cosmonaut and a Danish astronaut who

1110

00:59:15,550 --> 00:59:13,730

spent a short time aboard the

1111

00:59:23,850 --> 00:59:15,560

International Space Station please don't

1112

00:59:27,300 --> 00:59:23,860

stand in front of the camera scott kelly

1113

00:59:32,410 --> 00:59:27,310

scott kelly back on mother earth after

1114

00:59:35,470 --> 00:59:32,420

340 days in space dance thumbs up we got

1115

00:59:37,360 --> 00:59:35,480

a great view of him now the folks here

1116

00:59:40,630 --> 00:59:37,370

in Mission Control Houston letting out a

1117

00:59:43,590 --> 00:59:40,640

very big cheer Scott Kelly as you just

1118

00:59:46,750 --> 00:59:43,600

said returned after 340 days in space

1119

00:59:48,790 --> 00:59:46,760

NASA's one year crewmember conducted a

1120

00:59:51,310 --> 00:59:48,800

lot of very important research back down

1121

00:59:53,080 --> 00:59:51,320

on mother earth back down in Kazakhstan

1122

01:00:01,180 --> 00:59:53,090

where he launched from just about 12

1123

01:00:03,790 --> 01:00:01,190

months ago over here please and we're

1124

01:00:05,680 --> 01:00:03,800

seeing a big smile from scott kelly

1125

01:00:08,350 --> 01:00:05,690

there you can see just to his right

1126  
01:00:11,980 --> 01:00:08,360  
Steve Gilmore Scott's prime flight

1127  
01:00:14,500 --> 01:00:11,990  
surgeon for his urine space no stranger

1128  
01:00:17,050 --> 01:00:14,510  
to cold landings in Kazakhstan this is

1129  
01:00:21,880 --> 01:00:17,060  
his fourth mission as second landing in

1130  
01:00:25,240 --> 01:00:21,890  
osoyoos 520 total days in space across

1131  
01:00:29,500 --> 01:00:25,250  
his spaceflight career 340 days in this

1132  
01:00:31,780 --> 01:00:29,510  
historic here in space and then Scott

1133  
01:00:33,730 --> 01:00:31,790  
just looked at us and said the air feels

1134  
01:00:38,170 --> 01:00:33,740  
great out here I have no idea what you

1135  
01:00:42,650 --> 01:00:40,820  
with temperatures hovering right around

1136  
01:00:44,750 --> 01:00:42,660  
freezing I imagined you guys are

1137  
01:00:47,090 --> 01:00:44,760  
thankful for your jackets but for

1138  
01:00:48,830 --> 01:00:47,100

somebody who hasn't had the breeze on

1139

01:00:52,570 --> 01:00:48,840

his face for almost a year I bet it

1140

01:00:58,220 --> 01:00:55,640

and back over at the capsule we can see

1141

01:01:00,380 --> 01:00:58,230

me Kyle Kornienko the other one year

1142

01:01:03,170 --> 01:01:00,390

crew member outside the capsule getting

1143

01:01:12,350 --> 01:01:03,180

ready to get carried over as well you

1144

01:01:15,080 --> 01:01:12,360

aren't for Mission Control and Dan Kelly

1145

01:01:18,230 --> 01:01:15,090

absolutely relishing the fresh air out

1146

01:01:21,860 --> 01:01:18,240

here in the mid morning hours here in

1147

01:01:23,690 --> 01:01:21,870

southern steppe of Kazakhstan breathing

1148

01:01:29,480 --> 01:01:23,700

deeply enjoying every second of his

1149

01:01:31,610 --> 01:01:29,490

return to work and we just saw Mikhail

1150

01:01:33,470 --> 01:01:31,620

Kornienko go down the slide he's getting

1151

01:01:36,470 --> 01:01:33,480

carried over so he'll be joining you

1152

01:01:39,140 --> 01:01:36,480

shortly as well so without all three

1153

01:01:41,960 --> 01:01:39,150

crew members out of the Soyuz capsule

1154

01:01:45,880 --> 01:01:41,970

safely down there on the step and

1155

01:01:51,080 --> 01:01:45,890

Kazakhstan your mission guys I'm fine

1156

01:01:54,270 --> 01:01:51,090

how'd you do it yeah the deal didn't old

1157

01:02:00,760 --> 01:01:57,760

waku movie and then the very Swift work

1158

01:02:04,120 --> 01:02:00,770

made by the energy of folks sergei

1159

01:02:06,490 --> 01:02:04,130

volkov just a few feet away from me his

1160

01:02:09,580 --> 01:02:06,500

father is kneeling down right next to

1161

01:02:13,000 --> 01:02:09,590

him what a picture that is father and

1162

01:02:16,060 --> 01:02:13,010

son cosmonaut heritage that has been

1163

01:02:17,740 --> 01:02:16,070

several decades of Russian space history

1164

01:02:23,320 --> 01:02:17,750

everything as we taught as we were

1165

01:02:25,960 --> 01:02:23,330

taught and we just had a great view of

1166

01:02:30,010 --> 01:02:25,970

that saw Scott Kelly with a satellite

1167

01:02:32,920 --> 01:02:30,020

phone in his hand assuming making that

1168

01:02:35,650 --> 01:02:32,930

call to friends and family eagerly

1169

01:02:41,650 --> 01:02:35,660

awaiting his return here to Houston just

1170

01:02:43,240 --> 01:02:41,660

about 24 hours away or so from now a lot

1171

01:02:47,080 --> 01:02:43,250

of smiles from all three crew members

1172

01:02:49,930 --> 01:02:47,090

now safely out of that Soyuz vehicle oh

1173

01:02:54,460 --> 01:02:49,940

you see just let me go to sauna down

1174

01:02:58,060 --> 01:02:54,470

here yeah then I can fly again Alexander

1175

01:03:06,710 --> 01:02:58,070

hello twice he would review they please

1176  
01:03:12,570 --> 01:03:11,310  
yeah right now we're looking at Mikhail

1177  
01:03:16,320 --> 01:03:12,580  
Kornienko and the other crew members

1178  
01:03:18,150 --> 01:03:16,330  
where you can see the various flight

1179  
01:03:19,950 --> 01:03:18,160  
surgeons and nurses out there with the

1180  
01:03:21,480 --> 01:03:19,960  
search and recovery forces of fixing the

1181  
01:03:23,430 --> 01:03:21,490  
number of devices just to get those

1182  
01:04:18,829 --> 01:03:23,440  
initial medical readings from the crew

1183  
01:04:24,630 --> 01:04:21,749  
chairman of the state condition the

1184  
01:04:27,229 --> 01:04:24,640  
Soyuz crew is here the flight program

1185  
01:05:06,490 --> 01:04:27,239  
has been fully executed glad to report

1186  
01:05:06,500 --> 01:06:07,020  
welcome home

1187  
01:06:14,170 --> 01:06:10,480  
those last scenes we saw Sergei Volkov

1188  
01:06:18,339 --> 01:06:14,180

and Mikhail Kornienko returning to the

1189

01:06:20,740 --> 01:06:18,349

airfield in Star City getting back to to

1190

01:06:24,339 --> 01:06:20,750

their home being greeted by many fellow

1191

01:06:27,339 --> 01:06:24,349

cosmonauts their family Scott Kelly is

1192

01:06:29,760 --> 01:06:27,349

an route home to he is on the NASA

1193

01:06:32,530 --> 01:06:29,770

aircraft and route back to Houston and

1194

01:06:34,300 --> 01:06:32,540

currently expected to land at ellington

1195

01:06:37,510 --> 01:06:34,310

airport near the Johnson Space Center

1196

01:06:40,300 --> 01:06:37,520

about nine-thirty central time tonight

1197

01:06:42,849 --> 01:06:40,310

the nasa TV coverage will provide live

1198

01:06:45,609 --> 01:06:42,859

coverage of scott Kelly's home coming

1199

01:06:47,829 --> 01:06:45,619

into houston tonight we expect to go on

1200

01:06:51,010 --> 01:06:47,839

the air about nine-fifteen central time

1201

01:06:53,829 --> 01:06:51,020

this evening we also have two news

1202

01:06:57,040 --> 01:06:53,839

briefings scheduled for friday afternoon

1203

01:06:59,109 --> 01:06:57,050

at noon central time on friday we'll

1204

01:07:01,390 --> 01:06:59,119

have a discussion of the science of the

1205

01:07:03,730 --> 01:07:01,400

one-year mission and the twins study

1206

01:07:06,520 --> 01:07:03,740

with space station program chief

1207

01:07:09,150 --> 01:07:06,530

scientist Julie Robinson human research

1208

01:07:11,740 --> 01:07:09,160

program chief scientist John Charles and

1209

01:07:13,839 --> 01:07:11,750

former astronaut Mark Kelly Scott

1210

01:07:16,839 --> 01:07:13,849

Kelley's brother who participated in the

1211

01:07:19,150 --> 01:07:16,849

twins study at a one o'clock on Friday

1212

01:07:20,950 --> 01:07:19,160

Scott Kelly will be on hand to talk

1213

01:07:31,140 --> 01:07:20,960

about his mission and to answer

1214

01:07:36,000 --> 01:07:33,690

how much of the research is conducted

1215

01:07:38,850 --> 01:07:36,010

for the one-year mission of scott kelly

1216

01:07:41,460 --> 01:07:38,860

and mikhail kornienko focuses on how the

1217

01:07:43,680 --> 01:07:41,470

human body reacts to being in the

1218

01:07:46,140 --> 01:07:43,690

microgravity environment of space over

1219

01:07:48,090 --> 01:07:46,150

an extended period of time over the next

1220

01:07:49,380 --> 01:07:48,100

few weeks space station live will

1221

01:07:51,720 --> 01:07:49,390

highlight several of those

1222

01:07:53,460 --> 01:07:51,730

investigations my colleague Lori Meggs

1223

01:07:55,620 --> 01:07:53,470

is at the payload operations integration

1224

01:07:57,810 --> 01:07:55,630

Center at NASA's Marshall Space Flight

1225

01:08:02,760 --> 01:07:57,820

Center in Huntsville Alabama with more

1226

01:08:04,950 --> 01:08:02,770

more Lori good morning Scott Kelly may

1227

01:08:07,620 --> 01:08:04,960

be back on earth but when it comes to