



Niki Werkheiser

3-D Printing in Zero G Project Manager

NASA



1
00:00:03,019 --> 00:00:04,044
I everybody and

2
00:00:04,044 --> 00:00:09,137
welcome to our live Q&A discussion with
nasa and made a space regarding

3
00:00:10,037 --> 00:00:13,226
three-person space my name's Adam and
I'm

4
00:00:13,559 --> 00:00:16,085
the space physics reporter here at Wired
Science

5
00:00:16,085 --> 00:00:21,121
any pupil California and we've got that
much people here who are ready to take

6
00:00:22,021 --> 00:00:22,028
your

7
00:00:22,091 --> 00:00:27,107
questions and this discussion so why
don't we go ahead and

8
00:00:28,007 --> 00:00:31,033
and introduce ourselves and we'll start
over on the left

9
00:00:31,033 --> 00:00:35,087
I most box with their furniture want to
tell us name and and what you

10
00:00:35,087 --> 00:00:39,114
hi I'm on the chart a and I work for
nasa space technology Mission

11
00:00:40,014 --> 00:00:40,022

Directorate

12

00:00:40,094 --> 00:00:43,169
and I am one of my principal
investigators first best space

13

00:00:44,069 --> 00:00:44,153
technology

14

00:00:45,053 --> 00:00:48,089
responsible for advanced manufacturing
so we're

15

00:00:48,089 --> 00:00:53,125
rents cited about heart go quite yet and
then we've got to keep on

16

00:00:54,025 --> 00:01:00,116
sorry about that and of you'll be
hearing from Nikki soon and

17

00:01:01,016 --> 00:01:05,064
chandler's almost from a birthday about
was great effort that we will be

18

00:01:05,064 --> 00:01:05,153
launching

19

00:01:06,053 --> 00:01:09,110
on the summer 2014 all at all

20

00:01:10,001 --> 00:01:13,630
treat a I work for nasa space technology
Mission Directorate

21

00:01:13,729 --> 00:01:17,793
and I am 10 I am principal investigators
first best space technology

22

00:01:18,369 --> 00:01:21,094
responsible for expanding not sure I am
though we're

23
00:01:21,094 --> 00:01:26,108
cited our partner for

24
00:01:27,008 --> 00:01:31,083
sorry about that I

25
00:01:31,083 --> 00:01:34,108
you'll be hearing from Nikki's an
admission I

26
00:01:35,008 --> 00:01:39,042
ask her space about it's great effort
that we will be launching

27
00:01:39,042 --> 00:01:43,381
on the summer 2014 on church

28
00:01:43,759 --> 00:01:49,049
fast out struck first

29
00:01:49,049 --> 00:01:53,050
space technology or act right

30
00:01:53,059 --> 00:02:00,059
oh yeah signing not our for West

31
00:02:01,059 --> 00:02:04,071
they know who I am I

32
00:02:04,071 --> 00:02:10,162
joke asking fernbank

33
00:02:11,062 --> 00:02:14,068
of che on the summer transport as

34

00:02:14,068 --> 00:02:18,094

such fast

35

00:02:18,094 --> 00:02:23,125

first scotch

36

00:02:24,025 --> 00:02:31,025

I track for I

37

00:02:35,083 --> 00:02:38,109

for she

38

00:02:39,009 --> 00:02:42,098

suck

39

00:02:42,098 --> 00:02:45,120

Park Koch side

40

00:02:46,002 --> 00:02:49,047

mom anything you have to just send a
message everything

41

00:02:49,065 --> 00:02:53,124

I don't have any opal alright well

42

00:02:53,709 --> 00:02:58,036

a we can land a rover on Mars but
sometimes obstetrical care with a

43

00:02:58,036 --> 00:03:02,135

I'm sorry about that there was a a
little its grip on our site

44

00:03:02,459 --> 00:03:05,053

I'm Jimmy keep going with

45

00:03:05,053 --> 00:03:08,067

with my friends tell us a bit about

yourself share

46

00:03:08,067 --> 00:03:11,122

an hour tried only say it once here a

47

00:03:12,022 --> 00:03:15,097

are you get every think that's good
alright see I'm

48

00:03:15,097 --> 00:03:18,148

I Mike Chen I am what color banners made
in space

49

00:03:19,048 --> 00:03:22,089

I am helped to found the company in 2010

50

00:03:22,089 --> 00:03:25,104

and I wear that where basically making
the first

51

00:03:26,004 --> 00:03:29,087

3d printer that will be going to space
in manufacturing first objects

52

00:03:29,087 --> 00:03:34,108

are the service in the air later this
year call

53

00:03:35,008 --> 00:03:39,008

and Nikki

54

00:03:39,008 --> 00:03:44,002

I a rhyme make you work either on the
math project manager

55

00:03:44,002 --> 00:03:47,088

for their 3d printing and theory giss
technology demonstration

56

00:03:48,006 --> 00:03:53,265
as many mentioned it'll be watching on
space explorer in August anti-yeltsin 14

57
00:03:53,319 --> 00:03:54,000
anger barry

58
00:03:54,000 --> 00:03:58,239
it is be the first 3d printer ever and
launched into space

59
00:03:58,239 --> 00:04:01,045
and black it's great riding guide to be

60
00:04:01,045 --> 00:04:06,194
excellent I and just a reminder for
anybody who's watching you can now

61
00:04:06,599 --> 00:04:11,033
go to our Google+ Kate there should be a
link below this screen and ask us any

62
00:04:11,033 --> 00:04:12,101
questions during the Q&A will try and

63
00:04:13,001 --> 00:04:16,043
field as many of them as we can from
that and groupware

64
00:04:16,043 --> 00:04:20,242
I maybe to start off with just say get
the ball rolling here

65
00:04:20,629 --> 00:04:23,077
I'm 3d printers are really cool

66
00:04:23,077 --> 00:04:28,126
there upgrade fantastic new technology I
but maybe Mike you wanna start it up and

67

00:04:28,819 --> 00:04:28,891

tell us

68

00:04:29,539 --> 00:04:33,591

why I am weak we would want to send one
into space yeah it's a it's a great

69

00:04:34,059 --> 00:04:34,065

question

70

00:04:34,065 --> 00:04:37,136

and really even talk about it for the
whole time here but

71

00:04:38,036 --> 00:04:41,545

as to why wife and it really better
space on

72

00:04:41,869 --> 00:04:45,877

you never really like originally I years
ago and

73

00:04:45,949 --> 00:04:48,099

company started the idea actually arose

74

00:04:48,099 --> 00:04:51,518

from talking to you Danbury that three
time after not

75

00:04:52,409 --> 00:04:55,068

and he's been up there a few times and
I'm

76

00:04:55,068 --> 00:04:58,757

claim a 3d printers down here and really
just observing

77

00:04:59,369 --> 00:05:02,385

how useful it would be to be able to

have

78

00:05:02,529 --> 00:05:05,621
objects clinton to space without
actually having to watch them

79

00:05:06,449 --> 00:05:10,453
and so at the end of the day that's
really what it boils down to is it boils

80

00:05:10,849 --> 00:05:10,920
down to

81

00:05:11,559 --> 00:05:14,584
being able to actually put objects in
space without

82

00:05:14,809 --> 00:05:17,893
having to deal with that slow expensive
complex

83

00:05:18,649 --> 00:05:21,716
risky business rockets what if you could
just put a file

84

00:05:22,319 --> 00:05:27,337
directly on the computer and printer in
space minutes later so it'd be something

85

00:05:27,499 --> 00:05:27,596
they would use

86

00:05:28,469 --> 00:05:32,055
a maybe like in an emergency situation
or if there was something that was going

87

00:05:32,055 --> 00:05:34,724
to run a public space station

88

00:05:35,219 --> 00:05:38,024

you absolutely would I'm the one thing
that we

89

00:05:38,024 --> 00:05:41,029

we've looked at a lot is how we would be
able to be ready for situations like

90

00:05:41,074 --> 00:05:41,963

that

91

00:05:42,629 --> 00:05:46,099

they are whenever favorite for example
the party apollo thirteen example

92

00:05:46,099 --> 00:05:50,678

where they had to you basically a square
peg into a round hole in our to save

93

00:05:51,569 --> 00:05:56,046

yes not lives and they were able to rate
together a solution just had a base

94

00:05:56,046 --> 00:05:59,095

what they had up there at the time is
very fortunate

95

00:05:59,509 --> 00:06:02,574

I'm we actually have whatever interns
use that

96

00:06:03,159 --> 00:06:07,086

Autodesk software to cada a solution it
would also work in the parking situation

97

00:06:07,086 --> 00:06:08,105

printed

98

00:06:08,879 --> 00:06:11,888

on why the printers in our lab and did

the whole thing into

99

00:06:11,969 --> 00:06:15,083

in this matter hours at now he's hired
obviously

100

00:06:15,083 --> 00:06:18,222

I'm but yeah I could definitely be used
for emergency situations but there's

101

00:06:18,969 --> 00:06:19,981

really a whole

102

00:06:20,089 --> 00:06:23,162

wide range other things you can use it
for science experiments

103

00:06:23,819 --> 00:06:28,826

I hate space exploration commercial
satellite projects Israeli

104

00:06:28,889 --> 00:06:32,008

the list just goes on a I'm wondering

105

00:06:32,008 --> 00:06:35,317

perennial you actually haven't this I
love this partnership

106

00:06:35,389 --> 00:06:39,003

I get started who reached out to whose
idea was it

107

00:06:39,003 --> 00:06:43,402

but a 3d printer in space

108

00:06:43,699 --> 00:06:46,786

on yet Nikki and I want to talk a little
bit about that now there's been some

109

00:06:47,569 --> 00:06:48,049

work going on

110

00:06:48,049 --> 00:06:52,086

at Marshall for a while now I since
actually even before we

111

00:06:52,086 --> 00:06:55,111

began developing this printer a
Marshalls really been

112

00:06:56,011 --> 00:06:59,250

ahead of the game on that and so that's
why we're working with marcia maybe

113

00:06:59,349 --> 00:07:00,392

Nikki wants to talk about

114

00:07:00,779 --> 00:07:03,788

that our yes I'd be happy to you

115

00:07:03,869 --> 00:07:06,888

so actually in 1999 and one of our

116

00:07:07,059 --> 00:07:10,107

prince will medicare here can keeper
actually flew at 3d printer

117

00:07:10,539 --> 00:07:14,074

mind at repair bike lights
affectionately known as the vomit comet

118

00:07:14,074 --> 00:07:18,303

and detest act bentsen for Estes feels
like it's been a long time coming

119

00:07:18,969 --> 00:07:22,015

and as as you know and space station at
BN has been built for

120

00:07:22,429 --> 00:07:25,486

for quite some time in and out we've
been excited about getting this up as an

121

00:07:25,999 --> 00:07:27,043

actual payload

122

00:07:27,439 --> 00:07:30,439

and mainstay for NAFTA have flown
Espiritu the pair by

123

00:07:30,439 --> 00:07:34,003

flights to you test in microgravity just
to make sure that the prince would

124

00:07:34,003 --> 00:07:35,152

actually be at Wild

125

00:07:35,449 --> 00:07:38,496

earth quality prints like we do on the
ground but you can only get the short

126

00:07:38,919 --> 00:07:39,991

spurts and microgravity

127

00:07:40,639 --> 00:07:43,675

when you're on the parabolic flight so
this will be the first time and space we

128

00:07:43,999 --> 00:07:46,004

can actually complete an entire print

129

00:07:46,499 --> 00:07:50,077

and in microgravity so that's why we
caught a technology demonstration at the

130

00:07:50,077 --> 00:07:51,152

very first step to ensure that

131

00:07:52,052 --> 00:07:55,851

in the microgravity environment at the process is the same there are no

132

00:07:56,319 --> 00:07:57,353

surprises

133

00:07:57,659 --> 00:08:00,684

and that that we changed and the quality of the print

134

00:08:00,909 --> 00:08:04,003

and we feel quite confident that that will be I it will be equitable do what

135

00:08:04,003 --> 00:08:05,072

we do on the ground

136

00:08:05,369 --> 00:08:08,430

based on the parabolic flights yes we've been doing this for quite some time

137

00:08:08,979 --> 00:08:12,047

and we feel like there are many many uses a quick emergency case comes up

138

00:08:12,659 --> 00:08:15,703

like that kind of the exciting case but there's also the standard every day

139

00:08:16,099 --> 00:08:20,128

and people after they bakery will talk sometimes a battle losing a toll on

140

00:08:20,389 --> 00:08:21,421

space station you know what

141

00:08:21,709 --> 00:08:24,714

comments like how could you leave

something it's the space station where

142

00:08:24,759 --> 00:08:25,793

could it possibly go

143

00:08:26,099 --> 00:08:28,193

but if you're like me have lived in a
house for a few years back of it if he

144

00:08:29,039 --> 00:08:30,081

got my copy all seeking

145

00:08:30,459 --> 00:08:33,061

easily leads things and it contained
aren't and

146

00:08:33,061 --> 00:08:37,087

small parts especially tender flight of
English sect and by the filters

147

00:08:37,087 --> 00:08:40,296

you can imagine it home I drop something
also the floor I know where to look for

148

00:08:41,079 --> 00:08:42,150

it an idiot lights off

149

00:08:42,789 --> 00:08:47,047

on space station then its activities
filters never to be seen again so

150

00:08:47,047 --> 00:08:50,141

is water loss parts broken parts that
they have to find multiple spares

151

00:08:51,041 --> 00:08:55,390

order that take up a lot a mass and so
there are a lot of even everyday type

152

00:08:55,759 --> 00:08:59,074
activities with science in payloads and
crew tools

153
00:08:59,074 --> 00:09:02,533
and things like that that this will be a
great capability for

154
00:09:03,199 --> 00:09:07,043
I can I am 30 prep project as a as a

155
00:09:07,043 --> 00:09:12,066
great example of cooperation between
nasa mission directorate's as well

156
00:09:12,066 --> 00:09:16,475
as industry um this is a collaboration
between

157
00:09:17,069 --> 00:09:21,005
a space technician director as well as
our human exploration operations Mission

158
00:09:21,005 --> 00:09:21,654
Directorate

159
00:09:22,149 --> 00:09:25,192
which houses are I S s and our a yes

160
00:09:25,579 --> 00:09:28,616
programs which are also investing in Aus
and

161
00:09:28,949 --> 00:09:32,013
made in space um initial work out with
our

162
00:09:32,589 --> 00:09:37,592
quite Opportunity Program but they also
have a reset contract under our SBIR

163

00:09:37,889 --> 00:09:39,953

program so it's a really great example

164

00:09:40,529 --> 00:09:44,597

up how nasa comes together with industry
and %uh something really great

165

00:09:45,209 --> 00:09:49,251

both on the technology side and
operations side

166

00:09:49,629 --> 00:09:52,636

or hour and nikki is that a is that a
3d-printed

167

00:09:52,699 --> 00:09:57,012

first got here and there yes I wanted to
cut a kinda show apart here that it may

168

00:09:57,012 --> 00:09:58,100

not look super exciting and it

169

00:09:59,000 --> 00:10:02,043

people say what can you print what can
you do you think and something like this

170

00:10:02,043 --> 00:10:06,008

at it's kinda like unit it doesn't look
that exciting person but it is and this

171

00:10:06,008 --> 00:10:07,070

for example is a part

172

00:10:08,042 --> 00:10:12,461

with their filter extraction tool for
believe that we have on space station

173

00:10:12,839 --> 00:10:16,912

and a couple years ago it got lost on
space station and the filters had

174

00:10:17,569 --> 00:10:20,062
expired the certification for using at
facility

175

00:10:20,062 --> 00:10:23,086
and the crew can't use that facility
there are several of our science

176

00:10:23,086 --> 00:10:26,173
payloads I think it was 6-for-8 my aunts
they had to wait for that the next watch

177

00:10:27,073 --> 00:10:28,622
to launch at this little

178

00:10:29,279 --> 00:10:32,353
filter extraction tool we literally
could have uplink this piled space

179

00:10:33,019 --> 00:10:33,081
station

180

00:10:33,639 --> 00:10:36,097
and and had it printed with and saying
hour turnaround

181

00:10:36,097 --> 00:10:39,146
you can imagine the number hours and
days that

182

00:10:40,019 --> 00:10:43,036
that we were down at fidelity the
science that we didn't get to do

183

00:10:43,189 --> 00:10:46,054
i'm for lack of having this kind of
capability so I just wanted to show this

184

00:10:46,054 --> 00:10:47,061

is just gonna stand

185

00:10:47,061 --> 00:10:50,075

some fun parts and real-life real use

186

00:10:50,075 --> 00:10:53,110

at parts that we can get and that
they're quite quickly and in another

187

00:10:54,001 --> 00:10:55,014

reason we think act

188

00:10:55,023 --> 00:10:59,097

astronauts are pretty excited yeah like
you said it I guess it so it is kinda

189

00:10:59,097 --> 00:11:00,098

mundane but

190

00:11:00,098 --> 00:11:03,161

up really necessary

191

00:11:04,061 --> 00:11:08,086

exactly yeah on so we have to ask
questions here

192

00:11:08,086 --> 00:11:11,675

RAM are audience the first one is prime
fernando sanchez

193

00:11:12,449 --> 00:11:15,507

I D Evan I guess this is something that
probably everybody's wondering

194

00:11:16,029 --> 00:11:20,035

I may be like you can talk about this
book how does not having gravity

195

00:11:20,035 --> 00:11:23,122

affect 3d great thing actually like it
does it make it easier or harder what it

196

00:11:24,022 --> 00:11:25,641

what are the challenges

197

00:11:25,839 --> 00:11:30,049

yeah yes definitely a common question
and I'll try to stay as much a bit

198

00:11:30,049 --> 00:11:33,131

like and without saying certain things
between we are actually allowed to speak

199

00:11:34,031 --> 00:11:35,240

about but

200

00:11:35,519 --> 00:11:39,005

I mean really when we when we first
started the company the idea was

201

00:11:39,005 --> 00:11:42,067

I'll actually not too create our own 3d
printer

202

00:11:43,012 --> 00:11:46,591

we really we saw the benefit of having a
3d printer in space

203

00:11:46,699 --> 00:11:48,793

if there's a lot of people watching at
work familiar with but the concept is

204

00:11:49,639 --> 00:11:50,732

Shapeways a service-based

205

00:11:51,569 --> 00:11:55,061

reprinting businesses we just really
thought wow it really

206

00:11:55,061 --> 00:11:58,155

help further space exploration if we had
a 3d printer in space

207

00:11:59,055 --> 00:12:02,964

and so we started getting as many sorter
are already available

208

00:12:03,459 --> 00:12:06,099

repairs that we could get commercial off
the shelf and flying them on this

209

00:12:06,099 --> 00:12:09,858

bombing comments parabolic flights that
nicky was talking about

210

00:12:10,749 --> 00:12:13,092

and you know be between our engineers
there is a lot of debate in the

211

00:12:13,092 --> 00:12:15,168

beginning it was like what some people
thought that would require

212

00:12:16,068 --> 00:12:20,105

too much tweaking people thought they
would but we actually found out that I'm

213

00:12:21,005 --> 00:12:25,037

none of them where right and what you
really

214

00:12:25,037 --> 00:12:28,105

find out at the end of the day is
there's yes somewhere around like 15 to

215

00:12:29,005 --> 00:12:29,062

20

216

00:12:29,062 --> 00:12:33,068

little things that you you have to
change I'm in order to make 3d printing

217

00:12:33,068 --> 00:12:33,112

work

218

00:12:34,012 --> 00:12:37,271

in space as some the easy ones to sort
out

219

00:12:37,379 --> 00:12:41,074

visualize I'm would be me know that the
person at the control

220

00:12:41,074 --> 00:12:44,130

that you would need is is a great
example I'm there these these pieces

221

00:12:45,003 --> 00:12:47,064

these parts are very highly precise

222

00:12:47,091 --> 00:12:51,140

I haven't had manufactured in it it's
something of a been a little bit can be

223

00:12:51,959 --> 00:12:56,011

week inside all without having the force
of gravity two kinda hope things in

224

00:12:56,011 --> 00:12:57,062

place it's actually

225

00:12:57,062 --> 00:13:01,091

on can you really surprising I how bad
things can really get

226

00:13:01,649 --> 00:13:04,087
you know that's just just one other
things and in addition to

227
00:13:04,087 --> 00:13:07,095
I'm the gravity there's a whole bunch of
other yep that's all is well there's

228
00:13:08,067 --> 00:13:09,606
safety issues

229
00:13:10,209 --> 00:13:14,270
you know commercial off-the-shelf
requires met harmful toxic gases that

230
00:13:14,819 --> 00:13:15,863
you can't have up there so

231
00:13:16,259 --> 00:13:19,278
we never learning a over the years
through really

232
00:13:19,449 --> 00:13:23,006
I'm party rockin and part just are
amazing

233
00:13:23,006 --> 00:13:26,475
engineering team that there's all these
changes we had to make everything from

234
00:13:26,529 --> 00:13:29,529
the gravity to the safety to that of
casting

235
00:13:29,529 --> 00:13:32,576
and I'm when it up having to develop our
own

236
00:13:32,999 --> 00:13:36,008
3d printer from ground up to work in

space now we joke that we knew that we

237

00:13:36,899 --> 00:13:38,985

had to be that we probably might have even started getting this

238

00:13:39,759 --> 00:13:44,037

Arctic I but at work really excited to connect

239

00:13:44,037 --> 00:13:47,626

cool net ion ABS their

240

00:13:47,959 --> 00:13:50,965

manager maybe you could talk to this about what what exactly

241

00:13:51,559 --> 00:13:54,641

astronauts would potentially be pertinent space like me sonic use

242

00:13:55,379 --> 00:13:58,405

then he looked like he was mad classic is that sorted when you're thinking it

243

00:13:58,639 --> 00:14:00,062

would be printing and stay said

244

00:14:00,062 --> 00:14:03,381

I how often would you want to use it is this sort of like an everyday

245

00:14:03,939 --> 00:14:07,008

thank you you have guessed right to using for making our attack came

246

00:14:07,008 --> 00:14:10,065

oMG we received up to left love

247

00:14:11,037 --> 00:14:16,006
a usual tolls and parks stop after talks
with use or they may need

248
00:14:16,339 --> 00:14:19,347
resupply always received a list of 13

249
00:14:20,139 --> 00:14:25,011
so I to start teen will do a total of 21
parents

250
00:14:25,011 --> 00:14:28,930
caught that will me uploaded on the
printer

251
00:14:29,029 --> 00:14:33,055
prior to watch on the ballot Nikki talk
a little bit about the exact

252
00:14:33,055 --> 00:14:36,006
up polls in part opera and the material

253
00:14:36,006 --> 00:14:39,965
that Williams your nature tho and

254
00:14:40,559 --> 00:14:43,072
actually I will do our first three
different for me that 21 in

255
00:14:43,072 --> 00:14:45,671
we'll start with some some kind of thing
that might look kinda boring are

256
00:14:46,319 --> 00:14:49,357
maintaining our tensile specimens and
and and strain

257
00:14:49,699 --> 00:14:52,785
as best man so we can test is on the
ground they were made by and 18 referred

258

00:14:53,559 --> 00:14:56,036

to you that the crew tools we've been
working closely with their

259

00:14:56,036 --> 00:15:00,245

Aiba the intramolecular and tools of its
damage at its

260

00:15:00,569 --> 00:15:03,601

a thinner that supports that astronauts
to get a list of things that were kinda

261

00:15:03,889 --> 00:15:03,957

day

262

00:15:04,569 --> 00:15:07,583

no-brainers where would you start and I
did want to point out

263

00:15:07,709 --> 00:15:10,074

and you can see this when we first start
this is the feedstock

264

00:15:10,074 --> 00:15:13,161

so it looks very similar to wait and you
with the icon your weedeater reject what

265

00:15:14,061 --> 00:15:16,064

about your readers ball that's how it
starts

266

00:15:16,091 --> 00:15:19,104

and their elite tier three categories
are things you can print

267

00:15:20,004 --> 00:15:23,233

first already met the most common things
that we have to watch right any cost a

268

00:15:23,269 --> 00:15:24,003

lot to watch

269

00:15:24,003 --> 00:15:27,052

things and a spate we have to fly the
spares for the parts they really need

270

00:15:27,079 --> 00:15:31,748

multiple ranches and at it all kinds
impaired sample containers Inc

271

00:15:32,459 --> 00:15:36,085

and little at clips and type things that
don't super exciting but we have to pack

272

00:15:36,085 --> 00:15:39,804

you know ten or twelve spares at least
each other I don't your math adds up

273

00:15:40,569 --> 00:15:40,657

quickly

274

00:15:41,449 --> 00:15:44,454

but there's a whole nother Ag category
have to think about as well

275

00:15:44,949 --> 00:15:48,048

and that is a lot of things that we
designed to find space and you really

276

00:15:48,048 --> 00:15:48,467

have to

277

00:15:48,899 --> 00:15:52,965

the bins around the watch Lance so the
structure that you build it has to be

278

00:15:53,559 --> 00:15:57,049

and quite robust to survive actual aids

and watch

279

00:15:57,049 --> 00:16:01,368

if you can actually designed these parts
in space is where I get really excited

280

00:16:01,809 --> 00:16:04,866

and it's really a whole mentality shared
and you can design completely

281

00:16:05,379 --> 00:16:06,003

differently

282

00:16:06,003 --> 00:16:09,342

and so even things like at mount if
you've heard much about to keep stats

283

00:16:09,639 --> 00:16:14,024

the Manus at serbian might stand a fine
stack quite a few from space station now

284

00:16:14,024 --> 00:16:18,048

and with nanotechnology you can fit a
lot and then sat in as all sectors

285

00:16:18,048 --> 00:16:21,097

so you can do science you can do
communications you can do you at

286

00:16:21,097 --> 00:16:24,386

let their at things with these cute at
I'm if you could actually print

287

00:16:25,259 --> 00:16:29,311

the structure in space and instead
watching and have to design it to me to

288

00:16:29,779 --> 00:16:30,073

watch leads

289

00:16:30,073 --> 00:16:33,742

and you can come much space that that
actually at opens up for you

290

00:16:34,399 --> 00:16:36,497

so there are things all sorts things
were just now really starting a week and

291

00:16:37,379 --> 00:16:38,475

we need innovative ideas am

292

00:16:39,339 --> 00:16:42,048

nasa is is making calls in creating
challenges

293

00:16:42,048 --> 00:16:45,066

I'm to get innovative ideas for how
would you designed something differently

294

00:16:45,066 --> 00:16:45,149

in space

295

00:16:46,049 --> 00:16:49,368

I don't have my little ranch here with
me right now but for example

296

00:16:49,809 --> 00:16:52,842

I got home depot in a fire engine in
everybody has a and

297

00:16:53,139 --> 00:16:57,017

image in a metal ranch to get from Home
Depot but if I could design that for

298

00:16:57,017 --> 00:17:00,006

from application on space station around
noon on mars

299

00:17:00,006 --> 00:17:03,101

I'm I could design it differently am on
a 3d printer it might look flatter it

300

00:17:04,055 --> 00:17:04,148
might look at my

301

00:17:05,048 --> 00:17:08,907
a joke it might look kinda like that the
tools that my kids played with whenever

302

00:17:09,339 --> 00:17:12,005
real little toddlers a lil tool sets
with the Hammers in the trenches

303

00:17:12,005 --> 00:17:16,052
may be flatter and any different shape
but it might work just fine for what we

304

00:17:16,097 --> 00:17:16,163
need

305

00:17:17,063 --> 00:17:20,111
and this is really important space
station with extended like the space

306

00:17:21,011 --> 00:17:24,440
station and we have a lot things that
are running out a certification and and

307

00:17:24,539 --> 00:17:25,098
things that we need to iraq

308

00:17:25,098 --> 00:17:28,159
to fly at but its absolutely and I can't
stress this in at

309

00:17:29,059 --> 00:17:33,125
it's a critical technology and
capability if ur gonna go to norm arstan

310

00:17:34,025 --> 00:17:38,025

asteroid work really going to explore
our solar system

311

00:17:38,025 --> 00:17:42,038

this is something we can not be reliant
I and things watching the ground every

312

00:17:42,038 --> 00:17:43,077

time we need a new tool

313

00:17:43,077 --> 00:17:46,736

and we need are asked not to be able to
design what they need

314

00:17:47,429 --> 00:17:50,088

I'm kinda Micah and MacGyver on the
ghetto so at

315

00:17:50,088 --> 00:17:53,152

there's what upon and I'd add to that ok

316

00:17:54,052 --> 00:17:57,071

we like to think of it as on-demand
living

317

00:17:57,539 --> 00:18:02,034

so if you think about that we may not
can think about what the astronauts may

318

00:18:02,034 --> 00:18:03,087

need a particular moment but

319

00:18:03,087 --> 00:18:06,122

having the capability to be able to
print what

320

00:18:07,022 --> 00:18:10,046

a meeting as well be able to design what

they mean

321

00:18:10,046 --> 00:18:13,385

changes the whole logistical game 0 %uh

322

00:18:13,799 --> 00:18:17,001

SpaceX or a shed I'm just sad

323

00:18:17,001 --> 00:18:20,006

back all Nikki said this runner is a FTM

324

00:18:20,051 --> 00:18:23,094

modified FDM so that means we'll be
bringing past it

325

00:18:23,094 --> 00:18:26,803

um initially all and then we'll also

326

00:18:27,649 --> 00:18:31,649

I'll why up optical scanner

327

00:18:31,649 --> 00:18:36,687

%uh eventually that will allow us to
inspect apart after we printed

328

00:18:37,029 --> 00:18:41,055

or outlet are all those cases they show
it to you as are all

329

00:18:41,289 --> 00:18:44,328

3d printed in are those all things
better gonna be like

330

00:18:44,679 --> 00:18:48,021

things that printer that's going up on
the space station could do

331

00:18:48,021 --> 00:18:52,038

absolutely and yes and no. if make

adequate talk with ABS plastic but it's

332

00:18:52,038 --> 00:18:55,006

what your Legos or may not have said
that steady comin at a common

333

00:18:55,006 --> 00:18:55,085

terminology like

334

00:18:56,039 --> 00:18:59,101

throughout the yes you know that sample
containers you add with you print

335

00:19:00,001 --> 00:19:00,094

multiple

336

00:19:00,094 --> 00:19:03,102

get parts that fit together I got a lot
more fun parts at back in the lab

337

00:19:04,074 --> 00:19:05,172

echoecho but I don't have my with me

338

00:19:06,072 --> 00:19:10,126

and little clips and you know things
like at your favorite parts and you can

339

00:19:11,026 --> 00:19:14,032

also get very creative you can actually
build things and you

340

00:19:14,032 --> 00:19:18,044

your print by Amber any stack testing so
they can connect in certain ways

341

00:19:18,044 --> 00:19:21,102

I'm you can actually build larger
structures by connecting on Cerro

342

00:19:22,002 --> 00:19:25,034
and we're trying to think about what a
fine and useful

343
00:19:25,034 --> 00:19:28,049
things that we can print Yahoo and 18

344
00:19:28,049 --> 00:19:31,055
jump in and add to that I think there's
some really good points made their

345
00:19:32,009 --> 00:19:35,088
on I think what what we're most excited
about here

346
00:19:35,169 --> 00:19:38,062
on the maid's Bayside in addition to
that is that

347
00:19:38,062 --> 00:19:40,159
you know is kinda mention this is the
first primary standing up is is a

348
00:19:41,059 --> 00:19:42,768
technology demonstration

349
00:19:43,299 --> 00:19:46,350
I'm really based on the technology that
we've built here there's going to be a

350
00:19:46,809 --> 00:19:47,810
second crater

351
00:19:47,909 --> 00:19:51,034
going after that which is going to be a
commercial facility

352
00:19:51,034 --> 00:19:55,243
where we're going to actually be opening
it up so that anyone the world really

353

00:19:55,549 --> 00:19:59,584

can trent things in space and that
really speaks to you i think

354

00:19:59,899 --> 00:20:02,924

something that when the show is touching
on earlier about how greater partnership

355

00:20:03,149 --> 00:20:04,188

this is between

356

00:20:04,539 --> 00:20:07,085

nasa private industry and we've been
able to build this technology working

357

00:20:07,085 --> 00:20:07,163

with nasa

358

00:20:08,063 --> 00:20:12,007

but now you know we have I'm a lot of
people contacting us were saying that we

359

00:20:12,007 --> 00:20:15,019

like to put something in space wanna put
something I space station

360

00:20:15,082 --> 00:20:18,090

you know when when can you print for us
right and I think it's this is really

361

00:20:19,062 --> 00:20:20,621

really important for furthering

362

00:20:21,179 --> 00:20:24,025

space exploration now if you look at how
a

363

00:20:24,025 --> 00:20:27,674

amazing the potential is for space
exploration not only

364

00:20:27,899 --> 00:20:30,990

that hold the here the future of the
human race literally but

365

00:20:31,809 --> 00:20:34,820

also already the background have so many
of the essential

366

00:20:34,919 --> 00:20:37,944

pieces that what we do here on earth
today GPS cell phones

367

00:20:38,169 --> 00:20:41,218

satellites all of this space is so
important but really

368

00:20:41,659 --> 00:20:46,073

up until now it's been very very
difficult to access really only

369

00:20:46,073 --> 00:20:47,097

governments and

370

00:20:47,097 --> 00:20:50,172

powers with billions of dollars can you
never quite something

371

00:20:51,072 --> 00:20:55,161

and so what I things I'm most excited
about is once we have this printer there

372

00:20:55,809 --> 00:20:58,896

we're gonna be opening up access to
space to a whole new class

373

00:20:59,679 --> 00:21:04,013

so people organizations in individuals

and teams on earth

374

00:21:04,013 --> 00:21:07,074

literally I really mean this for anyone
who who is

375

00:21:07,074 --> 00:21:10,983

tuned in right now if there is something
the you you do you want to put in space

376

00:21:11,649 --> 00:21:14,738

I'm this really we really wanna make it
possible so that everybody

377

00:21:15,539 --> 00:21:19,566

as a chance to go ahead and do that you
might actually have the idea right now

378

00:21:19,809 --> 00:21:22,894

for a better way an astronaut could do
something up there you might have a

379

00:21:23,659 --> 00:21:24,711

better idea for how

380

00:21:25,179 --> 00:21:28,037

various things can be done and we want
to make it so that at

381

00:21:28,037 --> 00:21:31,816

global collaboration that we're seeing
with app development and

382

00:21:32,149 --> 00:21:35,094

all these other areas that you know some
fifteen-year-old

383

00:21:35,094 --> 00:21:38,175

in Europe somewhere comes up with an
idea and it

384

00:21:39,075 --> 00:21:43,112

suddenly it is able to get the top of
the App Store why can't that same kid be

385

00:21:44,012 --> 00:21:45,671

developing solutions for space

386

00:21:45,779 --> 00:21:49,049

and when the this 3d printers there are
really think that speaking at what we're

387

00:21:49,049 --> 00:21:50,108

gonna print that's the most exciting

388

00:21:51,008 --> 00:21:54,607

I think it's going to be the things that
we haven't bought it yet it when people

389

00:21:54,679 --> 00:21:57,025

on earth really wake up and realize that

390

00:21:57,025 --> 00:22:02,058

well now they actually can put things
into space at an affordable and fast way

391

00:22:02,058 --> 00:22:05,071

I'm that's when the innovation is really
gonna take off we're gonna get

392

00:22:05,071 --> 00:22:06,113

developments we need to

393

00:22:07,013 --> 00:22:11,013

further space exploration a mic and cam
all ads

394

00:22:11,013 --> 00:22:15,024

a student om getting access to a cab

file

395

00:22:15,024 --> 00:22:18,803
and up linking it directly to the
printer and printing something

396

00:22:19,019 --> 00:22:22,007
and zero-g_ on the space station

397

00:22:22,007 --> 00:22:25,007
I think that's a very powerful bad

398

00:22:25,007 --> 00:22:28,010
had to get back to you will have will
have some other files and that we're

399

00:22:28,037 --> 00:22:30,696
going to pretty in space available here
on the ground

400

00:22:31,029 --> 00:22:35,062
I'm a they've been opened I can be
initiated at open source information so

401

00:22:35,062 --> 00:22:38,341
anyone on the ground say and my
daughters were excited about this when

402

00:22:38,899 --> 00:22:40,075
they're good science fair there is an

403

00:22:40,075 --> 00:22:43,110
mommy I have access to a 3d printer I
can print the exact being on

404

00:22:44,001 --> 00:22:47,550
on the ground and show my friends at
BAFTAs and a prince eight net absolutely

405

00:22:47,649 --> 00:22:48,044

true

406

00:22:48,044 --> 00:22:51,123

I'd also like to add and mass is really trying to clear the path for this

407

00:22:52,023 --> 00:22:53,582

commercialization efforts

408

00:22:53,789 --> 00:22:57,073

an hour in goal is that eventually wants all this happened in in namespace

409

00:22:57,073 --> 00:23:00,862

I had to commercial printer on orbit an ass is actually a customer at that

410

00:23:01,519 --> 00:23:01,594

printer

411

00:23:02,269 --> 00:23:05,005

and we had a ISS is a national lab in Anchorage

412

00:23:05,005 --> 00:23:09,104

ok stay 22 gable at INSEAD a cool things that we're doing our space station and

413

00:23:10,049 --> 00:23:12,058

it like people know that it's up there and they know we're going probably three

414

00:23:13,039 --> 00:23:14,005

legal status

415

00:23:14,005 --> 00:23:17,804

and that but this commercialization and it's really a national asset that we

416

00:23:18,299 --> 00:23:20,095

want to utilize and effectively and
efficiently

417

00:23:20,095 --> 00:23:23,122

so ultimately we want to be a customer
this is well math is it looking to be

418

00:23:24,022 --> 00:23:27,581

the one to build the printers that
enable the path into into utilized

419

00:23:27,779 --> 00:23:31,061

runners cool a we actually have

420

00:23:31,061 --> 00:23:34,062

a a different another different question
every aircraft at

421

00:23:34,071 --> 00:23:37,540

Street your I'll and I think

422

00:23:38,179 --> 00:23:42,179

them to think the guys talking about who
people like excited

423

00:23:42,179 --> 00:23:45,035

I will ever be a chance that live
streaming or

424

00:23:45,035 --> 00:23:48,073

tweeting from the 3d printer in states
like are people gonna be able to see

425

00:23:48,073 --> 00:23:49,132

step come out

426

00:23:49,789 --> 00:23:54,026

the a I out of the picture somewhere on

nasa TV

427

00:23:54,026 --> 00:23:57,815

we actually will be recording and the
prints I will be analyzed science data

428

00:23:58,049 --> 00:24:00,087

from Mac but we actually are planning to
have an

429

00:24:00,429 --> 00:24:03,005

and tweet the printer itself to have a
Twitter account

430

00:24:03,005 --> 00:24:06,934

and it for help in the printer itself
will be tweeting and receiving tweets

431

00:24:07,429 --> 00:24:09,453

and that we can kinda see where it goes
from there

432

00:24:09,669 --> 00:24:13,036

I we do have some educational outreach
and systemic idiots

433

00:24:13,036 --> 00:24:16,215

and it would like to work with schools
and other outlets and some cool

434

00:24:16,539 --> 00:24:18,624

challenges there may need to kinda be
listening out for

435

00:24:19,389 --> 00:24:22,097

and at will be announced and the near
future

436

00:24:22,097 --> 00:24:25,656

said we're really excited about that but

yes we do plan for the printer to have a

437

00:24:26,529 --> 00:24:28,073

Twitter and I'm sure a Facebook account
as well

438

00:24:28,073 --> 00:24:31,157

as had a baby interact and we will be
having videos at the actual printing

439

00:24:32,057 --> 00:24:33,101

what are taking place

440

00:24:34,001 --> 00:24:37,760

cool a school I have another

441

00:24:37,769 --> 00:24:40,808

another question here rather than Travis
Nelson humble

442

00:24:41,159 --> 00:24:44,021

I and it is also something I'm wondering
it

443

00:24:44,021 --> 00:24:48,120

how I'll and we've got sorted about how
a

444

00:24:48,309 --> 00:24:52,315

things are moving in the future bada how
hard questions the idea of sending a 3d

445

00:24:52,909 --> 00:24:53,936

printer to

446

00:24:54,179 --> 00:24:59,074

asteroid to the Nooner cars in having a
bill that space station or

447

00:24:59,074 --> 00:25:03,145
you know 2007 some base for the
astronauts ellipse delivered

448
00:25:04,045 --> 00:25:08,049
yeah its that's a great question I'm
sure wall have something to say they're

449
00:25:08,049 --> 00:25:11,858
on I guess that the biggest thing that I
wanted this

450
00:25:12,299 --> 00:25:16,321
say in response is that really that's
why we're doing all this

451
00:25:16,519 --> 00:25:20,086
you know the when we I'm started looking
at had a three-person space we're very

452
00:25:20,086 --> 00:25:21,365
excited about

453
00:25:22,139 --> 00:25:25,204
the prospect that really changing the
way that things were done on the space

454
00:25:25,789 --> 00:25:25,837
station

455
00:25:26,269 --> 00:25:29,084
but as a company we we really are
focused on

456
00:25:29,084 --> 00:25:33,145
enabling does a bigger space exploration
galls Kauai prevention

457
00:25:34,045 --> 00:25:37,073
I'm going to asteroids Moon and Mars

458

00:25:37,073 --> 00:25:40,094

building entire space station's things
like that and

459

00:25:40,094 --> 00:25:44,122

I so we we focused the entire time on
developing technology that would be

460

00:25:45,022 --> 00:25:46,451

possible to use

461

00:25:46,649 --> 00:25:50,673

inside the space station but also have
major applications and all those

462

00:25:50,889 --> 00:25:54,084

other areas so we view this as a very
real

463

00:25:54,084 --> 00:25:58,113

an important step towards those its
further out goals

464

00:25:59,013 --> 00:26:02,292

that's kinda what amazing about 3d
printing as a technology that's so

465

00:26:02,409 --> 00:26:02,483

versatile

466

00:26:03,149 --> 00:26:06,058

the same thing they can print a little
ranch like this

467

00:26:06,058 --> 00:26:09,111

I'm may also be able to train a lot of
other a

468

00:26:10,011 --> 00:26:14,570
much more complicated than and larger
and more progressive thanks so

469
00:26:14,669 --> 00:26:19,047
I that that's absolutely the focus and
this sorta step up manufacturing the

470
00:26:19,047 --> 00:26:20,616
first thing in space

471
00:26:21,039 --> 00:26:24,088
at all and then the %uh the next 10 2013

472
00:26:24,529 --> 00:26:27,076
however many after that on station I is
is

473
00:26:27,076 --> 00:26:30,101
the very important milestone on the way
to those

474
00:26:31,001 --> 00:26:34,096
future steps both technologically and
just societal

475
00:26:34,096 --> 00:26:37,125
some ass as a whole we've left

476
00:26:38,025 --> 00:26:41,064
I entire road map oath

477
00:26:41,289 --> 00:26:46,001
about the future manufacturing in space
and we look at it from a point of view

478
00:26:46,001 --> 00:26:50,025
building the capability so we can
explore deeper and deeper space

479

00:26:50,034 --> 00:26:53,243

so we look at the International Space
Station and we look at

480

00:26:53,549 --> 00:26:57,608

up ground-based we look at other
planetary services that include a short

481

00:26:58,139 --> 00:27:01,073

as different testing and proving grounds
and platforms

482

00:27:01,073 --> 00:27:04,111

that first we start with the 3d printer
on zero-g_

483

00:27:05,011 --> 00:27:09,088

then you know as a plastic then maybe we
look at Matt Olson we look at a recycler

484

00:27:09,088 --> 00:27:12,093

and then we go external to the space
station and we look at

485

00:27:13,038 --> 00:27:16,125

how do we use what we learned from
the 3d printer

486

00:27:17,025 --> 00:27:21,037

and now starting using that to the
larger structures are being able to

487

00:27:21,037 --> 00:27:21,113

function

488

00:27:22,013 --> 00:27:25,034

on other planetary surfaces and then
using knows

489

00:27:25,034 --> 00:27:29,062
resources or in Sichuan resources from
another planetary surface

490
00:27:29,062 --> 00:27:33,121
to afford us on infrastructure that we
can explore

491
00:27:33,679 --> 00:27:36,085
com other parts as the numbers

492
00:27:36,085 --> 00:27:40,121
60 I can add to that just a little kids
this is a very exciting area and

493
00:27:41,021 --> 00:27:44,370
so the term that kinda be inclined to in
space manufacturing

494
00:27:44,559 --> 00:27:48,022
and likely nature and micro referred to
you it's it's really a whole suite of

495
00:27:48,022 --> 00:27:49,191
capabilities

496
00:27:49,389 --> 00:27:53,034
and the 3d printer in five a station
it's just a very very first at

497
00:27:53,034 --> 00:27:56,953
and as the nature image and I we have
things like external imagine if we had

498
00:27:57,259 --> 00:27:58,061
and the micro Miri

499
00:27:58,061 --> 00:28:02,100
erase in eighty gravity magic he had a
micrometer right here on station

500

00:28:03,000 --> 00:28:06,099

currently we don't have a really a way
to do it in space repair &

501

00:28:06,099 --> 00:28:10,258

imagine if we could structure lights and
they have handheld scanners which 22

502

00:28:11,149 --> 00:28:13,082

referred to earlier that and we plan to
fly Saints

503

00:28:13,082 --> 00:28:16,174

it actually stand and be here and then
you could reverse engineer a cad at

504

00:28:17,074 --> 00:28:19,111

model I did that and in print a patch

505

00:28:20,011 --> 00:28:23,580

and in addition to that and if you've
heard much about the Contra cracking an

506

00:28:23,679 --> 00:28:25,022

additive construction

507

00:28:25,022 --> 00:28:28,591

and if you go back today all season
articles of at and we're in china for

508

00:28:28,789 --> 00:28:30,098

example they've been building temporary
housing

509

00:28:30,098 --> 00:28:33,637

you that the capability that's not
science fiction that the capability that

510

00:28:34,519 --> 00:28:35,522

exist today

511

00:28:35,549 --> 00:28:39,099

on the ground am it's a very exciting way and you can imagine any case like a

512

00:28:39,099 --> 00:28:40,172

natural disaster with FEMA

513

00:28:41,072 --> 00:28:44,241

or and are our military out in a remote

514

00:28:44,889 --> 00:28:49,048

area if you could build things like landing pads and remote shelters

515

00:28:49,048 --> 00:28:52,837

and you can imagine on mars or a he needed a radiation

516

00:28:53,269 --> 00:28:57,049

at protection habitat and as a major mentioned ok trip for art space

517

00:28:57,049 --> 00:28:58,074

exploration you would use

518

00:28:58,074 --> 00:29:01,150

the in-state you say you would use that to regulate from whatever and

519

00:29:02,005 --> 00:29:06,076

and trestle being you might be I but on the ground maybe you could use a and

520

00:29:07,021 --> 00:29:11,450

so there's a lot of coal technologies and that are on the ground at nasa

521

00:29:11,639 --> 00:29:15,037

and companies like Maine's H I'm can leverage their things we have to tweak

522

00:29:15,037 --> 00:29:16,038

and do a little differently

523

00:29:16,047 --> 00:29:19,072

for that in space applications and that we are I

524

00:29:19,072 --> 00:29:22,991

keeping up with the current technologies and leveraging knows where we can

525

00:29:23,639 --> 00:29:27,038

and there's also things like recycling and we have to find station at

526

00:29:27,038 --> 00:29:30,087

today it matter act and I think there might be an announcement for a day

527

00:29:30,087 --> 00:29:33,136

2014 a swine at small business innovation

528

00:29:34,036 --> 00:29:37,335

awards and I we've got one out for recyclers

529

00:29:37,659 --> 00:29:40,698

we think the next key step would be to show that you could turn this part

530

00:29:41,049 --> 00:29:45,035

back in today the feedstock and reuse that they'd stop for exploration you can

531

00:29:45,035 --> 00:29:46,864
imagine how cue that would be

532
00:29:47,179 --> 00:29:49,277
and that's also something we could use
on the ground for if we had printers and

533
00:29:50,159 --> 00:29:52,061
her home which i think a lot of us will
shortly

534
00:29:52,061 --> 00:29:55,260
and say oh and we're excited about
looking into that type that that

535
00:29:55,809 --> 00:29:56,815
demonstration as well

536
00:29:57,409 --> 00:30:00,433
yeah and I had such as water one other
thing on the end there

537
00:30:00,649 --> 00:30:04,665
which is time back to what I said before
it's really reminding people that

538
00:30:04,809 --> 00:30:08,881
with these 3d printers on the space
station I you are going to be able to

539
00:30:09,529 --> 00:30:12,617
design things an impact space
exploration right so even if it

540
00:30:13,409 --> 00:30:17,057
we're doing something small on the space
station their experiments the can do

541
00:30:17,057 --> 00:30:19,126
there that are very relevant to say

542

00:30:19,639 --> 00:30:23,023

printing something out Astra rights if
you're interested in the idea

543

00:30:23,023 --> 00:30:27,722

what can you do one asteroids I'm making
true a lot of those ideas and testify

544

00:30:27,929 --> 00:30:30,950

that he is great what we're doing on
station now

545

00:30:31,139 --> 00:30:34,087

and I'm again be able to have that like
more global

546

00:30:34,087 --> 00:30:39,506

open access to ideas maybe now a high
school team can think of an experiment

547

00:30:40,289 --> 00:30:44,072

that I is simulating something about an
asteroid 3d printed and we do it

548

00:30:44,072 --> 00:30:48,088

it just having that so much more open to
the world is really can accelerate our

549

00:30:48,088 --> 00:30:49,159

progress towards being able to do it

550

00:30:50,059 --> 00:30:53,368

they were an actual Astra and I would
add that I'm

551

00:30:53,899 --> 00:30:57,048

never signing up for a 3d printer a box
a printing

552

00:30:57,048 --> 00:31:00,083

are another planetary surface we look
totally different

553

00:31:00,083 --> 00:31:04,052

um it would be stopped up very automated
very robotic

554

00:31:04,799 --> 00:31:08,048

up with ahead some sports so

555

00:31:08,048 --> 00:31:11,006

to stretch your imagination what what
that would look like

556

00:31:11,006 --> 00:31:14,067

and you have to start from somewhere to
establish that capability

557

00:31:15,021 --> 00:31:18,090

I think that 3d print I'm efforts really

558

00:31:18,279 --> 00:31:21,316

up triggers that up process to allow us
to

559

00:31:21,649 --> 00:31:25,059

to think what what that looks like what
was being able to use additive

560

00:31:29,625 --> 00:31:26,018

manufacturing

561

00:31:30,309 --> 00:31:34,001

to a create infrastructure on other
planetary surfaces

562

00:31:34,001 --> 00:31:37,710

clinically depressed what leaks six

matching

563

00:31:37,809 --> 00:31:42,011

that anything about it integrated system
taste like printable electronics

564

00:31:42,011 --> 00:31:45,082

its really height area code integrated
system we have

565

00:31:45,082 --> 00:31:48,147

all these capabilities where you can
verify the part meet specifications and

566

00:31:49,047 --> 00:31:50,486

you have printable electronics

567

00:31:50,909 --> 00:31:54,961

the autonomy and the software and say
it's very exciting and really hope to

568

00:31:55,429 --> 00:31:56,062

hear back from

569

00:31:56,062 --> 00:32:00,111

people out there in in in and
universities and schools in the general

570

00:32:00,669 --> 00:32:01,744

public because this is that

571

00:32:02,419 --> 00:32:05,442

a very innovative area and when that we
feel strongly we can

572

00:32:05,649 --> 00:32:09,022

interact with the public in and it is a
different way of thinking it's someone

573

00:32:09,022 --> 00:32:10,571
mentality shift and

574

00:32:10,769 --> 00:32:14,007
we look forward to hearing from from
folks across the country

575

00:32:14,007 --> 00:32:18,816
falls I'm yeah I guess I'm I was gonna
ask you if you could maybe described to

576

00:32:19,509 --> 00:32:19,572
a sweat

577

00:32:20,139 --> 00:32:23,047
what it's what I actually look like a
when

578

00:32:23,047 --> 00:32:26,123
let states developed obviously this is
yes action are out there but

579

00:32:27,023 --> 00:32:31,071
it wanted to build a house would you
have to drop house I specter down down

580

00:32:31,071 --> 00:32:34,910
there on the ballot saying

581

00:32:35,549 --> 00:32:38,007
but I think that we're looking at today
when a jerk and talked a bit like I said

582

00:32:38,007 --> 00:32:41,356
the technology on the ground exist today
and it's one that they've all been

583

00:32:42,049 --> 00:32:45,084
quickly because I think there's a a real
world need for that

584

00:32:45,399 --> 00:32:49,037

and an answer is really no and there's
some really cool technology

585

00:32:49,037 --> 00:32:52,796

out there now where and it doesn't have
to be decides the house to print house

586

00:32:53,129 --> 00:32:55,024

you can actually print at peace Aki

587

00:32:55,024 --> 00:32:58,303

and build on the structures and
autonomously with with robots

588

00:32:58,519 --> 00:33:01,096

and there's there's all kinds and that's
why I was sleeping at the innovative

589

00:33:01,096 --> 00:33:01,935

ideas

590

00:33:02,799 --> 00:33:06,097

and its its it doesn't have to be one
plus one equals to you and you can

591

00:33:06,097 --> 00:33:10,026

actually take advantage integrated
systems and robotics not on me

592

00:33:10,899 --> 00:33:14,096

and actually acting up with with new and
different way to doing it in a smaller

593

00:33:14,096 --> 00:33:15,015

package

594

00:33:15,879 --> 00:33:19,034

Ste cool I'm

595

00:33:19,034 --> 00:33:22,061

action again also just wondering you mentioned

596

00:33:22,061 --> 00:33:25,460

maybe I can talk about this as well that yes I had tests on the

597

00:33:26,009 --> 00:33:31,034

on the vomit comet I'll and hit you up can you describe that a little bit more

598

00:33:31,034 --> 00:33:33,133

and also just running like you've got thirty seconds this thing is printing

599

00:33:34,033 --> 00:33:35,582

it's in the middle of something

600

00:33:35,879 --> 00:33:39,046

and how your thirty-seconds up to you to grab the machine or gonna

601

00:33:39,046 --> 00:33:42,058

crashed Flores I'll

602

00:33:42,058 --> 00:33:45,007

yes so it's that no it is bolted down

603

00:33:45,007 --> 00:33:48,049

so you don't have to worry about that Johnson it its

604

00:33:49,012 --> 00:33:52,061

it supplies in a parabola so what you get is you get

605

00:33:52,169 --> 00:33:56,194
yeah about you know thirty seconds or so
zero-g_ and that it wasn't the 2g

606
00:33:56,419 --> 00:33:59,454
and that that the 2 G's actually the
part that most people's

607
00:33:59,769 --> 00:34:03,032
i mix have a problem with but now what
we actually it weighs

608
00:34:03,032 --> 00:34:06,007
it actually make it easier on ourselves
%uh %um

609
00:34:06,007 --> 00:34:09,043
started making the printer so that he
would actually dealer

610
00:34:10,006 --> 00:34:15,053
trent all the way throughout the entire
parabola so anywhere from zero to two

611
00:34:15,053 --> 00:34:18,150
actually anywhere so I had something
that I actually talk about that much but

612
00:34:19,005 --> 00:34:22,054
since you brought it up on me know what
we

613
00:34:22,099 --> 00:34:25,171
actually have developed is not just in
zero gravity printing technology but a

614
00:34:26,071 --> 00:34:29,109
gravity independent printing technology
so we actually just let it burn all the

615

00:34:30,009 --> 00:34:30,101
way through in our

616
00:34:31,001 --> 00:34:34,004
final iterations you you look at the
final prints and you couldn't even tell

617
00:34:34,004 --> 00:34:34,012
it's like

618
00:34:35,002 --> 00:34:39,009
whether ways year or two anywhere
between the car would be

619
00:34:39,027 --> 00:34:42,031
indistinguishable now all

620
00:34:42,031 --> 00:34:45,037
your a you guys know what the

621
00:34:45,037 --> 00:34:48,061
the very first thing you're going to
print on the space station is when it

622
00:34:48,061 --> 00:34:50,063
gets up there in August

623
00:34:50,081 --> 00:34:53,086
so we we are playing around with

624
00:34:53,086 --> 00:34:56,169
I'm unit a few different concept there
is one that's kinda

625
00:34:57,069 --> 00:35:00,115
at on our minds right now I'm

626
00:35:01,015 --> 00:35:04,071
but I guess Nick here we are we talking

about that publicly at this point

627

00:35:04,071 --> 00:35:07,114

or well left I mentioned earlier shoulda brought some money but that the very

628

00:35:08,014 --> 00:35:09,057

first parts and

629

00:35:09,057 --> 00:35:14,006

look kinda mind einon and trivial tear the comment layman I because they are

630

00:35:14,006 --> 00:35:16,013

things like 10 suspects an enzyme

631

00:35:16,067 --> 00:35:19,086

that the key objective here is to get their samples I will learn a lot with

632

00:35:19,086 --> 00:35:22,149

the camera recording the printout layers are being laid in real time

633

00:35:23,049 --> 00:35:26,073

and in Wall Street bringing it back to the ground and you in detail ground

634

00:35:26,073 --> 00:35:27,138

analysis so that kinda day

635

00:35:28,038 --> 00:35:31,039

society and we get excited about it everyone

636

00:35:31,048 --> 00:35:34,135

exciting and then after that we do have as several tools

637

00:35:35,035 --> 00:35:38,058

one thing I mention it's like
replacement parts for the printer

638

00:35:38,058 --> 00:35:41,083

and they're they're certain component to
the printer itself and

639

00:35:41,083 --> 00:35:44,170

and I let my cat you want Taco Bell a
bit more that if we need to replace

640

00:35:45,007 --> 00:35:47,074

those and just normal wear and tear just
like your

641

00:35:48,037 --> 00:35:51,079

the printer on on the ground we want to
be able to prepare summoners replacement

642

00:35:51,079 --> 00:35:51,153

parts

643

00:35:52,053 --> 00:35:55,081

and be our first time customer and user
and and Mike

644

00:35:55,081 --> 00:35:58,134

you wanna talk more about that 3 yea
Asher so yeah we

645

00:35:59,034 --> 00:36:02,128

we design the trainer itself to have a
number

646

00:36:03,028 --> 00:36:06,056

components inside that are actually
3d-printed right

647

00:36:06,056 --> 00:36:09,119

we sort it wanted to I'm proved that

648

00:36:10,019 --> 00:36:13,067

you know really you can you can have
real space hardware with three different

649

00:36:13,067 --> 00:36:14,165

person is something that we now

650

00:36:15,065 --> 00:36:18,138

but it's not you know it's not quite
clear to everyone so we we took every

651

00:36:19,038 --> 00:36:20,101

opportunity to make

652

00:36:21,001 --> 00:36:24,023

quite a number really important parts
insider 3d printer

653

00:36:24,023 --> 00:36:28,111

actually three principal and the printer
itself is actually going to be able to

654

00:36:29,011 --> 00:36:33,038

print its own replacement parts to a
certain extent and some other things

655

00:36:33,038 --> 00:36:34,040

reprinting

656

00:36:34,058 --> 00:36:38,061

are going to be a those actual
replacement parts

657

00:36:38,088 --> 00:36:42,114

and pro-business clatter actually gonna
maybe even try to install them back in

658

00:36:43,014 --> 00:36:47,035

the printer and show that it was
actually able to repair itself

659

00:36:47,035 --> 00:36:51,068

all I'm gonna take one with one last
question here from our audience this one

660

00:36:51,068 --> 00:36:52,073

is from jerry

661

00:36:52,073 --> 00:36:57,091

fits I who s said if there are any new
technologies that we believe

662

00:36:57,091 --> 00:37:00,185

we could see in zero G only that are
completely different that

663

00:37:01,085 --> 00:37:05,183

and what we would have here on earth
with 3d printing

664

00:37:06,083 --> 00:37:09,110

sure I'm yeah I think making is about it
together I

665

00:37:10,001 --> 00:37:14,014

I'll say medical it all excited about it
yeah the answer is

666

00:37:14,023 --> 00:37:18,117

actually could be the yet we do get
excited about that and the answer is it

667

00:37:19,017 --> 00:37:20,002

actually could be

668

00:37:20,002 --> 00:37:23,066

and wonder even if we do you call this a

technology demonstration is is just

669

00:37:23,084 --> 00:37:25,110

weird fan because five a parabolic
flight

670

00:37:26,001 --> 00:37:29,074

we can to play an entire print during
that my crappy boers

671

00:37:29,083 --> 00:37:33,098

on a pair by white so truly what what's
really exciting for us come and get you

672

00:37:33,098 --> 00:37:33,156

ok sign

673

00:37:34,056 --> 00:37:37,062

on the material cited this as well as is
we don't know for sure

674

00:37:38,016 --> 00:37:41,058

what Mr crabby might happen we might
actually see some improvements

675

00:37:41,058 --> 00:37:44,105

and the way the printer is designed you
know we don't have convection in space

676

00:37:45,005 --> 00:37:45,104

for example

677

00:37:46,004 --> 00:37:50,016

and so there backward on a crystal
growth we saw a lot of improvements in a

678

00:37:50,016 --> 00:37:51,069

way to crystal structure and

679

00:37:51,069 --> 00:37:55,145

add with ways is built and so we can
actually possibly see that as well we

680

00:37:56,045 --> 00:37:59,094

just don't know an act that is exciting
part about a technology demonstration

681

00:37:59,094 --> 00:38:03,137

as I mentioned earlier it's not just and
the mic ready aspect might we see

682

00:38:04,037 --> 00:38:04,113

something different

683

00:38:05,013 --> 00:38:08,038

it's how we can design differently and
we

684

00:38:08,038 --> 00:38:12,008

we my at the I'm positive that we're
gonna come up with an you the public

685

00:38:12,008 --> 00:38:16,009

help us come up with new and innovative
ways making step in space that we've

686

00:38:16,081 --> 00:38:17,108

never been able to do

687

00:38:18,008 --> 00:38:21,062

just because the way we have to watch it
I'm so the answer is yes we actually

688

00:38:21,062 --> 00:38:24,111

could find some cool and materials
aspects of this that make it and I

689

00:38:25,011 --> 00:38:26,086

differently preying on the ground

690

00:38:26,086 --> 00:38:29,009

but it's an absolute 100 percent
certainty that we will find new

691

00:38:29,009 --> 00:38:33,016

things to print in years and in a
different way

692

00:38:33,097 --> 00:38:37,119

and microgravity environment but I would
just add just right I'm sorry Mike

693

00:38:38,019 --> 00:38:41,084

compaq I'll just from the the mir
redesigned

694

00:38:41,084 --> 00:38:44,096

made in space did several PEPFAR whites
in

695

00:38:44,096 --> 00:38:47,097

they've had to come up with their own
design

696

00:38:48,006 --> 00:38:51,061

to start from that point we we've add it
to the

697

00:38:51,061 --> 00:38:55,067

to the knowledge base up 3d printing
from print heads to

698

00:38:55,067 --> 00:38:59,072

I'll you know how you know how's the
polymer going to flow out

699

00:39:00,017 --> 00:39:03,089

citing you know credit is is due to made
in space for just

700

00:39:03,089 --> 00:39:06,158

taking that risk in being innovative to design their own

701

00:39:07,058 --> 00:39:11,100

brenner now a bank's when a germantown like I said earlier we actually didn't

702

00:39:12,000 --> 00:39:13,077

even set out to do it and it was a

703

00:39:13,077 --> 00:39:17,106

very interesting wrote but yeah it's been its it you are right

704

00:39:18,006 --> 00:39:21,104

now we actually have developed a number technologies reprinting their

705

00:39:22,004 --> 00:39:25,062

I think it'll be really useful in space but also down here

706

00:39:25,062 --> 00:39:28,069

on earth I know we're almost at a time but I just wanted reiterate

707

00:39:29,032 --> 00:39:32,126

and Nikki's last point that it's the most I would take away to that question

708

00:39:36,007 --> 00:39:33,068

at

709

00:39:36,007 --> 00:39:39,060

out 3d printing works I mean if you've ever designed anything to be three

710

00:39:40,023 --> 00:39:40,097
printed

711
00:39:40,097 --> 00:39:43,159
I'm you're doing engineering you've
definitely thought about the fact that

712
00:39:44,059 --> 00:39:45,102
there's going to be

713
00:39:46,002 --> 00:39:50,016
gravity race you're going to have to
design the part to support its own way

714
00:39:50,016 --> 00:39:53,049
even worse if it has to be launched it
has to support much more than its own

715
00:39:53,049 --> 00:39:53,101
way

716
00:39:54,001 --> 00:39:57,005
also the vibrations everything like that
I'm just

717
00:39:57,005 --> 00:39:59,081
close your eyes one time and imagine
what it would be like to design

718
00:40:00,026 --> 00:40:01,028
something that had

719
00:40:01,046 --> 00:40:05,075
it didn't ever have to support any way
at all

720
00:40:05,075 --> 00:40:08,123
and you end up with these completely
different kinds of structures that

721

00:40:09,023 --> 00:40:12,107

I really could be incredibly beneficial
and a lot of waste

722

00:40:13,007 --> 00:40:16,083

and 3d printing in space is most likely
the only way to make

723

00:40:16,083 --> 00:40:20,127

structures South they say oh hell pace
and help Esquina termed what you we've

724

00:40:21,027 --> 00:40:23,118

been going around terms like zero-g_
structures

725

00:40:24,018 --> 00:40:28,021

that were really and TriMet to create a
term that is something that you can

726

00:40:28,048 --> 00:40:31,062

print with micro gravity that you can do
on our inside joke around with the guys

727

00:40:31,062 --> 00:40:34,086

at Maine's ethnic their cable how every
printer ground samples

728

00:40:34,086 --> 00:40:37,094

how do we know it works and and and that
the point is

729

00:40:37,094 --> 00:40:40,095

and you know it doesn't work on the
ground and that's why you're doing it in

730

00:40:41,004 --> 00:40:43,048

space for the red heat extractors

731

00:40:43,048 --> 00:40:46,052
an enemy bitch playing around like to
manage my key and its really

732
00:40:46,088 --> 00:40:50,151
and I love the hasher Anchorage on
people have their contact information

733
00:40:51,051 --> 00:40:54,144
out there and feel free to contact this
with with dry and cool idea

734
00:40:55,044 --> 00:40:58,086
designs or difference wave explain

735
00:40:58,086 --> 00:41:02,133
eregi structures up and I know about to
wrap up

736
00:41:03,033 --> 00:41:06,007
I just want it nasa does so many things

737
00:41:06,007 --> 00:41:09,103
31 at nasa's being the pool agency only
do so many

738
00:41:10,066 --> 00:41:13,157
ciskei its technology a quote for space
exploration

739
00:41:14,057 --> 00:41:17,058
ask all asked for daily life

740
00:41:17,067 --> 00:41:22,073
and 3d printing of as we all know that's
been around for twenty twenty-five years

741
00:41:23,027 --> 00:41:27,004
and there's a new resurgence 3d printing
and this week in

742

00:41:27,004 --> 00:41:30,015

nasa I'll had a booth at USA Science

743

00:41:30,051 --> 00:41:34,051

engineers possible and space tech had a
3d printer

744

00:41:34,051 --> 00:41:37,107

and there are so many young kids that
came to

745

00:41:38,007 --> 00:41:42,044

explored a 3d printer and I think this
is an opportunity with art 3d printing

746

00:41:42,044 --> 00:41:43,093

in zero G two really

747

00:41:43,093 --> 00:41:46,169

impact the next generation of scientists
and engineers

748

00:41:47,069 --> 00:41:52,117

and so I think it it it set aside the
technology that we're going to develop

749

00:41:53,017 --> 00:41:57,101

I think we're making us %uh real quick
impact on our younger generation and I

750

00:41:58,001 --> 00:42:00,008

think 30 parenting is that technology

751

00:42:00,008 --> 00:42:03,014

that really well will help influence
that

752

00:42:04,004 --> 00:42:08,051

ha so a we are pretty much almost that
time here

753

00:42:08,087 --> 00:42:12,093

I just wanted to maybe ask you guys call
of simple question

754

00:42:13,047 --> 00:42:16,140

if you okay I don't know if and you

755

00:42:17,004 --> 00:42:20,059

Evanescence this but how much where you
buyers by

756

00:42:20,095 --> 00:42:24,191

replicators a on Star Trek with this
technology

757

00:42:25,091 --> 00:42:28,102

I'll while I can say a hundred percent

758

00:42:29,002 --> 00:42:32,009

United definitely grew up watching all
that up and

759

00:42:32,009 --> 00:42:35,035

we actually had rod Roddenberry stop by
our office

760

00:42:36,016 --> 00:42:39,002

not too long ago who is the son of gene
roddenberry that crater

761

00:42:39,002 --> 00:42:44,009

Star Trek and we had the amazing moment
where he actually came into our

762

00:42:44,027 --> 00:42:48,085

are lab and put his hand on our printer
and actually said

763

00:42:48,085 --> 00:42:51,181

hero gray hot so that when they're
pretty calm moment for all that

764

00:42:52,081 --> 00:42:55,119

Star Trek fans out there course that
didn't make that he yet but

765

00:42:56,019 --> 00:42:59,021

now but for future future version of the
trainer and

766

00:42:59,039 --> 00:43:02,072

but yes absolutely inspired player cool

767

00:43:02,072 --> 00:43:06,164

yeah arlen a Cherokee

768

00:43:07,064 --> 00:43:11,067

absolutely hey I think I I think add
it's obvious we hear that a lie

769

00:43:11,067 --> 00:43:14,125

and in this Dec by age along that lines
the replicator we're trying to make

770

00:43:15,025 --> 00:43:19,048

atrial also think as Big Bang guys might
like this is where

771

00:43:19,048 --> 00:43:22,117

who definitely I'm a die-hard Traci

772

00:43:23,017 --> 00:43:26,034

and so what I think that this I think
the

773

00:43:26,034 --> 00:43:29,089

all the next the next step actually

774

00:43:29,089 --> 00:43:33,161

all trans transporting ourselves to a planetary surface the

775

00:43:34,061 --> 00:43:38,142

starting point so I think we've really get very excited about this and I

776

00:43:39,042 --> 00:43:42,063

hope that you see that when we talk about pretty frightening because we

777

00:43:42,063 --> 00:43:44,069

think it's the best bank sent some

778

00:43:45,023 --> 00:43:49,051

talk talk yeltsin all thanked everybody for

779

00:43:49,051 --> 00:43:52,066

for joining us for six years in our technical difficulty some

780

00:43:52,066 --> 00:43:55,098

construction here wires offices as well I

781

00:43:55,098 --> 00:43:58,113

if you want to find out more information we got information about

782

00:43:59,013 --> 00:44:03,029

over this nasa effort and made in space on our Google+ case

783

00:44:03,029 --> 00:44:06,088

I mean you can try and protect any the folks that you talk to today so

784

00:44:06,088 --> 00:44:09,177

thanks very much thanks Robert A court
hearing back