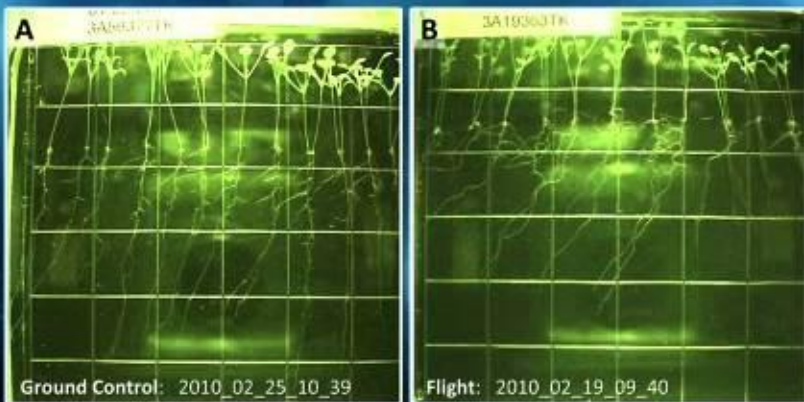


Plant Growth on International Space Station



1
00:00:03,750 --> 00:00:02,310
uh we have a special guest in mission

2
00:00:05,910 --> 00:00:03,760
control we have

3
00:00:08,070 --> 00:00:05,920
camille ain from the international space

4
00:00:09,750 --> 00:00:08,080
station program science office uh

5
00:00:11,669 --> 00:00:09,760
welcome camille

6
00:00:13,669 --> 00:00:11,679
thank you kelly for having me and you're

7
00:00:15,430 --> 00:00:13,679
here to talk about plant science today

8
00:00:16,950 --> 00:00:15,440
because we also have a special guest on

9
00:00:18,790 --> 00:00:16,960
the telephone line that we'll talk to in

10
00:00:20,310 --> 00:00:18,800
just a minute uh who is a principal

11
00:00:22,630 --> 00:00:20,320
investigator of one of the interesting

12
00:00:23,990 --> 00:00:22,640
experiments uh but tell us a little bit

13
00:00:25,990 --> 00:00:24,000

first of all about what we've been

14

00:00:27,750 --> 00:00:26,000

learning from plant biology on the

15

00:00:29,750 --> 00:00:27,760

international space station well we've

16

00:00:31,750 --> 00:00:29,760

been doing plant research in space for

17

00:00:33,110 --> 00:00:31,760

about 25 years

18

00:00:35,670 --> 00:00:33,120

and we've really advanced our

19

00:00:37,830 --> 00:00:35,680

fundamental knowledge in several areas

20

00:00:39,910 --> 00:00:37,840

first we've learned how plants respond

21

00:00:42,310 --> 00:00:39,920

to gravity and the technical term is

22

00:00:45,029 --> 00:00:42,320

gravitropism tropism meaning the

23

00:00:47,430 --> 00:00:45,039

external or environmental stimuli that

24

00:00:49,510 --> 00:00:47,440

plants respond to in order to grow and

25

00:00:51,590 --> 00:00:49,520

gravitropism means that they are

26
00:00:54,549 --> 00:00:51,600
responding to gravity in order in order

27
00:00:57,350 --> 00:00:54,559
to grow so in plant biology 101 or

28
00:00:59,510 --> 00:00:57,360
botany 101 we've learned that stocks

29
00:01:02,630 --> 00:00:59,520
grow up towards the light and that's

30
00:01:04,229 --> 00:01:02,640
called phototropism and roots grow down

31
00:01:06,230 --> 00:01:04,239
because of gravity

32
00:01:09,190 --> 00:01:06,240
and that's called gravitropism and i

33
00:01:11,830 --> 00:01:09,200
think dr paul in a few minutes will

34
00:01:15,350 --> 00:01:11,840
talk to us about what we've learned

35
00:01:18,070 --> 00:01:15,360
recently her findings in in on the

36
00:01:20,390 --> 00:01:18,080
knowledge base in this area we've also

37
00:01:22,710 --> 00:01:20,400
learned how to inform the design of

38
00:01:25,109 --> 00:01:22,720

advanced plant growth habitats or

39

00:01:27,270 --> 00:01:25,119

facilities and these are facilities that

40

00:01:30,870 --> 00:01:27,280

have grown in complexity and

41

00:01:33,350 --> 00:01:30,880

functionality and capability over time

42

00:01:35,270 --> 00:01:33,360

we've achieved the complete life cycle

43

00:01:37,910 --> 00:01:35,280

of plants meaning we've gone from seed

44

00:01:40,630 --> 00:01:37,920

to seed so we've gone from seeds to

45

00:01:43,030 --> 00:01:40,640

plant growth to full plants mature

46

00:01:45,190 --> 00:01:43,040

plants and that plant has been able to

47

00:01:48,230 --> 00:01:45,200

produce seeds that are viable so we've

48

00:01:50,469 --> 00:01:48,240

learned that and then we've demonstrated

49

00:01:53,030 --> 00:01:50,479

the physiological processes that are

50

00:01:55,350 --> 00:01:53,040

necessary for biological life support

51
00:01:57,749 --> 00:01:55,360
that those are sustainable and those are

52
00:02:00,230 --> 00:01:57,759
critical if we want to further explore

53
00:02:02,230 --> 00:02:00,240
space over long durations

54
00:02:04,950 --> 00:02:02,240
and so the research we've done over the

55
00:02:07,190 --> 00:02:04,960
last 25 years has really also identified

56
00:02:08,869 --> 00:02:07,200
some critical areas that we still need

57
00:02:11,589 --> 00:02:08,879
to research

58
00:02:14,070 --> 00:02:11,599
in areas such as the impact of gravity

59
00:02:16,790 --> 00:02:14,080
on the cellular and tissue levels of

60
00:02:19,670 --> 00:02:16,800
plants the whole plant level and then

61
00:02:21,110 --> 00:02:19,680
communities of plants level

62
00:02:22,550 --> 00:02:21,120
and there are a whole suite of these

63
00:02:24,869 --> 00:02:22,560

different experiments they look at

64

00:02:26,550 --> 00:02:24,879

different kinds of plants

65

00:02:28,309 --> 00:02:26,560

but we've recently gotten some results

66

00:02:31,030 --> 00:02:28,319

from one particular experiment one that

67

00:02:33,350 --> 00:02:31,040

we call tages let's bring in

68

00:02:34,790 --> 00:02:33,360

anna-lysa paul from florida

69

00:02:37,430 --> 00:02:34,800

welcome

70

00:02:39,589 --> 00:02:37,440

thank you and analisa could you tell us

71

00:02:41,270 --> 00:02:39,599

a little bit about yourself but where

72

00:02:42,070 --> 00:02:41,280

you are and what your line of research

73

00:02:42,869 --> 00:02:42,080

is

74

00:02:45,509 --> 00:02:42,879

sure

75

00:02:47,270 --> 00:02:45,519

my i am a research associate professor

76

00:02:49,830 --> 00:02:47,280

at the university of florida in the

77

00:02:51,589 --> 00:02:49,840

department of horticultural sciences

78

00:02:53,990 --> 00:02:51,599

also that's the program of plant

79

00:02:54,790 --> 00:02:54,000

molecular and cellular biology

80

00:03:02,149 --> 00:02:54,800

i

81

00:03:04,309 --> 00:03:02,159

plants work at the gene level and what

82

00:03:06,229 --> 00:03:04,319

turns genes on what turns them off and

83

00:03:08,390 --> 00:03:06,239

how plants respond especially to

84

00:03:10,309 --> 00:03:08,400

environmental stress and in particular

85

00:03:11,990 --> 00:03:10,319

novel environmental stresses like say

86

00:03:13,830 --> 00:03:12,000

space flight

87

00:03:15,750 --> 00:03:13,840

i think we have some interesting video

88

00:03:17,509 --> 00:03:15,760

of the tages experiment maybe you could

89

00:03:19,270 --> 00:03:17,519

tell us a little bit about tages what it

90

00:03:22,229 --> 00:03:19,280

stands for and what you're looking for

91

00:03:24,949 --> 00:03:22,239

there as we air this video sure um tejas

92

00:03:27,430 --> 00:03:24,959

stands for transgenic arabidopsis gene

93

00:03:29,270 --> 00:03:27,440

expression system and it actually has

94

00:03:30,789 --> 00:03:29,280

some space flight heritage over the past

95

00:03:31,830 --> 00:03:30,799

10 years in

96

00:03:33,910 --> 00:03:31,840

a number of different types of

97

00:03:36,470 --> 00:03:33,920

experiments that we've conducted

98

00:03:38,789 --> 00:03:36,480

we have engineered these plants to be

99

00:03:39,589 --> 00:03:38,799

reporters of their environment so that

100

00:03:41,509 --> 00:03:39,599

they

101

00:03:43,030 --> 00:03:41,519

that's the transgenic part is with a

102

00:03:45,830 --> 00:03:43,040

green fluorescent protein that can

103

00:03:47,830 --> 00:03:45,840

respond to environmental cues

104

00:03:49,670 --> 00:03:47,840

microgravity being one of them that's

105

00:03:50,949 --> 00:03:49,680

actually not the major focus of this

106

00:03:53,190 --> 00:03:50,959

particular experiment that you're

107

00:03:55,429 --> 00:03:53,200

highlighting right now but it uses the

108

00:03:57,670 --> 00:03:55,439

same hardware and that is it takes video

109

00:04:00,309 --> 00:03:57,680

images of the plants as they grow

110

00:04:02,149 --> 00:04:00,319

because we can use this uh very

111

00:04:04,710 --> 00:04:02,159

sophisticated imaging hardware developed

112

00:04:07,429 --> 00:04:04,720

by kennedy space center to collect

113

00:04:09,750 --> 00:04:07,439

images of the plants every six hours we

114

00:04:11,910 --> 00:04:09,760

can essentially get these movies of how

115

00:04:13,990 --> 00:04:11,920

the plants traverse across the surface

116

00:04:15,110 --> 00:04:14,000

of these nutrient plates in which we

117

00:04:16,870 --> 00:04:15,120

place them

118

00:04:19,030 --> 00:04:16,880

the information that we can get from

119

00:04:21,430 --> 00:04:19,040

that not only is some of the gene

120

00:04:24,230 --> 00:04:21,440

expression data which is the subject of

121

00:04:25,990 --> 00:04:24,240

another sub-study but also how they grow

122

00:04:28,150 --> 00:04:26,000

and how they grow over time and how they

123

00:04:30,469 --> 00:04:28,160

navigate across that surface and that's

124

00:04:32,710 --> 00:04:30,479

really the focus of this particular

125

00:04:36,390 --> 00:04:32,720

study that gave us some very interesting

126
00:04:40,310 --> 00:04:37,749
you know we've been showing some

127
00:04:42,390 --> 00:04:40,320
pictures of the experiment results that

128
00:04:44,390 --> 00:04:42,400
you've just published and one of them

129
00:04:46,070 --> 00:04:44,400
was a view that shows a lot of blue and

130
00:04:47,510 --> 00:04:46,080
red markers could you explain that a

131
00:04:50,070 --> 00:04:47,520
little bit to us why you highlighted

132
00:04:53,189 --> 00:04:50,080
those yes and so the blue and red is

133
00:04:55,510 --> 00:04:53,199
helps you track uh over time so each

134
00:04:57,990 --> 00:04:55,520
each little segment alternating red and

135
00:05:00,629 --> 00:04:58,000
blue is six hours or represents six

136
00:05:02,469 --> 00:05:00,639
hours on the on the tape i guess you

137
00:05:04,469 --> 00:05:02,479
could say so the plant grows for six

138
00:05:06,629 --> 00:05:04,479

hours it gets a little blue tag another

139

00:05:08,870 --> 00:05:06,639

six hours it gets a red one and so what

140

00:05:11,670 --> 00:05:08,880

that allowed us to do is to then

141

00:05:13,430 --> 00:05:11,680

mathematically map the progress of the

142

00:05:15,830 --> 00:05:13,440

roots across the plates and that could

143

00:05:18,469 --> 00:05:15,840

be then graphed and we could calculate

144

00:05:21,510 --> 00:05:18,479

and use statistical analyses to show

145

00:05:23,110 --> 00:05:21,520

that the divergence of the

146

00:05:26,469 --> 00:05:23,120

the pattern of growth from what you

147

00:05:29,029 --> 00:05:26,479

would consider a straight vertical is uh

148

00:05:31,830 --> 00:05:29,039

is a statistically significant

149

00:05:33,270 --> 00:05:31,840

phenomenon that we see on on orbit and

150

00:05:35,029 --> 00:05:33,280

that's why we tag them that way it's

151

00:05:37,430 --> 00:05:35,039

just to help us queue into it and give

152

00:05:39,990 --> 00:05:37,440

it a a number essentially

153

00:05:42,469 --> 00:05:40,000

okay and as i look at those pictures

154

00:05:44,469 --> 00:05:42,479

they look remarkably similar the ground

155

00:05:46,390 --> 00:05:44,479

version versus the one that was grown in

156

00:05:49,029 --> 00:05:46,400

space

157

00:05:50,870 --> 00:05:49,039

yes and that's that's the thing and so

158

00:05:52,790 --> 00:05:50,880

what you can see is all those plants

159

00:05:54,870 --> 00:05:52,800

well there's two different cultivars of

160

00:05:57,029 --> 00:05:54,880

plants on those plates cultivars many

161

00:05:59,189 --> 00:05:57,039

different ecotypes they're slightly

162

00:06:00,469 --> 00:05:59,199

different genetically but but very very

163

00:06:03,670 --> 00:06:00,479

similar

164

00:06:05,909 --> 00:06:03,680

the ones that that are as you look at it

165

00:06:07,749 --> 00:06:05,919

sort of on the right those cultivars

166

00:06:09,510 --> 00:06:07,759

naturally on the ground will just go

167

00:06:11,189 --> 00:06:09,520

straight down the surface of the plate

168

00:06:12,230 --> 00:06:11,199

the ones that are on the left will grow

169

00:06:15,990 --> 00:06:12,240

a little bit

170

00:06:18,870 --> 00:06:16,000

the left as you look at them but from

171

00:06:20,390 --> 00:06:18,880

the plants point of view they skew to

172

00:06:21,350 --> 00:06:20,400

the right and that's how i'll i'll talk

173

00:06:23,430 --> 00:06:21,360

about it

174

00:06:25,350 --> 00:06:23,440

and so naturally on earth those

175

00:06:27,029 --> 00:06:25,360

particular types of arabidopsis plants

176

00:06:29,510 --> 00:06:27,039

and many plants do this thing called

177

00:06:31,510 --> 00:06:29,520

skewing and also waving and when you

178

00:06:33,189 --> 00:06:31,520

look at the comparisons between the ones

179

00:06:35,270 --> 00:06:33,199

on flight and the ones on the ground

180

00:06:37,430 --> 00:06:35,280

they both look like they're growing

181

00:06:39,270 --> 00:06:37,440

straight down the place and they're

182

00:06:41,670 --> 00:06:39,280

skewing to the left

183

00:06:43,670 --> 00:06:41,680

now what is strange is when you think

184

00:06:45,029 --> 00:06:43,680

about it if you ask a

185

00:06:46,790 --> 00:06:45,039

person on the street well how do you

186

00:06:48,629 --> 00:06:46,800

think plant roots would grow in

187

00:06:50,870 --> 00:06:48,639

microgravity say well you know pretty

188

00:06:52,390 --> 00:06:50,880

much everybody knows that gravity pulls

189

00:07:02,629 --> 00:06:52,400

the

190

00:07:04,550 --> 00:07:02,639

don't and we first saw those pictures

191

00:07:06,629 --> 00:07:04,560

when they first came started coming down

192

00:07:08,150 --> 00:07:06,639

to us we were surprised that not only

193

00:07:11,110 --> 00:07:08,160

did they grow very

194

00:07:13,270 --> 00:07:11,120

cleanly you know straight away from from

195

00:07:16,070 --> 00:07:13,280

the the top of the plate if you will but

196

00:07:17,990 --> 00:07:16,080

they also do this skewing behavior and

197

00:07:20,230 --> 00:07:18,000

the reason why that is is particularly

198

00:07:22,710 --> 00:07:20,240

interesting is because that the dogma is

199

00:07:25,270 --> 00:07:22,720

in the literature and and most of us

200

00:07:28,150 --> 00:07:25,280

have always thought is this skewing this

201
00:07:30,550 --> 00:07:28,160
job to the left phenomenon is is

202
00:07:33,510 --> 00:07:30,560
thought to have been a combination of

203
00:07:35,110 --> 00:07:33,520
how the plant surfaces the the

204
00:07:37,189 --> 00:07:35,120
senses the surface of the environment

205
00:07:39,270 --> 00:07:37,199
that it's touching like the soil or in

206
00:07:41,670 --> 00:07:39,280
this case the top of the agar and the

207
00:07:42,950 --> 00:07:41,680
force of gravity then pulling down on

208
00:07:44,869 --> 00:07:42,960
those roots

209
00:07:48,309 --> 00:07:44,879
without

210
00:07:50,230 --> 00:07:48,319
you know you wouldn't have this kind of

211
00:07:52,390 --> 00:07:50,240
skewing phenomenon but we see it and we

212
00:07:54,390 --> 00:07:52,400
see it quite quite strongly and that is

213
00:07:56,469 --> 00:07:54,400

the surprising part is that we see that

214

00:07:58,869 --> 00:07:56,479

pattern that looks very much like what

215

00:08:00,230 --> 00:07:58,879

we see on the ground controls

216

00:08:02,469 --> 00:08:00,240

well and i know you're interested in

217

00:08:04,550 --> 00:08:02,479

plant growth at the genetic level what

218

00:08:06,309 --> 00:08:04,560

is this telling you that that might

219

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

affect the way we grow plants here on

220

00:08:10,550 --> 00:08:08,479

earth or the way we might grow them uh

221

00:08:12,790 --> 00:08:10,560

on long duration space flights uh to

222

00:08:14,869 --> 00:08:12,800

distant destinations well that's a

223

00:08:17,589 --> 00:08:14,879

that's a complex question and there's

224

00:08:20,309 --> 00:08:17,599

two two good parts there and so so bring

225

00:08:22,230 --> 00:08:20,319

me back to what tells us about long-term

226

00:08:23,510 --> 00:08:22,240

space flight growth but let me ask you

227

00:08:25,350 --> 00:08:23,520

first about what does it tell us

228

00:08:27,110 --> 00:08:25,360

fundamentally and that is

229

00:08:28,869 --> 00:08:27,120

as i said a number part the other part

230

00:08:30,309 --> 00:08:28,879

of this particular experiment is looking

231

00:08:32,230 --> 00:08:30,319

at the gene expression patterns and

232

00:08:33,350 --> 00:08:32,240

that's the subject of a different paper

233

00:08:35,029 --> 00:08:33,360

but

234

00:08:37,269 --> 00:08:35,039

we know that looking at the patterns of

235

00:08:38,949 --> 00:08:37,279

how genes are turned on or turned off in

236

00:08:41,430 --> 00:08:38,959

the space flight environment

237

00:08:45,030 --> 00:08:41,440

actually recapitulate some of the things

238

00:08:47,750 --> 00:08:45,040

that we see morphologically and so

239

00:08:50,630 --> 00:08:47,760

a lot of the genes that we see that are

240

00:08:53,350 --> 00:08:50,640

that are expressed also are

241

00:08:55,829 --> 00:08:53,360

related to how cells especially cell

242

00:08:57,750 --> 00:08:55,839

walls are remodeled and so if you look

243

00:09:00,870 --> 00:08:57,760

at some of those genes they're also ones

244

00:09:03,750 --> 00:09:00,880

that that dictate how plants

245

00:09:06,310 --> 00:09:03,760

do this kind of skewing phenomenon and

246

00:09:07,190 --> 00:09:06,320

so that gives us a very fundamental look

247

00:09:08,470 --> 00:09:07,200

into

248

00:09:12,070 --> 00:09:08,480

how plants

249

00:09:13,990 --> 00:09:12,080

turn their mechanisms on and off by in a

250

00:09:16,070 --> 00:09:14,000

very fundamental kind of level so that's

251

00:09:18,550 --> 00:09:16,080

that's one of the things that that is

252

00:09:22,150 --> 00:09:18,560

also interesting to us it also gives us

253

00:09:24,470 --> 00:09:22,160

a clue that the the ability for plants

254

00:09:26,470 --> 00:09:24,480

to have these kinds of

255

00:09:29,430 --> 00:09:26,480

behaviors if you will is inherent it's

256

00:09:31,509 --> 00:09:29,440

something that is that is not requiring

257

00:09:33,509 --> 00:09:31,519

a gravitational

258

00:09:35,190 --> 00:09:33,519

response and remember these are growing

259

00:09:36,949 --> 00:09:35,200

in a novel environment something that's

260

00:09:39,269 --> 00:09:36,959

absolutely outside their evolutionary

261

00:09:41,509 --> 00:09:39,279

experience and so what that tells us is

262

00:09:45,030 --> 00:09:41,519

that even though plants have never

263

00:09:47,269 --> 00:09:45,040

evolved with a gravity-free environment

264

00:09:49,750 --> 00:09:47,279

there are these inherent mechanisms by

265

00:09:52,710 --> 00:09:49,760

which the seed will germinate and the

266

00:09:55,750 --> 00:09:52,720

roots will grow away from where the seed

267

00:09:58,310 --> 00:09:55,760

is planted in the in search of nutrients

268

00:10:00,070 --> 00:09:58,320

and water etc and we've known for a long

269

00:10:01,670 --> 00:10:00,080

time that that of course they can do

270

00:10:03,190 --> 00:10:01,680

this without gravity from a lot of the

271

00:10:05,350 --> 00:10:03,200

other previous

272

00:10:07,670 --> 00:10:05,360

experiments but to see that they used

273

00:10:09,110 --> 00:10:07,680

the same inherent mechanisms but would

274

00:10:12,069 --> 00:10:09,120

like with the skewing these waving

275

00:10:14,150 --> 00:10:12,079

phenomena that is a real fundamental

276

00:10:15,829 --> 00:10:14,160

interesting phenomenon that we've seen

277

00:10:17,910 --> 00:10:15,839

now does this make us better gardeners

278

00:10:19,750 --> 00:10:17,920

in space well yes it does because what

279

00:10:23,030 --> 00:10:19,760

that what that shows us is it sort of

280

00:10:25,110 --> 00:10:23,040

takes some of the um the uh

281

00:10:27,190 --> 00:10:25,120

concern about how

282

00:10:29,269 --> 00:10:27,200

how well plants do how well plants will

283

00:10:31,190 --> 00:10:29,279

be able to adapt to environments where

284

00:10:33,190 --> 00:10:31,200

the gravity is altered for long periods

285

00:10:35,110 --> 00:10:33,200

of time as camille said that we have

286

00:10:37,430 --> 00:10:35,120

grown plants on orbit from seed to seed

287

00:10:38,949 --> 00:10:37,440

so we know that they can do it we also

288

00:10:41,509 --> 00:10:38,959

know though though they engage a lot of

289

00:10:42,949 --> 00:10:41,519

metabolic processes that

290

00:10:45,190 --> 00:10:42,959

that they know they're in space they

291

00:10:47,590 --> 00:10:45,200

know that they're in a place that's not

292

00:10:49,910 --> 00:10:47,600

exactly ideal but nonetheless that they

293

00:10:52,949 --> 00:10:49,920

can manage it the more information we

294

00:10:55,030 --> 00:10:52,959

get on the the how and the why

295

00:10:56,710 --> 00:10:55,040

of of how they mount these responses

296

00:10:59,030 --> 00:10:56,720

that allows us to be

297

00:11:00,870 --> 00:10:59,040

better and better gardeners in designing

298

00:11:02,550 --> 00:11:00,880

our habitats and designing the hardware

299

00:11:04,069 --> 00:11:02,560

that supports these plants and that's

300

00:11:05,829 --> 00:11:04,079

what will help us in the long term

301
00:11:07,430 --> 00:11:05,839
because you know when we leave earth's

302
00:11:09,430 --> 00:11:07,440
orbit no matter where we leave we'll be

303
00:11:11,269 --> 00:11:09,440
taking plants with us just like the guys

304
00:11:13,430 --> 00:11:11,279
who were going out to the oregon trail

305
00:11:15,509 --> 00:11:13,440
took their plants with us and we have to

306
00:11:17,590 --> 00:11:15,519
adjust to the new environments and the

307
00:11:19,110 --> 00:11:17,600
new situations that we'll have to put

308
00:11:21,030 --> 00:11:19,120
them in and all these kind of data

309
00:11:22,310 --> 00:11:21,040
informs that

310
00:11:24,310 --> 00:11:22,320
and so i guess what you're getting at

311
00:11:26,150 --> 00:11:24,320
there is that uh what you're learning

312
00:11:27,829 --> 00:11:26,160
now not only would help us grow plants

313
00:11:29,030 --> 00:11:27,839

that would help support people on long

314

00:11:31,190 --> 00:11:29,040

journeys

315

00:11:33,990 --> 00:11:31,200

to other worlds but also it might help

316

00:11:36,069 --> 00:11:34,000

us be able to cultivate them on those

317

00:11:37,430 --> 00:11:36,079

other worlds even though say in mars

318

00:11:40,150 --> 00:11:37,440

you've got one-third the gravity you

319

00:11:40,790 --> 00:11:40,160

have on earth sure yeah absolutely and

320

00:11:47,269 --> 00:11:40,800

it

321

00:11:48,470 --> 00:11:47,279

what mechanisms plants use to adjust to

322

00:11:50,870 --> 00:11:48,480

those kinds of

323

00:11:52,470 --> 00:11:50,880

new and novel situations

324

00:11:54,470 --> 00:11:52,480

well dr paul i want to thank you very

325

00:11:55,990 --> 00:11:54,480

much for joining us here today and and

326

00:11:58,310 --> 00:11:56,000

we're going to go back to camille here

327

00:12:00,310 --> 00:11:58,320

for some some wrapping up questions here

328

00:12:02,389 --> 00:12:00,320

about uh the international space station

329

00:12:03,670 --> 00:12:02,399

research and other plant but i did want

330

00:12:05,430 --> 00:12:03,680

to ask you one more thing you've got

331

00:12:06,470 --> 00:12:05,440

another experiment called brick 17.

332

00:12:10,470 --> 00:12:06,480

could you tell us a little bit about

333

00:12:12,550 --> 00:12:10,480

that one ah sure um right 17 is

334

00:12:14,629 --> 00:12:12,560

instead of using seedlings for you know

335

00:12:18,150 --> 00:12:14,639

arabidopsis type seedlings or small

336

00:12:20,710 --> 00:12:18,160

plants it uses undifferentiated cells

337

00:12:21,750 --> 00:12:20,720

and that in a nutshell is

338

00:12:26,470 --> 00:12:21,760

the

339

00:12:28,069 --> 00:12:26,480

instead of being looking like seedlings

340

00:12:30,069 --> 00:12:28,079

they look a little bit well like

341

00:12:32,069 --> 00:12:30,079

couscous on the surface of a plate they

342

00:12:33,670 --> 00:12:32,079

are all the cells are essentially the

343

00:12:34,389 --> 00:12:33,680

same and they don't have the same kind

344

00:12:37,350 --> 00:12:34,399

of

345

00:12:40,389 --> 00:12:37,360

roots and shoots and and

346

00:12:42,790 --> 00:12:40,399

sensing organs that if you like the our

347

00:12:44,870 --> 00:12:42,800

initial brick experiment brick 16 we did

348

00:12:46,470 --> 00:12:44,880

run these undifferentiated cells plus

349

00:12:50,069 --> 00:12:46,480

the

350

00:12:52,949 --> 00:12:50,079

undifferentiated cells respond in a

351

00:12:55,350 --> 00:12:52,959

dramatically profoundly different way

352

00:12:56,790 --> 00:12:55,360

and so our follow-on experiment is to

353

00:12:59,829 --> 00:12:56,800

explore

354

00:13:01,509 --> 00:12:59,839

the mechanisms by which they

355

00:13:03,670 --> 00:13:01,519

engage these gene expression patterns

356

00:13:05,430 --> 00:13:03,680

that are so extraordinary mostly heat

357

00:13:08,069 --> 00:13:05,440

shock genes that there should be no

358

00:13:09,990 --> 00:13:08,079

reason for them to be induced and so we

359

00:13:11,590 --> 00:13:10,000

designed this follow-on experiment with

360

00:13:13,590 --> 00:13:11,600

different types of mutants and different

361

00:13:15,269 --> 00:13:13,600

types of gene pathways that will allow

362

00:13:16,710 --> 00:13:15,279

us to test some of the hypotheses that

363

00:13:20,230 --> 00:13:16,720

we developed from our first brick

364

00:13:22,150 --> 00:13:20,240

experiment which flew last year well

365

00:13:23,509 --> 00:13:22,160

thanks again for being with us today and

366

00:13:25,269 --> 00:13:23,519

maybe we can bring you back when you've

367

00:13:27,030 --> 00:13:25,279

got some results from the brick

368

00:13:28,389 --> 00:13:27,040

experiments that you can talk about oh

369

00:13:30,150 --> 00:13:28,399

i'd love to thank you so much for the

370

00:13:32,710 --> 00:13:30,160

opportunity well thanks for being with

371

00:13:34,949 --> 00:13:32,720

us again and camille any last thoughts

372

00:13:37,910 --> 00:13:34,959

about plant research on the space

373

00:13:39,910 --> 00:13:37,920

station and and how it may apply to

374

00:13:41,269 --> 00:13:39,920

making benefits for people here on earth

375

00:13:44,470 --> 00:13:41,279

in the long run

376

00:13:46,550 --> 00:13:44,480

when we talk about the benefits of iss

377

00:13:48,629 --> 00:13:46,560

research or any type of research we're

378

00:13:51,750 --> 00:13:48,639

doing on the international space station

379

00:13:53,430 --> 00:13:51,760

we categorize that in three ways

380

00:13:55,750 --> 00:13:53,440

we talk about discovery that's the

381

00:13:58,389 --> 00:13:55,760

fundamental knowledge we gain we talk

382

00:14:00,949 --> 00:13:58,399

about space benefits which is what dr

383

00:14:03,269 --> 00:14:00,959

paul talked about with her plans the

384

00:14:06,230 --> 00:14:03,279

fact that plans are great food source

385

00:14:07,990 --> 00:14:06,240

for long duration space flight but then

386

00:14:10,629 --> 00:14:08,000

we also talk about earth benefits and

387

00:14:12,629 --> 00:14:10,639

that's the benefits that have an impact

388

00:14:14,389 --> 00:14:12,639

on our lives and improve the quality of

389

00:14:16,710 --> 00:14:14,399

our lives so there are couple

390

00:14:20,310 --> 00:14:16,720

investigations dr paul talked about

391

00:14:22,310 --> 00:14:20,320

brick 17 1 there's a brick 17 2

392

00:14:24,470 --> 00:14:22,320

that's looking at the noxic response

393

00:14:27,189 --> 00:14:24,480

anoxic meaning a low oxygen

394

00:14:30,150 --> 00:14:27,199

environmental or oxygen conditions and

395

00:14:32,069 --> 00:14:30,160

how these plants respond in in the space

396

00:14:33,350 --> 00:14:32,079

flight environment under these

397

00:14:34,949 --> 00:14:33,360

conditions

398

00:14:36,949 --> 00:14:34,959

so researchers are hoping that the

399

00:14:38,629 --> 00:14:36,959

results from that would help them

400

00:14:40,949 --> 00:14:38,639

develop genetic engineering

401
00:14:43,110 --> 00:14:40,959
countermeasures for terrestrial plants

402
00:14:44,629 --> 00:14:43,120
who suffer the same stressful

403
00:14:46,389 --> 00:14:44,639
environment

404
00:14:48,470 --> 00:14:46,399
there's also another investigation that

405
00:14:51,110 --> 00:14:48,480
was done a couple years ago called

406
00:14:52,389 --> 00:14:51,120
national lab pathfinder cells and that

407
00:14:55,269 --> 00:14:52,399
was looking at the effect of

408
00:14:58,870 --> 00:14:55,279
microgravity on biofuel plants and we

409
00:15:01,110 --> 00:14:58,880
know biofuel plants have a high

410
00:15:04,629 --> 00:15:01,120
content of oil that could be extracted

411
00:15:06,470 --> 00:15:04,639
and used as fuel or renewable energy and

412
00:15:08,550 --> 00:15:06,480
so they're hoping that the results from

413
00:15:11,110 --> 00:15:08,560

those can contribute to alternative

414

00:15:13,829 --> 00:15:11,120

energy crop production that can be

415

00:15:15,829 --> 00:15:13,839

accessible to u.s farmers so those are a

416

00:15:18,870 --> 00:15:15,839

couple of the earth benefits

417

00:15:20,470 --> 00:15:18,880

that we look for looking forward to from

418

00:15:22,949 --> 00:15:20,480

some of the plant research we're doing

419

00:15:24,790 --> 00:15:22,959

on the isis all right well uh camille

420

00:15:26,629 --> 00:15:24,800

ayin from the international program

421

00:15:29,030 --> 00:15:26,639

science office thank you much for

422

00:15:31,030 --> 00:15:29,040

joining us today thank you kelly and and

423

00:15:32,710 --> 00:15:31,040

anna-lysa paul from the florida

424

00:15:34,389 --> 00:15:32,720

university thank you so much for joining

425

00:15:35,990 --> 00:15:34,399

us today i

426

00:15:37,590 --> 00:15:36,000

think that very interesting work going

427

00:15:39,189 --> 00:15:37,600

on on the space station with this plant

428

00:15:40,389 --> 00:15:39,199

research just one of the many types of

429

00:15:42,150 --> 00:15:40,399

research we're doing on the space