1
00:00:12,130 --> 00:00:39,560
[Music]

2
00:00:39,570 --> 00:00:47,690
t-minus one minute

3
00:01:22,720 --> 00:00:55,850
[Music]

4
00:01:22,730 --> 00:01:28,750
we are go for launch

5
00:01:28,760 --> 00:01:37,090
t-minus ten nine eight six

6
00:01:41,470 --> 00:01:39,640
[Music]

7
00:01:43,450 --> 00:01:41,480
next up we're gonna talk about plant

8
00:01:46,060 --> 00:01:43,460
growth in space things happening inside

9
00:02:29,330 --> 00:01:46,070
this lab to help sustain our presence on

10
00:02:32,300 --> 00:02:30,949
welcome back we are coming to you live

11
00:02:34,580 --> 00:02:32,310
once again from NASA's Kennedy Space

12
00:02:36,470 --> 00:02:34,590
Center I'm Joshua Santoro and that's the

13
00:02:38,480 --> 00:02:36,480

communication here in front of the

14
00:02:40,430 --> 00:02:38,490
beautiful space shuttle Atlantis a

15
00:02:42,860 --> 00:02:40,440
beautiful coast as always the last

16
00:02:45,740 --> 00:02:42,870
vehicle to take humans into low-earth

17
00:02:47,120 --> 00:02:45,750
orbit from America and we're getting

18
00:02:48,290 --> 00:02:47,130
ready to do that again in just two short

19
00:02:49,940 --> 00:02:48,300
days Philip

20
00:02:51,979 --> 00:02:49,950
my guest today or my co-host today

21
00:02:54,140 --> 00:02:51,989
rather Philip thanks for joining me

22
00:02:55,400 --> 00:02:54,150
thank you so much my name is Philip R

23
00:02:57,380 --> 00:02:55,410
Grove and I'm with the launch services

24
00:02:59,390 --> 00:02:57,390
program I'm really excited to be here

25
00:03:01,160 --> 00:02:59,400
today as Joshua said we're getting ready

26
00:03:03,320 --> 00:03:01,170
for human spaceflight from American soil

27
00:03:04,910 --> 00:03:03,330
again and for today's show we're gonna

28
00:03:07,190 --> 00:03:04,920
be talking about one of NASA's efforts

29
00:03:08,990 --> 00:03:07,200
to sustain life in space by talking

30
00:03:11,030 --> 00:03:09,000
about veggie so I want to encourage

31
00:03:12,949 --> 00:03:11,040
everybody watching online to submit your

32
00:03:14,570 --> 00:03:12,959
questions we normally would be able to

33
00:03:16,640 --> 00:03:14,580
bring you on to Center for the NASA

34
00:03:18,110 --> 00:03:16,650
social so you could you know engage with

35
00:03:20,150 --> 00:03:18,120
us and ask questions and see all of

36
00:03:21,470 --> 00:03:20,160
these really cool things here but just

37
00:03:23,030 --> 00:03:21,480
because you can't do that that doesn't

38
00:03:24,710 --> 00:03:23,040

mean that you can't be engaged so please

39
00:03:26,509 --> 00:03:24,720
be a part of the discussion and we're

40
00:03:29,030 --> 00:03:26,519
excited to talk to our special guests

41
00:03:31,130 --> 00:03:29,040
today yeah I mean such a good point two

42
00:03:33,740 --> 00:03:31,140
things obviously just a virtual aspect

43
00:03:35,750 --> 00:03:33,750
of this and King on the sustain presence

44
00:03:37,310 --> 00:03:35,760
beyond Earth that's a big part hopefully

45
00:03:39,680 --> 00:03:37,320
you've heard that NASA's going back to

46
00:03:41,810 --> 00:03:39,690
the moon but it's not just a camping

47
00:03:44,390 --> 00:03:41,820
trip as some might say historically is

48
00:03:46,610 --> 00:03:44,400
what the Apollo program was like this

49
00:03:48,229 --> 00:03:46,620
time we are going to stay there for a

50
00:03:49,729 --> 00:03:48,239
longer period of time and just like

51
00:03:51,740 --> 00:03:49,739
you're coming to us virtually our guest

52
00:03:54,380 --> 00:03:51,750
is as well so legal hadn't introduced

53
00:03:56,319 --> 00:03:54,390
dr. Gioia Massa Joya thank you as always

54
00:04:07,990 --> 00:03:56,329
for contributing to our outreach efforts

55
00:04:13,490 --> 00:04:12,349
so obviously I think people hopefully

56
00:04:15,470 --> 00:04:13,500
people understand that we talked about

57
00:04:16,849 --> 00:04:15,480
growing plants in space this isn't just

58
00:04:18,140 --> 00:04:16,859
throwing seeds in the ground and

59
00:04:18,770 --> 00:04:18,150
watching them grow there's a lot more to

60
00:04:21,440 --> 00:04:18,780
it than that

61
00:04:23,870 --> 00:04:21,450
so I want to let you kind of introduce a

62
00:04:26,330 --> 00:04:23,880
little bit about what you're doing and

63
00:04:29,100 --> 00:04:26,340

kind of what this big picture is as far

64
00:04:33,240 --> 00:04:29,110
as plant growth in space

65
00:04:35,939 --> 00:04:33,250
well we are working on being able to oak

66
00:04:39,300 --> 00:04:35,949
box for the food to supplement the

67
00:04:41,189 --> 00:04:39,310
packaged diet in the near term and this

68
00:04:44,909 --> 00:04:41,199
will get really important as we go onto

69
00:04:49,170 --> 00:04:44,919
the moon and beyond that because the

70
00:04:51,390 --> 00:04:49,180
stored food nutrition and who's talking

71
00:04:54,420 --> 00:04:51,400
over time and so we need to ensure that

72
00:04:57,899 --> 00:04:54,430
the gastroc to be healthy but I'm giving

73
00:05:00,629 --> 00:04:57,909
them supplemental fresh produce and then

74
00:05:06,240 --> 00:05:00,639
as we go and stay longer we'll be able

75
00:05:07,649 --> 00:05:06,250
to grow more awesome and you brought

76
00:05:08,700 --> 00:05:07,659
along a few videos today there's four

77
00:05:10,529 --> 00:05:08,710
total we're gonna try and get through

78
00:05:12,180 --> 00:05:10,539
all these want to take questions like

79
00:05:13,860 --> 00:05:12,190
philip mentioned as we go let's jump

80
00:05:15,540 --> 00:05:13,870
right in here obviously this one

81
00:05:17,430 --> 00:05:15,550
focusing definitely on that plant growth

82
00:05:19,909 --> 00:05:17,440
in space so Julia tell us what we're

83
00:05:22,890 --> 00:05:19,919
watching as we check out this video

84
00:05:25,379 --> 00:05:22,900
sure so this is on the International

85
00:05:28,050 --> 00:05:25,389
Space Station where we have a veggie

86
00:05:30,300 --> 00:05:28,060
hardware so veggie is one of the two

87
00:05:33,959 --> 00:05:30,310
plant growth chamber types that we have

88
00:05:36,540 --> 00:05:33,969

on Space Station and we've done a lot of

89
00:05:39,839 --> 00:05:36,550
improv experiments with veggie or I

90
00:05:44,029 --> 00:05:39,849
should say the astronauts have we have

91
00:05:47,790 --> 00:05:44,039
the zinnias kelly group and these

92
00:05:50,459 --> 00:05:47,800
problems related to the watering which

93
00:05:52,980 --> 00:05:50,469
we'll talk about a little bit soon but

94
00:05:55,409 --> 00:05:52,990
scott took over as an autonomous

95
00:05:58,140 --> 00:05:55,419
gardener he was really able to do a

96
00:05:58,950 --> 00:05:58,150
wonderful job to bring the zinnias back

97
00:06:01,890 --> 00:05:58,960
to life

98
00:06:04,409 --> 00:06:01,900
getting them to flower and even did the

99
00:06:08,159 --> 00:06:04,419
first on-orbit flower arrangement ever

100
00:06:09,629 --> 00:06:08,169
she's pretty awesome we were really

101
00:06:11,610 --> 00:06:09,639
thrilled by that we got a lot of these

102
00:06:13,829 --> 00:06:11,620
flowers back and were able to grow

103
00:06:17,159 --> 00:06:13,839
daughter plants from the seeds that were

104
00:06:19,730 --> 00:06:17,169
on in the flowers and here you'll see a

105
00:06:22,559 --> 00:06:19,740
beautiful shot of in spot arrangement

106
00:06:24,279 --> 00:06:22,569
we've also grown a number of other types

107
00:06:26,559 --> 00:06:24,289
of crops of the

108
00:06:29,589 --> 00:06:26,569
crops primarily that the crew could grow

109
00:06:31,689 --> 00:06:29,599
and eat and we monitor everything from

110
00:06:33,730 --> 00:06:31,699
our ground station our experiment

111
00:06:36,519 --> 00:06:33,740
monitoring station here at Kennedy Space

112
00:06:40,929 --> 00:06:36,529
Center where we get over the shoulder

113
00:06:43,510 --> 00:06:40,939

video we also got great photos times we

114
00:06:57,459 --> 00:06:43,520
run around to experiments in our

115
00:07:01,059 --> 00:06:57,469
chambers we a wonderful team the view

116
00:07:05,829 --> 00:07:01,069
team is really knowledgeable and react

117
00:07:14,260 --> 00:07:05,839
very well to quite a few it's not easy

118
00:07:16,480 --> 00:07:14,270
growing plants in space eat produce we

119
00:07:23,679 --> 00:07:16,490
do a lot of ground test leading up at

120
00:07:26,769 --> 00:07:23,689
the back so that we can ensure so you

121
00:07:35,709 --> 00:07:26,779
know brilliantly successful you know

122
00:07:36,909 --> 00:07:35,719
fighting some of the challenge you know

123
00:07:38,889 --> 00:07:36,919
I want to get into some social media

124
00:07:40,959 --> 00:07:38,899
questions but I wanted to ask you for

125
00:07:42,189 --> 00:07:40,969
there's there's probably a dozen things

126
00:07:44,379 --> 00:07:42,199
I could ask you about just that short

127
00:07:46,179 --> 00:07:44,389
video but I want to kind of key on the

128
00:07:49,149 --> 00:07:46,189
fact that you mentioned you have a small

129
00:07:52,839 --> 00:07:49,159
team and and you all are responsible for

130
00:07:55,389 --> 00:07:52,849
growing plants and flowers in space like

131
00:07:57,189 --> 00:07:55,399
on the space station like that's that's

132
00:08:02,139 --> 00:07:57,199
incredible joy I like it that's that's

133
00:08:04,389 --> 00:08:02,149
that's how this works right it was a

134
00:08:07,719 --> 00:08:04,399
Ledge long dream of mine to be here and

135
00:08:09,100 --> 00:08:07,729
so we plant the seeds you'll get to see

136
00:08:11,060 --> 00:08:09,110
some of that and then one of the later

137
00:08:14,150 --> 00:08:11,070
videos

138
00:08:17,150 --> 00:08:14,160

we do selection of the crops beforehand

139
00:08:18,680 --> 00:08:17,160
and really trying to figure out what

140
00:08:21,440 --> 00:08:18,690
will grow well in this unique

141
00:08:24,110 --> 00:08:21,450
environment of space station it's you

142
00:08:28,160 --> 00:08:24,120
know without gravity without natural

143
00:08:30,980 --> 00:08:28,170
convection and we have you know humans

144
00:08:34,460 --> 00:08:30,990
and plants and microorganisms all living

145
00:08:36,080 --> 00:08:34,470
together yeah joy that's a great segue

146
00:08:37,790 --> 00:08:36,090
into some of the first questions that we

147
00:08:39,950 --> 00:08:37,800
got from our online audience can you

148
00:08:43,850 --> 00:08:39,960
tell us about some of those future crops

149
00:09:00,620 --> 00:08:43,860
that are going to be they're gonna be on

150
00:09:03,920 --> 00:09:00,630
beta yeah so right now kind of tastes

151
00:09:06,890 --> 00:09:03,930
like a meaty flavor almost we can call

152
00:09:09,380 --> 00:09:06,900
it a steak plant is kind of our fun

153
00:09:11,380 --> 00:09:09,390
common name for it we hope that the

154
00:09:15,770 --> 00:09:11,390
astronauts will really enjoy that one

155
00:09:18,230 --> 00:09:15,780
we're working on peppers or the advanced

156
00:09:20,360 --> 00:09:18,240
plant habitat I'll show some shots of

157
00:09:23,300 --> 00:09:20,370
that in a little bit and we're looking

158
00:09:25,250 --> 00:09:23,310
at Tomatoes for next year as well as

159
00:09:27,020 --> 00:09:25,260
other varieties of leafy crops

160
00:09:28,730 --> 00:09:27,030
there's no way to cook anything on space

161
00:09:32,120 --> 00:09:28,740
station so we're only looking at things

162
00:09:34,370 --> 00:09:32,130
you can pick and eat fresh right now so

163
00:09:35,930 --> 00:09:34,380

as we think about you can't cook things

164
00:09:37,190 --> 00:09:35,940
in space at least not yet I'm sure

165
00:09:39,770 --> 00:09:37,200
someday somebody's gonna make that

166
00:09:41,960 --> 00:09:39,780
happen we've seen hopefully people see

167
00:09:43,790 --> 00:09:41,970
movies like the Martian which was put

168
00:09:46,190 --> 00:09:43,800
together with the help and support of a

169
00:09:48,530 --> 00:09:46,200
lot of NASA scientists so obviously we

170
00:09:50,900 --> 00:09:48,540
saw a lot of potato usage there is that

171
00:09:52,730 --> 00:09:50,910
just hey you can eat raw potatoes or is

172
00:09:56,000 --> 00:09:52,740
that like hey the future of we can

173
00:09:58,730 --> 00:09:56,010
actually cook potatoes now well as soon

174
00:10:00,500 --> 00:09:58,740
as you have a microwave or an oven or

175
00:10:02,450 --> 00:10:00,510
some you know fairly straightforward way

176
00:10:04,370 --> 00:10:02,460
to cook things and they do actually have

177
00:10:06,710 --> 00:10:04,380
a small oven on space station for

178
00:10:08,420 --> 00:10:06,720
cookies but it took about two hours to

179
00:10:10,820 --> 00:10:08,430
bake one chocolate chip cookies so I

180
00:10:13,640 --> 00:10:10,830
think you know about 24 hours to do a

181
00:10:16,340 --> 00:10:13,650
big but as soon as you have something

182
00:10:18,320 --> 00:10:16,350
that would work well potatoes are great

183
00:10:21,770 --> 00:10:18,330
Robin we've studied the Kennedy Space

184
00:10:22,590 --> 00:10:21,780
Center for many many years they're very

185
00:10:25,139 --> 00:10:22,600
productive

186
00:10:28,800 --> 00:10:25,149
and they've got you know good calories

187
00:10:29,730 --> 00:10:28,810
and a few nutrients in there too let's

188
00:10:31,920 --> 00:10:29,740

do one more question then we'll go back

189
00:10:33,300 --> 00:10:31,930
to the next video great so there's a lot

190
00:10:34,860 --> 00:10:33,310
of questions about the methods that are

191
00:10:36,449 --> 00:10:34,870
being used to grow these plants can you

192
00:10:39,800 --> 00:10:36,459
talk about some of the challenges that

193
00:10:42,689 --> 00:10:39,810
you're particularly having to to solve

194
00:10:45,240 --> 00:10:42,699
to make this happen well that's a segue

195
00:10:48,749 --> 00:10:45,250
for the next video our biggest challenge

196
00:10:52,259 --> 00:10:48,759
is water water and plants and space is

197
00:10:54,420 --> 00:10:52,269
really very hard because water is it's

198
00:10:56,790 --> 00:10:54,430
kind of a blob and water and air don't

199
00:10:59,160 --> 00:10:56,800
mix but plant roots really need both

200
00:11:01,290 --> 00:10:59,170
water and they need oxygen so we'll see

201
00:11:05,069 --> 00:11:01,300
some videos on that you know other

202
00:11:07,559 --> 00:11:05,079
challenges are are really just trying to

203
00:11:10,889 --> 00:11:07,569
keep the environment for the plants a

204
00:11:13,290 --> 00:11:10,899
suitable so keeping the light the right

205
00:11:15,660 --> 00:11:13,300
levels keeping the humidity high enough

206
00:11:19,110 --> 00:11:15,670
that the plants can grow well but not so

207
00:11:22,259 --> 00:11:19,120
high the fungus grows so it's a lot of

208
00:11:23,280 --> 00:11:22,269
finding happy mediums yeah you mentioned

209
00:11:28,769 --> 00:11:23,290
this segue let's go ahead and take a

210
00:11:31,439 --> 00:11:28,779
look at this next video you know blobs

211
00:11:34,110 --> 00:11:31,449
and it coats surfaces and water and air

212
00:11:36,059 --> 00:11:34,120
don't mix well and so we're looking at a

213
00:11:38,999 --> 00:11:36,069

lot of different ways to water plants in

214
00:11:40,889 --> 00:11:39,009
space to try and get not not too little

215
00:11:42,420 --> 00:11:40,899
water not too much water we don't want

216
00:11:44,350 --> 00:11:42,430
to drown the plants and we don't want to

217
00:11:46,510 --> 00:11:44,360
dry them out

218
00:11:58,760 --> 00:11:46,520
[Music]

219
00:12:03,800 --> 00:12:01,220
today I'm going to show you how we water

220
00:12:12,160 --> 00:12:03,810
the garden here in space this is our

221
00:12:17,769 --> 00:12:14,440
zero gravity nothing's gonna make the

222
00:12:19,300 --> 00:12:17,779
water fall down over the place like it

223
00:12:21,340 --> 00:12:19,310
might when you water your plants on

224
00:12:24,060 --> 00:12:21,350
earth so here we have to use something

225
00:12:52,510 --> 00:12:25,879
we

226
00:12:52,520 --> 00:13:16,390
[Applause]

227
00:13:16,400 --> 00:13:31,070
this little sad has all recently

228
00:13:31,080 --> 00:13:37,780
to eat with lettuce

229
00:13:37,790 --> 00:13:47,710
[Music]

230
00:13:52,700 --> 00:13:50,690
thanks for watching

231
00:13:58,520 --> 00:13:52,710
goodbye from the International Space

232
00:14:00,410 --> 00:13:58,530
Station awesome so that that video

233
00:14:02,060 --> 00:14:00,420
showed us and gave us some insight into

234
00:14:03,710 --> 00:14:02,070
what the astronauts have to do to make

235
00:14:05,660 --> 00:14:03,720
these plants grow do the plants

236
00:14:08,060 --> 00:14:05,670
themselves behave differently do they

237
00:14:14,600 --> 00:14:08,070
grow in any unique ways in space that we

238
00:14:17,930 --> 00:14:14,610

might be surprised by changes on the

239
00:14:20,540 --> 00:14:17,940
genetic signaling level and so we have a

240
00:14:23,360 --> 00:14:20,550
number of researchers around the world

241
00:14:26,210 --> 00:14:23,370
who study you know plant responses to

242
00:14:29,480 --> 00:14:26,220
gravity and how how plants sense the

243
00:14:31,670 --> 00:14:29,490
different environment of space but when

244
00:14:33,800 --> 00:14:31,680
we're looking at the whole crop level as

245
00:14:35,870 --> 00:14:33,810
we're mostly doing it in the veggie

246
00:14:38,810 --> 00:14:35,880
proof we know to see too many

247
00:14:41,360 --> 00:14:38,820
differences in growth some of the plants

248
00:14:43,220 --> 00:14:41,370
do look very different between flight

249
00:14:45,530 --> 00:14:43,230
and ground we've had one variety of

250
00:14:49,790 --> 00:14:45,540
lettuce that just had a totally

251
00:14:52,490 --> 00:14:49,800
different shape grows habit but most of

252
00:14:55,160 --> 00:14:52,500
the plants grow pretty normally if we

253
00:14:57,200 --> 00:14:55,170
can get just that right amount of water

254
00:14:59,600 --> 00:14:57,210
and the right temperature and the right

255
00:15:03,080 --> 00:14:59,610
amount of light so the trick is getting

256
00:15:05,570 --> 00:15:03,090
that environment pretty good but yeah

257
00:15:08,510 --> 00:15:05,580
Christina did a wonderful job showing

258
00:15:11,120 --> 00:15:08,520
the watering process for veggie is

259
00:15:14,150 --> 00:15:11,130
pretty manual you know the astronauts

260
00:15:15,740 --> 00:15:14,160
have to go and add that water we hope to

261
00:15:18,920 --> 00:15:15,750
become more automated with their

262
00:15:21,560 --> 00:15:18,930
watering systems in the future okay

263
00:15:22,880 --> 00:15:21,570

awesome so what type of lighting do they

264
00:15:24,830 --> 00:15:22,890
use you talked about the environment in

265
00:15:26,420 --> 00:15:24,840
terms of the water we could see sort of

266
00:15:28,220 --> 00:15:26,430
I think there was some blue and some

267
00:15:29,720 --> 00:15:28,230
purple kind of looking lights they look

268
00:15:31,730 --> 00:15:29,730
like there was two different sections is

269
00:15:33,200 --> 00:15:31,740
there any unique or particular type of

270
00:15:38,240 --> 00:15:33,210
lighting that you use to support the

271
00:15:41,630 --> 00:15:38,250
plants so veggie has red green and blue

272
00:15:43,820 --> 00:15:41,640
LEDs and we can control the ratio of

273
00:15:46,310 --> 00:15:43,830
those and so that experiment that you

274
00:15:50,450 --> 00:15:46,320
were looking at was Ejiofor which was

275
00:15:52,640 --> 00:15:50,460
conducted last fall and that one is

276
00:15:55,010 --> 00:15:52,650
looking at the difference between those

277
00:15:57,920 --> 00:15:55,020
different kind of a blue ridge treatment

278
00:15:59,810 --> 00:15:57,930
and a red Ridge treatment in veggie to

279
00:16:01,400 --> 00:15:59,820
see how that impacted how well the

280
00:16:04,730 --> 00:16:01,410
plants grow

281
00:16:07,640 --> 00:16:04,740
how they tasted how nutritious they are

282
00:16:09,620 --> 00:16:07,650
and if their food safety was different

283
00:16:12,800 --> 00:16:09,630
and so we're still analyzing all of the

284
00:16:14,690 --> 00:16:12,810
data from that mission but in general

285
00:16:18,050 --> 00:16:14,700
plants are very sensitive to light and

286
00:16:21,440 --> 00:16:18,060
you can kind of dial it in differently

287
00:16:23,870 --> 00:16:21,450
for different plants our other Hardware

288
00:16:28,130 --> 00:16:23,880

up there our advanced plant have had it

289
00:16:31,010 --> 00:16:28,140
also have white lights and far red LEDs

290
00:16:33,560 --> 00:16:31,020
so we can really play with the color

291
00:16:37,580 --> 00:16:33,570
spectrum and tailor it for different

292
00:16:38,780 --> 00:16:37,590
plants so just thinking about all the

293
00:16:42,980 --> 00:16:38,790
challenges you hear talking about

294
00:16:45,740 --> 00:16:42,990
customizing per plant per flower how

295
00:16:47,210 --> 00:16:45,750
much of this process is executing good

296
00:16:51,250 --> 00:16:47,220
ideas and how much of this is just

297
00:16:53,630 --> 00:16:51,260
discovering new things for for the team

298
00:16:55,580 --> 00:16:53,640
well as you said earlier we have a

299
00:16:58,400 --> 00:16:55,590
pretty small team and we're kind of

300
00:17:02,510 --> 00:16:58,410
limited on what we can do so we look at

301
00:17:06,220 --> 00:17:02,520
the greater scientific groups around the

302
00:17:15,920 --> 00:17:06,230
world to see what they're finding and

303
00:17:19,069 --> 00:17:15,930
they're fine to our research we did have

304
00:17:22,600 --> 00:17:19,079
a surgery with our group we specialized

305
00:17:25,699 --> 00:17:22,610
in lighting and he a lot of custom

306
00:17:28,100 --> 00:17:25,709
testing and super really able to learn

307
00:17:30,950 --> 00:17:28,110
from his work to apply it to what we're

308
00:17:33,740 --> 00:17:30,960
doing out but we also keep up with on

309
00:17:35,090 --> 00:17:33,750
everywhere else to try to figure out

310
00:17:40,520 --> 00:17:35,100
what's gonna work best in this

311
00:17:43,100 --> 00:17:40,530
environment so can you tell us how this

312
00:17:45,530 --> 00:17:43,110
translates from the space station to the

313
00:17:49,910 --> 00:17:45,540

Moon or Mars or wherever else humans may

314
00:17:52,220 --> 00:17:49,920
go right well you know this station

315
00:17:54,350 --> 00:17:52,230
micrograph is a big challenge and

316
00:17:56,960 --> 00:17:54,360
especially from the watering as you saw

317
00:17:59,420 --> 00:17:56,970
with that great water video with the

318
00:18:02,960 --> 00:17:59,430
washcloth being wrung out you know water

319
00:18:06,350 --> 00:18:02,970
is so strained without gravity when we

320
00:18:07,840 --> 00:18:06,360
get on the moon we'll have one 6g a

321
00:18:09,640 --> 00:18:07,850
little bit of gravity

322
00:18:12,520 --> 00:18:09,650
and that will probably make it a lot

323
00:18:16,029 --> 00:18:12,530
easier to water your plants and Mars

324
00:18:20,590 --> 00:18:16,039
will have 3/8 gravity and so that will

325
00:18:22,390 --> 00:18:20,600
probably be even easier still but we

326
00:18:24,190 --> 00:18:22,400
want to develop systems that are going

327
00:18:27,960 --> 00:18:24,200
to work in all of those different

328
00:18:31,600 --> 00:18:27,970
environments so we're doing work testing

329
00:18:35,710 --> 00:18:31,610
water and nutrient delivery systems with

330
00:18:38,680 --> 00:18:35,720
hydroponics problems that we can easily

331
00:18:44,500 --> 00:18:38,690
clean out and reuse without taking a lot

332
00:18:47,350 --> 00:18:44,510
of substrate to space and would like to

333
00:18:52,169 --> 00:18:47,360
develop these I'll be pendant of gravity

334
00:18:55,360 --> 00:18:52,179
and you know others use LED lights

335
00:19:00,130 --> 00:18:55,370
environmental controls translate much

336
00:19:01,090 --> 00:19:00,140
more easily to all the different alright

337
00:19:02,799 --> 00:19:01,100
let's go ahead and jump into the next

338
00:19:04,630 --> 00:19:02,809

video on this is number three of

339
00:19:05,980 --> 00:19:04,640
hopefully we'll get to all for today so

340
00:19:11,649 --> 00:19:05,990
joy once again walk us through this

341
00:19:15,100 --> 00:19:11,659
video ok so this shows our preparation

342
00:19:16,960 --> 00:19:15,110
of plant pillows for veggie so as I said

343
00:19:18,899 --> 00:19:16,970
we want to get into hydroponic

344
00:19:21,880 --> 00:19:18,909
approaches but right now we're using

345
00:19:25,180 --> 00:19:21,890
substrates and veggie we use a bait

346
00:19:28,570 --> 00:19:25,190
ceramic with a controlled Rupert Eliezer

347
00:19:31,899 --> 00:19:28,580
and we put that inside a pillow which is

348
00:19:35,500 --> 00:19:31,909
essentially a space grow bag and we add

349
00:19:38,289 --> 00:19:35,510
these wicks help draw water throughout

350
00:19:42,070 --> 00:19:38,299
that that substrate and up to help the

351
00:19:44,860 --> 00:19:42,080
seeds germinate so you know we spend a

352
00:19:46,570 --> 00:19:44,870
lot of time preparing these seeds are

353
00:19:48,640 --> 00:19:46,580
something we're very interested

354
00:19:50,860 --> 00:19:48,650
normally we plant the seeds on the

355
00:19:53,649 --> 00:19:50,870
ground we blew them in the whigs but

356
00:19:56,950 --> 00:19:53,659
we're working on these seeds homes to

357
00:19:58,240 --> 00:19:56,960
allow the astronauts to handle seeds and

358
00:20:00,310 --> 00:19:58,250
these are going to be petted of the

359
00:20:03,490 --> 00:20:00,320
international space station suit with

360
00:20:05,200 --> 00:20:03,500
our red romaine lettuce seeds and so the

361
00:20:08,500 --> 00:20:05,210
astronauts will take a piece of this

362
00:20:11,830 --> 00:20:08,510
water-soluble film with seeds and put it

363
00:20:14,169 --> 00:20:11,840

inside those wigs space to hopefully

364
00:20:17,399 --> 00:20:14,179
grow some lettuce like this lettuce

365
00:20:20,380 --> 00:20:17,409
through in our earlier ground testing

366
00:20:21,190 --> 00:20:20,390
we're also testing a variety of new

367
00:20:23,530 --> 00:20:21,200
crops

368
00:20:25,480 --> 00:20:23,540
including tomatoes and so these are some

369
00:20:29,350 --> 00:20:25,490
of the dwarf tomatoes that were hoping

370
00:20:32,470 --> 00:20:29,360
to grow in Beijing next year we've down

371
00:20:35,560 --> 00:20:32,480
selected two variety of Red Robin that's

372
00:20:39,430 --> 00:20:35,570
the very productive dwarf tomato variety

373
00:20:42,430 --> 00:20:39,440
well in containers and we're testing a

374
00:20:45,190 --> 00:20:42,440
wide variety of leafy crops on the

375
00:20:50,140 --> 00:20:45,200
ground so it's not just red romaine

376
00:20:53,530 --> 00:20:50,150
lettuce we've grown mustards Changi coup

377
00:20:56,500 --> 00:20:53,540
which is an edible chrysanthemum things

378
00:21:00,550 --> 00:20:56,510
like wasabi which was already tested in

379
00:21:04,870 --> 00:21:00,560
space mizuna mustard which is this one

380
00:21:08,800 --> 00:21:04,880
is just fun check our pseudoknot or our

381
00:21:11,680 --> 00:21:08,810
veggie experiments and this was our last

382
00:21:13,270 --> 00:21:11,690
ground control or the test that we did

383
00:21:15,250 --> 00:21:13,280
with the different red to blue lighting

384
00:21:20,320 --> 00:21:15,260
recipes on order

385
00:21:21,850 --> 00:21:20,330
on orbit so so from that video and then

386
00:21:23,710 --> 00:21:21,860
one of the first ones you showed are the

387
00:21:25,030 --> 00:21:23,720
first ones we showed what there there's

388
00:21:27,100 --> 00:21:25,040

an interesting topic here about

389
00:21:28,810 --> 00:21:27,110
astronauts performing the science and

390
00:21:30,820 --> 00:21:28,820
you made a comment that made it it

391
00:21:33,100 --> 00:21:30,830
seemed like you were saying that

392
00:21:35,230 --> 00:21:33,110
essentially astronauts there are simply

393
00:21:36,880 --> 00:21:35,240
executing the orders that you get your

394
00:21:39,040 --> 00:21:36,890
team is providing on how to do this is

395
00:21:42,760 --> 00:21:39,050
that is that a fair summary of what's

396
00:21:45,690 --> 00:21:42,770
going on up in space well it depends on

397
00:21:48,750 --> 00:21:45,700
the experiment an astronaut so we

398
00:21:52,600 --> 00:21:48,760
started by developing you know really

399
00:21:55,570 --> 00:21:52,610
defined crew procedures to allow them to

400
00:21:58,210 --> 00:21:55,580
to grow the you know the plants based on

401
00:22:00,970 --> 00:21:58,220
the the plans that we put together on

402
00:22:04,000 --> 00:22:00,980
the ground but as Scott Kelly showed

403
00:22:07,600 --> 00:22:04,010
with the zinnias the best-laid plans

404
00:22:10,540 --> 00:22:07,610
don't always work and so he actually

405
00:22:12,610 --> 00:22:10,550
over what we call autonomous the

406
00:22:14,830 --> 00:22:12,620
gardening where he was the one making

407
00:22:18,910 --> 00:22:14,840
all of the decisions on when to water

408
00:22:21,790 --> 00:22:18,920
the plants in and how they change them

409
00:22:22,540 --> 00:22:21,800
and he did a wonderful job you've very

410
00:22:26,170 --> 00:22:22,550
engaged

411
00:22:29,020 --> 00:22:26,180
we've had other astronauts who have also

412
00:22:29,830 --> 00:22:29,030
done an incredible job at growing the

413
00:22:33,669 --> 00:22:29,840

crops

414
00:22:35,560 --> 00:22:33,679
and so you know if we want to get to the

415
00:22:37,269 --> 00:22:35,570
point where that's there they're the

416
00:22:39,010 --> 00:22:37,279
gardener's they're there they're seeing

417
00:22:41,320 --> 00:22:39,020
the cops and they're they're the ones

418
00:22:44,230 --> 00:22:41,330
doing the response not everyone's

419
00:22:46,750 --> 00:22:44,240
comfortable with that and so our ground

420
00:22:49,180 --> 00:22:46,760
team provides support as needed or

421
00:22:50,350 --> 00:22:49,190
different astronauts yeah I don't know

422
00:22:52,830 --> 00:22:50,360
what you feel it but I don't have a

423
00:22:54,640 --> 00:22:52,840
green thumb that's not my thing so

424
00:22:56,500 --> 00:22:54,650
that's really interesting to think about

425
00:22:58,210 --> 00:22:56,510
astronauts as gardeners I never really

426
00:23:00,700 --> 00:22:58,220
thought of that so yeah again very

427
00:23:02,260 --> 00:23:00,710
talented men and women so right so they

428
00:23:05,110 --> 00:23:02,270
noticed you mentioned that there's

429
00:23:07,060 --> 00:23:05,120
potentially impacts on taste and texture

430
00:23:08,919 --> 00:23:07,070
do the astronauts you know provide you

431
00:23:10,299 --> 00:23:08,929
that feedback and you you would just

432
00:23:13,690 --> 00:23:10,309
what you're doing based on that have you

433
00:23:16,720 --> 00:23:13,700
have you've seen those things happen we

434
00:23:19,299 --> 00:23:16,730
have gotten feedback from the crew you

435
00:23:21,789 --> 00:23:19,309
know mostly that they want edible crops

436
00:23:24,970 --> 00:23:21,799
first as ornamentals so we're doing a

437
00:23:27,310 --> 00:23:24,980
lot more food crops they like strong

438
00:23:30,279 --> 00:23:27,320

flavors and so that's why we're testing

439
00:23:34,299 --> 00:23:30,289
some things like the wasabi mustard or

440
00:23:36,580 --> 00:23:34,309
some of the spicier peppers and we are

441
00:23:39,310 --> 00:23:36,590
actually getting official taste test

442
00:23:41,620 --> 00:23:39,320
data back from the last experiment with

443
00:23:43,630 --> 00:23:41,630
the red to blue light and we hope to do

444
00:23:46,570 --> 00:23:43,640
more of that in the future where the

445
00:23:48,460 --> 00:23:46,580
astronauts actually raped the produce on

446
00:23:52,299 --> 00:23:48,470
you know the characteristics they like

447
00:23:54,130 --> 00:23:52,309
and they just like awesome

448
00:23:55,330 --> 00:23:54,140
so I know we're getting a little bit low

449
00:23:58,539 --> 00:23:55,340
on time here so let's go and roll this

450
00:24:00,340 --> 00:23:58,549
last video Joya and tell us again some

451
00:24:01,360 --> 00:24:00,350
more about what your team is doing we're

452
00:24:02,230 --> 00:24:01,370
not showing these because they were done

453
00:24:07,360 --> 00:24:02,240
and we're showing these because there's

454
00:24:09,370 --> 00:24:07,370
so much work happening yeah so this is

455
00:24:11,169 --> 00:24:09,380
some of our testing of different

456
00:24:13,810 --> 00:24:11,179
varieties of crops and this is our

457
00:24:17,289 --> 00:24:13,820
scientist Michele Spencer and Jason

458
00:24:20,919 --> 00:24:17,299
Fischer who are harvesting peppers so we

459
00:24:24,159 --> 00:24:20,929
do a lot of variety testing with peppers

460
00:24:27,039 --> 00:24:24,169
and tomatoes and leafy crops to really

461
00:24:29,860 --> 00:24:27,049
find high yielding plants that will grow

462
00:24:33,519 --> 00:24:29,870
well in the environment of the space

463
00:24:35,080 --> 00:24:33,529

station and peppers are really exciting

464
00:24:38,200 --> 00:24:35,090
and they're they're very nutritious

465
00:24:40,360 --> 00:24:38,210
they're very flavorful and we are hoping

466
00:24:42,190 --> 00:24:40,370
to grow those on the international space

467
00:24:45,400 --> 00:24:42,200
station in

468
00:24:49,840 --> 00:24:45,410
our advanced plant habitat hardware at

469
00:24:52,840 --> 00:24:49,850
the end of this year so this hardware

470
00:24:55,690 --> 00:24:52,850
the the APH or the advanced plant

471
00:24:56,910 --> 00:24:55,700
habitat is actually kind of like veggies

472
00:25:00,250 --> 00:24:56,920
big-sister

473
00:25:02,290 --> 00:25:00,260
it controls all the aspects of the

474
00:25:05,380 --> 00:25:02,300
environment so it's more of a plant

475
00:25:07,330 --> 00:25:05,390
physiology research tool

476
00:25:11,500 --> 00:25:07,340
whereas veggies a little more like a

477
00:25:14,740 --> 00:25:11,510
garden and we can control and monitor

478
00:25:17,490 --> 00:25:14,750
the environment so that we hopefully

479
00:25:20,950 --> 00:25:17,500
will be able to grow peppers really well

480
00:25:23,650 --> 00:25:20,960
here again is our tomato testing

481
00:25:25,900 --> 00:25:23,660
different varieties looking which ones

482
00:25:28,960 --> 00:25:25,910
will yield a lot of fruit in a short

483
00:25:31,330 --> 00:25:28,970
amount of time with pretty small growing

484
00:25:34,180 --> 00:25:31,340
space and there's a great shot of our

485
00:25:38,850 --> 00:25:34,190
advanced plant habitat on space station

486
00:25:42,010 --> 00:25:38,860
so unlike veggie it actually has a door

487
00:25:44,590 --> 00:25:42,020
so veggie is more the transparent

488
00:25:49,000 --> 00:25:44,600

bellows and you know the astronauts are

489
00:25:51,610 --> 00:25:49,010
growing and eating the crops and we also

490
00:25:54,580 --> 00:25:51,620
now have the capability on space station

491
00:25:57,040 --> 00:25:54,590
to way to the props as they eat it and

492
00:25:59,950 --> 00:25:57,050
so this is from veggie Oh for this is a

493
00:26:02,500 --> 00:25:59,960
mass measuring device to weigh the

494
00:26:04,480 --> 00:26:02,510
amount that they brew so that they can

495
00:26:06,970 --> 00:26:04,490
eat it but we can still get a good yield

496
00:26:09,970 --> 00:26:06,980
of the plants but really this this

497
00:26:13,240 --> 00:26:09,980
eating is our end goal you know we want

498
00:26:16,120 --> 00:26:13,250
happy astronauts that have lots of

499
00:26:19,090 --> 00:26:16,130
nutrition and also really good delicious

500
00:26:21,300 --> 00:26:19,100
food awesome thank you so much so we

501
00:26:23,710 --> 00:26:21,310
have two more questions to close out one

502
00:26:25,810 --> 00:26:23,720
in the long run how much of the

503
00:26:28,090 --> 00:26:25,820
astronauts diet is going to come from

504
00:26:30,370 --> 00:26:28,100
plants that they actually grew and then

505
00:26:34,080 --> 00:26:30,380
one person asked where can people access

506
00:26:37,510 --> 00:26:34,090
veggie research is it publicly available

507
00:26:40,480 --> 00:26:37,520
so we'll enter the last one first all

508
00:26:43,300 --> 00:26:40,490
our research is publicly available you

509
00:26:45,940 --> 00:26:43,310
know we get the data and publish it as

510
00:26:48,970 --> 00:26:45,950
frequently as we can it takes a while to

511
00:26:52,540 --> 00:26:48,980
gather it all together but you know

512
00:26:53,520 --> 00:26:52,550
nasa.gov has information on 50 and

513
00:26:56,330 --> 00:26:53,530

there's a

514
00:27:00,020 --> 00:26:56,340
a passbook where you can search for

515
00:27:03,270 --> 00:27:00,030
articles and things related to the vegie

516
00:27:06,390 --> 00:27:03,280
in terms of the percentage of the diet

517
00:27:10,530 --> 00:27:06,400
that will grow you know we're first

518
00:27:14,040 --> 00:27:10,540
looking to just have a fresh produce

519
00:27:16,050 --> 00:27:14,050
like maybe a salad a day or salad every

520
00:27:19,560 --> 00:27:16,060
other day and then we'll build from

521
00:27:21,540 --> 00:27:19,570
there we won't have a lot of space to

522
00:27:24,780 --> 00:27:21,550
grow plants so we're trying to get as

523
00:27:27,630 --> 00:27:24,790
much productivity in a small area as

524
00:27:30,000 --> 00:27:27,640
possible and we're even looking at new

525
00:27:32,550 --> 00:27:30,010
crops like microgreens which are really

526
00:27:36,060 --> 00:27:32,560
short leafy crops that can grow very

527
00:27:38,760 --> 00:27:36,070
fast and be very nutritious as a short

528
00:27:41,220 --> 00:27:38,770
term solution but then you know the

529
00:27:44,640 --> 00:27:41,230
longer that we stay on the moon or on

530
00:27:47,790 --> 00:27:44,650
Mars the the more we hope the diet and

531
00:27:50,270 --> 00:27:47,800
ultimately be great to get to the point

532
00:27:53,160 --> 00:27:50,280
where we have like a green house module

533
00:27:55,890 --> 00:27:53,170
on the surface of the Moon and on the

534
00:27:58,470 --> 00:27:55,900
surface of Mars where the crew can

535
00:28:00,780 --> 00:27:58,480
interact with the plants if they want if

536
00:28:03,660 --> 00:28:00,790
not maybe we'll have robotic gardeners

537
00:28:06,630 --> 00:28:03,670
taking care of the plants but providing

538
00:28:11,460 --> 00:28:06,640

them the fresh food that they like to

539
00:28:12,840 --> 00:28:11,470
have awesome as always we could talk for

540
00:28:14,220 --> 00:28:12,850
hours there's so much to learn joyeux

541
00:28:17,160 --> 00:28:14,230
thank you for joining us and

542
00:28:18,750 --> 00:28:17,170
contributing to our NASA social thank

543
00:28:20,790 --> 00:28:18,760
you for having me as a pleasure being

544
00:28:22,920 --> 00:28:20,800
here awesome and Philip thank you for

545
00:28:24,450 --> 00:28:22,930
joining me helping co-host today for

546
00:28:26,040 --> 00:28:24,460
this show and I think the next one is

547
00:28:27,810 --> 00:28:26,050
yours so looking forward to that that we

548
00:28:31,020 --> 00:28:27,820
coming up in just a few minutes we are

549
00:28:33,750 --> 00:28:31,030
targeting 2:00 p.m. Eastern Time hanger

550
00:28:35,700 --> 00:28:33,760
hanger AE this is the telemetry center

551
00:28:37,380 --> 00:28:35,710
of the universe for rocket launches so

552
00:28:39,360 --> 00:28:37,390
very exciting stuff want to tie this all

553
00:28:40,800 --> 00:28:39,370
together and remind you that a big part

554
00:28:43,410 --> 00:28:40,810
of what the Commercial Crew program is

555
00:28:45,390 --> 00:28:43,420
about what demo2 is about is developing

556
00:28:47,970 --> 00:28:45,400
a capability to increase the science

557
00:28:50,400 --> 00:28:47,980
research aboard the space station space

558
00:28:52,470 --> 00:28:50,410
X is only flying to people this week but

559
00:28:55,380 --> 00:28:52,480
their regular crewed flights will have

560
00:28:57,150 --> 00:28:55,390
four crew members on board both American

561
00:28:59,730 --> 00:28:57,160
and international and that capability

562
00:29:02,310 --> 00:28:59,740
that that volume of people is actually

563
00:29:05,870 --> 00:29:02,320

going to double our research capacity on

564
00:29:07,909 --> 00:29:05,880
Space Station so a tremendously big

565
00:29:09,650 --> 00:29:07,919
win for America and the entire world as

566
00:29:12,799 --> 00:29:09,660
we look towards the future of sustained

567
00:29:14,930 --> 00:29:12,809
presence beyond Earth doing stuff yes

568
00:29:16,070 --> 00:29:14,940
super exciting so is awesome yep alright