1
00:00:07,039 --> 00:00:05,150
good afternoon everyone and welcome to

2
00:00:09,620 --> 00:00:07,049
today's International Space Station

3
00:00:10,400 --> 00:00:09,630
research and technology news briefing we

4
00:00:12,200 --> 00:00:10,410
thought this would be a great

5
00:00:14,390 --> 00:00:12,210
opportunity as we prepare for the launch

6
00:00:17,480 --> 00:00:14,400
of space shuttle Atlantis to fill you in

7
00:00:19,099 --> 00:00:17,490
on how things are going up in space 220

8
00:00:21,109 --> 00:00:19,109
miles above where the international

9
00:00:23,480 --> 00:00:21,119
space station has been cruising for the

10
00:00:26,390 --> 00:00:23,490
last 10 years doing meaningful science

11
00:00:28,070 --> 00:00:26,400
we have a panel of experts today to give

12
00:00:30,919 --> 00:00:28,080
us an update and I'd like to introduce

13
00:00:32,720 --> 00:00:30,929

them now and after that we'll have

14
00:00:35,840 --> 00:00:32,730
opening comments from them and then take

15
00:00:38,500 --> 00:00:35,850
questions from the reporters adjacent to

16
00:00:40,819 --> 00:00:38,510
me right here is dr. Julie Robinson

17
00:00:45,260 --> 00:00:40,829
International Space Station program

18
00:00:48,229 --> 00:00:45,270
scientist to her left is dr. Cheryl

19
00:00:51,650 --> 00:00:48,239
Nickerson professor with the Biodesign

20
00:00:55,819 --> 00:00:51,660
Institute at Arizona State University to

21
00:00:58,689 --> 00:00:55,829
her left dr. Eduardo Almeida research

22
00:01:02,709 --> 00:00:58,699
scientists at the Ames Research Center

23
00:01:05,240 --> 00:01:02,719
and to his left dr. Amara Pereira

24
00:01:07,250 --> 00:01:05,250
research associate professor the

25
00:01:10,850 --> 00:01:07,260
department of plant biology at North

26
00:01:12,800 --> 00:01:10,860
Carolina State University so welcome and

27
00:01:16,460 --> 00:01:12,810
I will begin with some comments from dr.

28
00:01:18,020 --> 00:01:16,470
Julie Robinson Julie thanks Michael so

29
00:01:19,999 --> 00:01:18,030
we're really excited to be here with you

30
00:01:21,620 --> 00:01:20,009
today and talk to you about just a few

31
00:01:23,300 --> 00:01:21,630
of the experiments that are going to be

32
00:01:25,520 --> 00:01:23,310
enabled by this last space shuttle

33
00:01:27,770 --> 00:01:25,530
flight of course the space shuttle was

34
00:01:29,630 --> 00:01:27,780
important for us at NASA because we

35
00:01:31,850 --> 00:01:29,640
needed it it's really large carrying

36
00:01:34,160 --> 00:01:31,860
capacity to assemble the vehicle of the

37
00:01:35,990 --> 00:01:34,170
space station to assemble a laboratory

38
00:01:38,450 --> 00:01:36,000

that is essentially the size of a four

39
00:01:40,310 --> 00:01:38,460
bedroom house and we've brought today to

40
00:01:42,109 --> 00:01:40,320
you some of the scientists who are using

41
00:01:43,700 --> 00:01:42,119
this laboratory in their research and

42
00:01:46,429 --> 00:01:43,710
whose research will be flying on the

43
00:01:48,530 --> 00:01:46,439
space shuttle in any six-month period we

44
00:01:50,090 --> 00:01:48,540
have about 200 investigations that are

45
00:01:52,460 --> 00:01:50,100
active on the space station now that

46
00:01:54,440 --> 00:01:52,470
it's Assembly has been completed in 2011

47
00:01:56,410 --> 00:01:54,450
and about half of those are US

48
00:01:59,870 --> 00:01:56,420
scientists there are dozens of

49
00:02:01,310 --> 00:01:59,880
experiments that go up and return on any

50
00:02:04,219 --> 00:02:01,320
given flight whether that's a space

51
00:02:06,289 --> 00:02:04,229
shuttle flight or an ATV automated

52
00:02:09,589 --> 00:02:06,299
Transfer Vehicle european flight or an

53
00:02:11,690 --> 00:02:09,599
HTV japanese Transfer Vehicle flight and

54
00:02:13,280 --> 00:02:11,700
so that keeps our space station

55
00:02:14,020 --> 00:02:13,290
resupplied keeps our scientists work

56
00:02:17,110 --> 00:02:14,030
active

57
00:02:19,190 --> 00:02:17,120
today we'll be sharing some samplings of

58
00:02:22,160 --> 00:02:19,200
biotechnology investigations that are

59
00:02:23,840 --> 00:02:22,170
going on some of these are through ISS

60
00:02:25,550 --> 00:02:23,850
as a national laboratory where any

61
00:02:27,260 --> 00:02:25,560
scientist in the country can use the

62
00:02:29,600 --> 00:02:27,270
space station as a laboratory for their

63
00:02:31,400 --> 00:02:29,610

research others are sponsored by NASA

64
00:02:33,530 --> 00:02:31,410
because NASA has an interest in the

65
00:02:36,140 --> 00:02:33,540
exploration potential of the research

66
00:02:38,600 --> 00:02:36,150
and after you see the science briefing

67
00:02:40,280 --> 00:02:38,610
you'll have the opportunity both here at

68
00:02:42,320 --> 00:02:40,290
the Kennedy Space Center press center as

69
00:02:44,240 --> 00:02:42,330
well as on NASA TV to see some

70
00:02:45,800 --> 00:02:44,250
demonstrations of technology development

71
00:02:47,120 --> 00:02:45,810
that will also be doing based on

72
00:02:49,160 --> 00:02:47,130
Hardware flying on this flight

73
00:02:51,440 --> 00:02:49,170
especially the robotic refueling mission

74
00:02:54,110 --> 00:02:51,450
which is a collaboration of NASA and the

75
00:02:56,750 --> 00:02:54,120
Canadian Space Agency to test refueling

76
00:02:59,270 --> 00:02:56,760
technologies in orbit so with that as a

77
00:03:00,920 --> 00:02:59,280
sampling of the dozens and dozens of

78
00:03:02,720 --> 00:03:00,930
investigations enabled by the shuttle

79
00:03:04,460 --> 00:03:02,730
flight I'd like to hand over to dr.

80
00:03:06,979 --> 00:03:04,470
Nickerson to tell you about her new

81
00:03:09,290 --> 00:03:06,989
partnership with NASA so good afternoon

82
00:03:12,110 --> 00:03:09,300
it's an honor to have the opportunity to

83
00:03:13,760 --> 00:03:12,120
talk to you today about our sts-135

84
00:03:16,430 --> 00:03:13,770
flight experiment that's operationally

85
00:03:18,110 --> 00:03:16,440
called r a civ and the potential for

86
00:03:19,759 --> 00:03:18,120
this work to lead to better vaccine

87
00:03:21,500 --> 00:03:19,769
development to prevent infectious

88
00:03:23,780 --> 00:03:21,510

diseases back here for the general

89
00:03:25,729 --> 00:03:23,790
public on earth her assets stands for

90
00:03:27,979 --> 00:03:25,739
recombinant attenuated Salmonella

91
00:03:29,900 --> 00:03:27,989
vaccine and I know that sounds like a

92
00:03:32,570 --> 00:03:29,910
bit of a complicated title but it's

93
00:03:34,430 --> 00:03:32,580
really just the next phase in our

94
00:03:35,960 --> 00:03:34,440
infectious disease research that is

95
00:03:37,220 --> 00:03:35,970
fundamentally advancing and moving

96
00:03:39,199 --> 00:03:37,230
forward are the results from our

97
00:03:41,330 --> 00:03:39,209
previous space flight experiments our

98
00:03:43,220 --> 00:03:41,340
collaborative recive teams come from

99
00:03:45,050 --> 00:03:43,230
three different laboratories two of

100
00:03:46,750 --> 00:03:45,060
those laboratories are at the Biodesign

101
00:03:49,100 --> 00:03:46,760
Institute at Arizona State University

102
00:03:50,870 --> 00:03:49,110
those being my laboratory and the

103
00:03:53,000 --> 00:03:50,880
laboratory of dr. Roy Curtis the third

104
00:03:55,180 --> 00:03:53,010
and then at the NASA Johnson Space

105
00:03:57,890 --> 00:03:55,190
Center the laboratory of dr. marcotte

106
00:04:00,530 --> 00:03:57,900
collectively are a civ team has years of

107
00:04:02,240 --> 00:04:00,540
experience and expertise in studying the

108
00:04:04,490 --> 00:04:02,250
responses and infectious disease

109
00:04:07,130 --> 00:04:04,500
potential of microbial pathogens to

110
00:04:09,740 --> 00:04:07,140
space light and also in the clinical

111
00:04:12,710 --> 00:04:09,750
design and in the engineering and

112
00:04:15,020 --> 00:04:12,720
clinical design and testing recive

113
00:04:17,360 --> 00:04:15,030

vaccine strains is immunizing vectors to

114
00:04:19,580 --> 00:04:17,370
protect against infectious disease here

115
00:04:22,370 --> 00:04:19,590
for the general public on earth having

116
00:04:24,469 --> 00:04:22,380
said that it's important to mention that

117
00:04:27,020 --> 00:04:24,479
in our space flight experiment we're not

118
00:04:27,680 --> 00:04:27,030
trying to blindly develop a new vaccine

119
00:04:30,110 --> 00:04:27,690
strain

120
00:04:32,510 --> 00:04:30,120
rather we are focused on improving a

121
00:04:34,160 --> 00:04:32,520
vaccine strain that currently exists

122
00:04:36,680 --> 00:04:34,170
here on earth it's in human clinical

123
00:04:39,200 --> 00:04:36,690
trials and while this rasa vaccine

124
00:04:41,180 --> 00:04:39,210
strain is showing exciting promise it

125
00:04:43,070 --> 00:04:41,190
needs to be improved in terms of

126
00:04:45,710 --> 00:04:43,080
enhancing its protective immunogenicity

127
00:04:48,740 --> 00:04:45,720
to confer better protection against

128
00:04:51,080 --> 00:04:48,750
infectious disease so I often get asked

129
00:04:52,520 --> 00:04:51,090
the story or the question why do

130
00:04:53,990 --> 00:04:52,530
infectious disease research and

131
00:04:55,370 --> 00:04:54,000
spaceflight what is the value of that

132
00:04:57,500 --> 00:04:55,380
well there's tremendous potential in

133
00:05:00,040 --> 00:04:57,510
using the spaceflight platform for this

134
00:05:03,350 --> 00:05:00,050
because first of all we know every time

135
00:05:06,080 --> 00:05:03,360
that we force biological systems to

136
00:05:08,090 --> 00:05:06,090
survive and respond and adapt to extreme

137
00:05:10,040 --> 00:05:08,100
environments we have learned tremendous

138
00:05:12,650 --> 00:05:10,050

new insight in terms of about how they

139
00:05:14,630 --> 00:05:12,660
function about how they live about how

140
00:05:17,540 --> 00:05:14,640
they exist and we've been able to take

141
00:05:20,270 --> 00:05:17,550
that new insight and translate it to new

142
00:05:22,310 --> 00:05:20,280
therapies new products new strategies

143
00:05:24,440 --> 00:05:22,320
that we use on a daily basis here on

144
00:05:25,790 --> 00:05:24,450
earth to improve our quality of life so

145
00:05:27,380 --> 00:05:25,800
it shouldn't be surprising then that

146
00:05:29,480 --> 00:05:27,390
space flight is just the next logical

147
00:05:31,400 --> 00:05:29,490
extreme environment to use that's been

148
00:05:33,500 --> 00:05:31,410
relatively untapped but which holds

149
00:05:35,270 --> 00:05:33,510
tremendous potential to provide novel

150
00:05:37,730 --> 00:05:35,280
insight into cellular response

151
00:05:39,920 --> 00:05:37,740
mechanisms especially for the infectious

152
00:05:42,110 --> 00:05:39,930
disease world and it's also important to

153
00:05:44,140 --> 00:05:42,120
note that spaceflight produces a fluidic

154
00:05:46,760 --> 00:05:44,150
environment that's very similar to

155
00:05:48,560 --> 00:05:46,770
environments in our body that microbial

156
00:05:52,040 --> 00:05:48,570
pathogens encounter when they infect us

157
00:05:53,810 --> 00:05:52,050
so the take-home message is and I think

158
00:05:55,460 --> 00:05:53,820
we should be on the second slide by now

159
00:05:58,430 --> 00:05:55,470
my apologies for not having that slide

160
00:06:01,850 --> 00:05:58,440
advanced the take-home message is cells

161
00:06:04,400 --> 00:06:01,860
grown in microgravity exhibit novel bio

162
00:06:06,830 --> 00:06:04,410
medically relevant responses that they

163
00:06:08,750 --> 00:06:06,840

do not or we cannot observe when we grow

164
00:06:10,670 --> 00:06:08,760
those cells here on earth that's because

165
00:06:13,400 --> 00:06:10,680
Matt gravity masks a lot of those

166
00:06:15,290 --> 00:06:13,410
effects so it is for these very exact

167
00:06:17,420 --> 00:06:15,300
reasons to find these novel insights

168
00:06:19,580 --> 00:06:17,430
into human health and disease and

169
00:06:21,530 --> 00:06:19,590
cellular response mechanisms that we

170
00:06:23,390 --> 00:06:21,540
have paired and joined with NASA in a

171
00:06:25,550 --> 00:06:23,400
space act agreement to use the

172
00:06:27,440 --> 00:06:25,560
International Space Station for research

173
00:06:30,140 --> 00:06:27,450
to translationally advanced human health

174
00:06:33,470 --> 00:06:30,150
so on the third slide if you take a look

175
00:06:35,480 --> 00:06:33,480
at that you will see a little overview

176
00:06:38,270 --> 00:06:35,490
of our previous and now our current

177
00:06:40,490 --> 00:06:38,280
spaceflight work and our previous

178
00:06:41,300 --> 00:06:40,500
spaceflight work has provided novel

179
00:06:43,580 --> 00:06:41,310
insight into

180
00:06:46,610 --> 00:06:43,590
how the major human pathogen salmonella

181
00:06:48,800 --> 00:06:46,620
causes disease in the body and we

182
00:06:51,050 --> 00:06:48,810
discovered that space light increases

183
00:06:53,690 --> 00:06:51,060
the disease-causing potential or what we

184
00:06:55,700 --> 00:06:53,700
call virulence of this pathogen but

185
00:06:57,830 --> 00:06:55,710
interestingly when we looked at the

186
00:07:01,550 --> 00:06:57,840
genes that were switched on and off in

187
00:07:02,570 --> 00:07:01,560
space flight that Salmonella expressed

188
00:07:05,150 --> 00:07:02,580

that were important for its virulence

189
00:07:07,550 --> 00:07:05,160
they were switched on and off in a very

190
00:07:09,320 --> 00:07:07,560
different way than how they're regulated

191
00:07:11,000 --> 00:07:09,330
those same genes are regulated when we

192
00:07:13,300 --> 00:07:11,010
study the virulence that organism here

193
00:07:15,830 --> 00:07:13,310
on earth that's very important because

194
00:07:18,380 --> 00:07:15,840
understanding how virulent genes are

195
00:07:20,690 --> 00:07:18,390
switched on and off is critical for

196
00:07:22,730 --> 00:07:20,700
designing new strategies to prevent

197
00:07:25,130 --> 00:07:22,740
infection and disease such as vaccines

198
00:07:27,260 --> 00:07:25,140
so with the knowledge of the space

199
00:07:28,850 --> 00:07:27,270
flight environment uniquely turns on or

200
00:07:30,070 --> 00:07:28,860
switches on and off genes that are

201
00:07:32,960 --> 00:07:30,080
important for the disease-causing

202
00:07:34,970 --> 00:07:32,970
ability of this pathogen those genes

203
00:07:37,010 --> 00:07:34,980
serve or lend themselves as novel

204
00:07:38,870 --> 00:07:37,020
targets for vaccine development we're

205
00:07:41,840 --> 00:07:38,880
going to apply a very similar approach

206
00:07:43,130 --> 00:07:41,850
now thuy Salmonella vaccine strain and

207
00:07:45,320 --> 00:07:43,140
I'm going to tell you about that vaccine

208
00:07:47,480 --> 00:07:45,330
strain we're going to fly this

209
00:07:49,490 --> 00:07:47,490
particular Salmonella vaccine strain has

210
00:07:52,790 --> 00:07:49,500
been genetically engineered so that does

211
00:07:55,460 --> 00:07:52,800
not cause disease in humans but it has

212
00:07:58,310 --> 00:07:55,470
had inserted into it or art carries a

213
00:08:00,140 --> 00:07:58,320

special antigenic protein that is

214
00:08:02,780 --> 00:08:00,150
protective against disease caused by

215
00:08:06,080 --> 00:08:02,790
streptococcus pneumonia or pneumococcus

216
00:08:08,000 --> 00:08:06,090
so this edition of this antigenic

217
00:08:09,740 --> 00:08:08,010
protein stimulates a protective immune

218
00:08:12,320 --> 00:08:09,750
response in the body without actually

219
00:08:14,270 --> 00:08:12,330
causing disease we chose pneumococcus is

220
00:08:16,460 --> 00:08:14,280
our disease to study because this is a

221
00:08:18,650 --> 00:08:16,470
globally devastating disease it kills 10

222
00:08:20,960 --> 00:08:18,660
million people annually but particularly

223
00:08:24,530 --> 00:08:20,970
vulnerable are the newborns very young

224
00:08:28,100 --> 00:08:24,540
children and elderly people whose immune

225
00:08:29,750 --> 00:08:28,110
responses are less able to be protected

226
00:08:32,000 --> 00:08:29,760
by the current pneumococcal vaccines

227
00:08:35,630 --> 00:08:32,010
that exist they are just not protected

228
00:08:39,290 --> 00:08:35,640
as well at all so our hope is that we

229
00:08:41,330 --> 00:08:39,300
can use the space flight platform to to

230
00:08:43,610 --> 00:08:41,340
help engineer the wrath of strain back

231
00:08:45,470 --> 00:08:43,620
here on earth to enhance its protective

232
00:08:47,810 --> 00:08:45,480
immunogenicity capabilities and make it

233
00:08:50,840 --> 00:08:47,820
of X better vaccine strain so for our

234
00:08:52,280 --> 00:08:50,850
experiment our rasa vaccine strain is

235
00:08:54,170 --> 00:08:52,290
going to go up in these specially

236
00:08:57,110 --> 00:08:54,180
designed canisters and

237
00:08:59,870 --> 00:08:57,120
once on orbit the crew will activate our

238
00:09:02,570 --> 00:08:59,880

experiment in these canisters these same

239
00:09:04,070 --> 00:09:02,580
canisters will be loaded and used by my

240
00:09:06,530 --> 00:09:04,080
team on the ground at the Kennedy Space

241
00:09:08,870 --> 00:09:06,540
Center under identical conditions except

242
00:09:12,260 --> 00:09:08,880
it doesn't fly with the same vaccine

243
00:09:14,870 --> 00:09:12,270
strain after return from Earth the wrath

244
00:09:17,360 --> 00:09:14,880
of vaccine strain will be compared to

245
00:09:19,220 --> 00:09:17,370
the synchronous ground control vaccine

246
00:09:21,949 --> 00:09:19,230
strain for its ability to protect

247
00:09:24,019 --> 00:09:21,959
against disease caused by pneumococcus

248
00:09:25,820 --> 00:09:24,029
and also to globally look at how the

249
00:09:28,250 --> 00:09:25,830
gene expression patterns have changed

250
00:09:30,920 --> 00:09:28,260
between the flight Brown and the ground

251
00:09:32,720 --> 00:09:30,930
control strain and because wrasses are

252
00:09:35,389 --> 00:09:32,730
protective against a wide variety of

253
00:09:37,040 --> 00:09:35,399
different human and animal pathogens the

254
00:09:39,560 --> 00:09:37,050
outcome of this experiment could really

255
00:09:41,600 --> 00:09:39,570
hold exciting promise to lead to new

256
00:09:43,430 --> 00:09:41,610
treatments for diseases other than just

257
00:09:45,829 --> 00:09:43,440
pneumococcus and that is indeed what we

258
00:09:47,870 --> 00:09:45,839
hope that our space like a Space Act

259
00:09:50,180 --> 00:09:47,880
agreement will provide to us at ASU is

260
00:09:52,160 --> 00:09:50,190
the potential to continually and

261
00:09:53,960 --> 00:09:52,170
routinely have access to the ISS

262
00:09:58,420 --> 00:09:53,970
National Laboratory platform to advance

263
00:10:03,790 --> 00:10:01,420

dr. almeida yes it's a pleasure to speak

264
00:10:06,130 --> 00:10:03,800
to you today I'm going to talk about the

265
00:10:09,070 --> 00:10:06,140
experiment that we're conducting using

266
00:10:12,880 --> 00:10:09,080
stem cells to assess what the effects of

267
00:10:16,690 --> 00:10:12,890
microgravity are on stem cell health so

268
00:10:20,050 --> 00:10:16,700
one of the most profound findings that

269
00:10:24,430 --> 00:10:20,060
we have made about the nature of space

270
00:10:26,710 --> 00:10:24,440
is that when you take gravity away from

271
00:10:30,310 --> 00:10:26,720
a biological organism all kinds of

272
00:10:32,290 --> 00:10:30,320
changes happen and we've collected a lot

273
00:10:34,150 --> 00:10:32,300
of physiology information over the years

274
00:10:36,970 --> 00:10:34,160
about these we know about bone loss

275
00:10:39,610 --> 00:10:36,980
immune dysfunction perhaps problems with

276
00:10:43,019 --> 00:10:39,620
bone healing and the problems go on and

277
00:10:45,880 --> 00:10:43,029
on and on recently what we have

278
00:10:48,180 --> 00:10:45,890
discovered is that perhaps a lot of

279
00:10:50,230 --> 00:10:48,190
these problems that we observe

280
00:10:53,079 --> 00:10:50,240
physiological changes that we observe in

281
00:10:56,110 --> 00:10:53,089
space have one thing in common and it's

282
00:10:59,290 --> 00:10:56,120
that perhaps stem cells that are

283
00:11:02,860 --> 00:10:59,300
required to regenerate for instance bone

284
00:11:04,240 --> 00:11:02,870
muscle the immune system and for

285
00:11:06,760 --> 00:11:04,250
instance participating in wound healing

286
00:11:09,250 --> 00:11:06,770
perhaps those stem cells are not

287
00:11:12,400 --> 00:11:09,260
functioning property under conditions of

288
00:11:16,360 --> 00:11:12,410

microgravity and so that realization is

289
00:11:19,030 --> 00:11:16,370
what has motivated us to study precisely

290
00:11:21,100 --> 00:11:19,040
the effects of microgravity on stem

291
00:11:23,380 --> 00:11:21,110
cells and so stem cell health is

292
00:11:26,019 --> 00:11:23,390
incredibly important because throughout

293
00:11:28,540 --> 00:11:26,029
your life all your body is being

294
00:11:32,350 --> 00:11:28,550
constantly renewed and regenerated by

295
00:11:36,040 --> 00:11:32,360
adult stem cells so we all know

296
00:11:39,519 --> 00:11:36,050
intuitively that a mechanical loading

297
00:11:42,730 --> 00:11:39,529
physical exercise is good for you and so

298
00:11:44,890 --> 00:11:42,740
that reflects itself in bigger muscles

299
00:11:47,290 --> 00:11:44,900
stronger bones stronger immune system

300
00:11:49,870 --> 00:11:47,300
even better memory and so for each one

301
00:11:52,900 --> 00:11:49,880
of these things that mechanical loading

302
00:11:55,540 --> 00:11:52,910
of the body does on earth we think that

303
00:11:58,060 --> 00:11:55,550
there may be a deficit in space and so

304
00:12:01,329 --> 00:11:58,070
we're precisely focusing on that problem

305
00:12:03,699 --> 00:12:01,339
of stem cell health in the body and how

306
00:12:05,199 --> 00:12:03,709
it might be affected by microgravity so

307
00:12:09,460 --> 00:12:05,209
we've already done one of these

308
00:12:11,740 --> 00:12:09,470
experiments on sts-131 with mouse

309
00:12:14,230 --> 00:12:11,750
embryonic stem cells as a model

310
00:12:18,460 --> 00:12:14,240
and what we did was to differentiate

311
00:12:20,500 --> 00:12:18,470
those cells into adult like tissues so

312
00:12:22,390 --> 00:12:20,510
we took the stem cells which are

313
00:12:25,510 --> 00:12:22,400

immortal and change the culture

314
00:12:29,290 --> 00:12:25,520
conditions so that they differentiated

315
00:12:32,230 --> 00:12:29,300
into cells that artwork for instance in

316
00:12:35,050 --> 00:12:32,240
beating cardiomyocytes epithelial cells

317
00:12:37,180 --> 00:12:35,060
and neural cells and so on and so we

318
00:12:39,010 --> 00:12:37,190
looked at gene expression patterns we

319
00:12:42,690 --> 00:12:39,020
look at their function and what we've

320
00:12:45,430 --> 00:12:42,700
realized it in space that process of

321
00:12:49,090 --> 00:12:45,440
changing from a stem cell into an adult

322
00:12:52,030 --> 00:12:49,100
tissue is greatly impaired so the cells

323
00:12:55,570 --> 00:12:52,040
maintain their stemness they keep

324
00:12:58,900 --> 00:12:55,580
markers of stem cells and they fail to

325
00:13:03,040 --> 00:12:58,910
move on to differentiated tissue status

326
00:13:05,230 --> 00:13:03,050
so in this flight on sts-135 we're going

327
00:13:07,930 --> 00:13:05,240
to follow up on those results and we are

328
00:13:10,450 --> 00:13:07,940
specifically differentiating mouse

329
00:13:13,090 --> 00:13:10,460
embryonic stem cells into keratinocytes

330
00:13:15,700 --> 00:13:13,100
and we're interested in the specific

331
00:13:18,100 --> 00:13:15,710
problem of the participation of these

332
00:13:20,500 --> 00:13:18,110
epidermal cells in wound healing this is

333
00:13:22,240 --> 00:13:20,510
one of the things that has been noted in

334
00:13:23,950 --> 00:13:22,250
Space Flight there are some evidence

335
00:13:26,170 --> 00:13:23,960
that wound healing may not be

336
00:13:27,670 --> 00:13:26,180
functioning normally and we think that

337
00:13:30,040 --> 00:13:27,680
one of the reasons this might be

338
00:13:32,829 --> 00:13:30,050

happening is because the stem cells that

339
00:13:35,800 --> 00:13:32,839
exist adults themselves it exists in the

340
00:13:38,770 --> 00:13:35,810
epidermis may not be progressing

341
00:13:41,829 --> 00:13:38,780
normally from that state of stem cell to

342
00:13:45,340 --> 00:13:41,839
a differentiated functional tissue so

343
00:13:48,040 --> 00:13:45,350
that's a the idea behind the experiment

344
00:13:50,680 --> 00:13:48,050
so how we're going to do it I didn't

345
00:13:53,320 --> 00:13:50,690
bring the whole set of hardware but I

346
00:13:57,550 --> 00:13:53,330
brought one bioreactor which you can see

347
00:13:59,880 --> 00:13:57,560
here this system is a chamber with

348
00:14:02,800 --> 00:13:59,890
hollow fibers that pass through

349
00:14:05,710 --> 00:14:02,810
nutrients and the cells will be here and

350
00:14:07,600 --> 00:14:05,720
it's almost like a dialysis machine when

351
00:14:10,900 --> 00:14:07,610
the nutrient medium goes through the

352
00:14:13,300 --> 00:14:10,910
fibers it exchanges nutrients and

353
00:14:16,540 --> 00:14:13,310
removes waste products from the cell

354
00:14:19,630 --> 00:14:16,550
culture and so in this way using the CCM

355
00:14:22,300 --> 00:14:19,640
cell culture module hardware we can

356
00:14:24,860 --> 00:14:22,310
culture cells for several weeks without

357
00:14:27,860 --> 00:14:24,870
human intervention fully automated

358
00:14:30,829 --> 00:14:27,870
at the end we will analyze both live

359
00:14:33,050 --> 00:14:30,839
cells that come back to earth as well as

360
00:14:35,480 --> 00:14:33,060
cells that will be fixed during the

361
00:14:38,030 --> 00:14:35,490
flight so that we have a snapshot in

362
00:14:40,010 --> 00:14:38,040
micro gravity of what the gene

363
00:14:43,370 --> 00:14:40,020

expression patterns are of these cells

364
00:14:46,610 --> 00:14:43,380
so hopefully what we learn from these

365
00:14:49,550 --> 00:14:46,620
studies is whether or not stem cell

366
00:14:51,700 --> 00:14:49,560
health and tissue regeneration is going

367
00:14:54,230 --> 00:14:51,710
to be a problem for long-term

368
00:14:55,820 --> 00:14:54,240
spaceflight you know right now we are

369
00:14:58,519 --> 00:14:55,830
seeing a lot of these regenerative

370
00:15:00,440 --> 00:14:58,529
problems emerge with short terms of

371
00:15:02,840 --> 00:15:00,450
spaceflight but if we are going to

372
00:15:04,640 --> 00:15:02,850
travel too far planets and if we are

373
00:15:06,710 --> 00:15:04,650
going to have a continued present in

374
00:15:09,470 --> 00:15:06,720
space we need to understand this and

375
00:15:12,230 --> 00:15:09,480
this is also a unique way of

376
00:15:15,620 --> 00:15:12,240
understanding problems on earth because

377
00:15:17,900 --> 00:15:15,630
you know it's only when you lose gravity

378
00:15:19,880 --> 00:15:17,910
that we get really appreciate how

379
00:15:23,060 --> 00:15:19,890
important that mechanical stimulation of

380
00:15:25,910 --> 00:15:23,070
the body is for health so in a way the

381
00:15:28,340 --> 00:15:25,920
environment on the shuttle on the ISS is

382
00:15:32,840 --> 00:15:28,350
really a unique laboratory for

383
00:15:35,120 --> 00:15:32,850
understanding this prevail pervasive

384
00:15:41,180 --> 00:15:35,130
factor that we cannot get away from on

385
00:15:42,949 --> 00:15:41,190
earth dr. Perera yes hello it's a

386
00:15:44,570 --> 00:15:42,959
pleasure to be here and I'm going to

387
00:15:46,760 --> 00:15:44,580
tell you about something that's a little

388
00:15:50,150 --> 00:15:46,770

bit different but is also very important

389
00:15:52,070 --> 00:15:50,160
for human health i experiment is focused

390
00:15:54,440 --> 00:15:52,080
on plants and as you know on earth

391
00:15:56,390 --> 00:15:54,450
plants are very important as a source of

392
00:15:58,730 --> 00:15:56,400
food and also to clean the air and the

393
00:16:00,769 --> 00:15:58,740
water and if you think about any long

394
00:16:03,590 --> 00:16:00,779
distance space mission in the future

395
00:16:06,170 --> 00:16:03,600
it's going to be important plants will

396
00:16:08,480 --> 00:16:06,180
be a vital component of regenerable life

397
00:16:10,060 --> 00:16:08,490
support so we need to understand how

398
00:16:13,790 --> 00:16:10,070
plants grow in the microgravity

399
00:16:15,470 --> 00:16:13,800
environment and right now space or

400
00:16:17,690 --> 00:16:15,480
microgravity is not the optimal

401
00:16:19,430 --> 00:16:17,700
environment for plant growth so our

402
00:16:22,490 --> 00:16:19,440
experiment is focused on trying to

403
00:16:25,699 --> 00:16:22,500
understand the molecular responses of

404
00:16:28,730 --> 00:16:25,709
plants to microgravity in order to be

405
00:16:31,760 --> 00:16:28,740
able to better engineer plants for

406
00:16:32,280 --> 00:16:31,770
future space flight and if I can have oh

407
00:16:38,009 --> 00:16:32,290
yes

408
00:16:40,050 --> 00:16:38,019
so our patch kind of expresses this you

409
00:16:42,329 --> 00:16:40,060
can see our little model organism

410
00:16:46,170 --> 00:16:42,339
arabidopsis which is kind of like the

411
00:16:48,060 --> 00:16:46,180
e.coli for plant genetic studies it's

412
00:16:50,009 --> 00:16:48,070
ideal for these studies because it's

413
00:16:51,749 --> 00:16:50,019

really small and it grows fast and

414
00:16:54,930 --> 00:16:51,759
there's a lot of genetic information out

415
00:16:57,870 --> 00:16:54,940
then molecular tools for arabidopsis you

416
00:16:59,610 --> 00:16:57,880
can see the DNA strand at the bottom

417
00:17:01,530 --> 00:16:59,620
that's to represent that we are going to

418
00:17:04,559 --> 00:17:01,540
do gene expression studies and look at

419
00:17:09,299 --> 00:17:04,569
transcript profiles of plants grown in

420
00:17:11,460 --> 00:17:09,309
microgravity and the other thing that's

421
00:17:13,650 --> 00:17:11,470
important is you can see that this is a

422
00:17:16,530 --> 00:17:13,660
collaborative effort we are very

423
00:17:18,990 --> 00:17:16,540
grateful to NASA and ISA and ames

424
00:17:22,880 --> 00:17:19,000
research for helping us with this

425
00:17:26,850 --> 00:17:22,890
project if we can go to the next slide

426
00:17:29,669 --> 00:17:26,860
as you can see here the big picture

427
00:17:33,180 --> 00:17:29,679
shows you an experimental container and

428
00:17:35,039 --> 00:17:33,190
above that is a little seed cassette the

429
00:17:38,430 --> 00:17:35,049
seed cassettes were designed by Ames

430
00:17:41,399 --> 00:17:38,440
Research and I have one here too you can

431
00:17:43,860 --> 00:17:41,409
see the seeds will be mounted in this

432
00:17:47,030 --> 00:17:43,870
seed cassette they're stable in this

433
00:17:49,260 --> 00:17:47,040
condition and they will be a carried on

434
00:17:52,320 --> 00:17:49,270
sts-135 to the International Space

435
00:17:54,720 --> 00:17:52,330
Station once we get to the International

436
00:17:57,210 --> 00:17:54,730
Space Station these experimental

437
00:17:59,460 --> 00:17:57,220
containers which are the containers at

438
00:18:02,850 --> 00:17:59,470

the bottom of the screen those will be

439
00:18:05,640 --> 00:18:02,860
loaded onto a special chamber called the

440
00:18:08,340 --> 00:18:05,650
EMC s or European modular cultivation

441
00:18:09,899 --> 00:18:08,350
system this is a unique experimental

442
00:18:11,909 --> 00:18:09,909
system for us because it's

443
00:18:13,860 --> 00:18:11,919
environmentally contained chamber and

444
00:18:17,039 --> 00:18:13,870
the nice thing about it is that it

445
00:18:19,830 --> 00:18:17,049
actually has two centrifuges on it so we

446
00:18:22,649 --> 00:18:19,840
can do a bungee control in the same

447
00:18:25,590 --> 00:18:22,659
space environment so what that means is

448
00:18:28,500 --> 00:18:25,600
one rotor will be spinning to simulate

449
00:18:30,539 --> 00:18:28,510
1g or its gravity and the other one will

450
00:18:33,240 --> 00:18:30,549
remain stationary and that will be micro

451
00:18:35,399 --> 00:18:33,250
G so other than the difference in G all

452
00:18:39,080 --> 00:18:35,409
the other conditions within the EMC s

453
00:18:42,930 --> 00:18:39,090
will be the same so we have a nice

454
00:18:46,279 --> 00:18:42,940
controlled experiment we also from

455
00:18:51,060 --> 00:18:49,200
determined I are interested in a

456
00:18:53,340 --> 00:18:51,070
particular signaling pathway that's

457
00:18:55,140 --> 00:18:53,350
operational in plants and so we actually

458
00:18:57,560 --> 00:18:55,150
have two different types of plants that

459
00:19:00,029 --> 00:18:57,570
will be comparing in this experiment

460
00:19:01,980 --> 00:19:00,039
control plants and plants that have been

461
00:19:05,820 --> 00:19:01,990
genetically modified to have the

462
00:19:07,830 --> 00:19:05,830
signaling components compromised and so

463
00:19:09,840 --> 00:19:07,840

using this information comparing these

464
00:19:12,330 --> 00:19:09,850
two types of plants we hope that we'll

465
00:19:14,340 --> 00:19:12,340
be able to get a snapshot of what's

466
00:19:17,070 --> 00:19:14,350
going on at a molecular level and

467
00:19:18,960 --> 00:19:17,080
compare these experiments compare these

468
00:19:22,140 --> 00:19:18,970
plants so that we can better engineer

469
00:19:23,720 --> 00:19:22,150
them for future space experiments in

470
00:19:26,789 --> 00:19:23,730
addition to that this work has

471
00:19:30,180 --> 00:19:26,799
application to ground earth to earth as

472
00:19:33,419 --> 00:19:30,190
well because the space environment as I

473
00:19:35,159 --> 00:19:33,429
said is very stressful and this will

474
00:19:38,070 --> 00:19:35,169
give us some information about extreme

475
00:19:41,580 --> 00:19:38,080
environments on ground as well for the

476
00:19:44,070 --> 00:19:41,590
final slide this will just show you

477
00:19:45,810 --> 00:19:44,080
these are the kinds of data that will be

478
00:19:48,750 --> 00:19:45,820
collected while the experiment is

479
00:19:50,700 --> 00:19:48,760
running so once the seed cassettes once

480
00:19:53,370 --> 00:19:50,710
the experiment starts the seed cassettes

481
00:19:55,799 --> 00:19:53,380
will be hydrated and we will get two

482
00:19:57,690 --> 00:19:55,809
sets of images every success we have

483
00:19:59,549 --> 00:19:57,700
what we call the overview image which

484
00:20:01,110 --> 00:19:59,559
will show you every single seed cassette

485
00:20:03,600 --> 00:20:01,120
and the little seedlings growing and

486
00:20:06,690 --> 00:20:03,610
then we'll also get close-up images that

487
00:20:09,390 --> 00:20:06,700
you can see in the blowup and this

488
00:20:11,340 --> 00:20:09,400

experiment will run for five days at the

489
00:20:14,250 --> 00:20:11,350
end of that the samples will be

490
00:20:16,140 --> 00:20:14,260
preserved on the ISS frozen on the ISS

491
00:20:17,640 --> 00:20:16,150
and then return to our satellite a date

492
00:20:21,690 --> 00:20:17,650
so we can carry out our molecular

493
00:20:23,789 --> 00:20:21,700
analysis thank you all right thank you

494
00:20:25,470 --> 00:20:23,799
we'll be happy to take any questions you

495
00:20:27,240 --> 00:20:25,480
might have please wait for the

496
00:20:28,710 --> 00:20:27,250
microphone state your name and

497
00:20:30,450 --> 00:20:28,720
affiliation and to whom you're

498
00:20:34,560 --> 00:20:30,460
addressing your question and we'll start

499
00:20:38,010 --> 00:20:34,570
off with Seth Borenstein yes using Seth

500
00:20:41,100 --> 00:20:38,020
Borenstein ap for dr. Nickerson the

501
00:20:43,890 --> 00:20:41,110
vaccine you said it's salmonella and

502
00:20:46,260 --> 00:20:43,900
it's got the added pneumococcus accepted

503
00:20:49,470 --> 00:20:46,270
genic pneumococcus but you're only

504
00:20:51,950 --> 00:20:49,480
looking at the pneumococcus effects on

505
00:20:55,999 --> 00:20:51,960
the pneumococcus why aren't you looking

506
00:21:00,899 --> 00:20:56,009
specifically at the effects of the other

507
00:21:03,239 --> 00:21:00,909
you know the other protective for other

508
00:21:05,879 --> 00:21:03,249
diseases there and have there been other

509
00:21:07,200 --> 00:21:05,889
vaccines what's been the result of other

510
00:21:09,600 --> 00:21:07,210
vaccines that have been flown in

511
00:21:11,850 --> 00:21:09,610
microgravity some excellent questions

512
00:21:13,649 --> 00:21:11,860
I'll answer the second one first and the

513
00:21:15,479 --> 00:21:13,659

first one second to my knowledge no

514
00:21:17,279 --> 00:21:15,489
other vaccines have been flown in

515
00:21:19,440 --> 00:21:17,289
microgravity this is the first

516
00:21:21,570 --> 00:21:19,450
experiment to actually fly a vaccine

517
00:21:23,729 --> 00:21:21,580
that's in human clinical trials that

518
00:21:25,289 --> 00:21:23,739
just needs to be improved okay other

519
00:21:26,940 --> 00:21:25,299
approaches are trying to develop

520
00:21:28,529 --> 00:21:26,950
vaccines in spaceflight we're just

521
00:21:30,779 --> 00:21:28,539
taking a different approach we're flying

522
00:21:33,840 --> 00:21:30,789
a vaccine that exists and needs to be

523
00:21:36,029 --> 00:21:33,850
made better okay the other question in

524
00:21:39,239 --> 00:21:36,039
terms of yes we are looking to improve

525
00:21:43,379 --> 00:21:39,249
the anti pneumococcal protective

526
00:21:45,899 --> 00:21:43,389
immunity for this vaccine it's already

527
00:21:47,849 --> 00:21:45,909
protective against salmonella because it

528
00:21:51,210 --> 00:21:47,859
carries salmonella as a crippled vector

529
00:21:56,159 --> 00:21:51,220
so that's the easy part the hard part is

530
00:21:58,529 --> 00:21:56,169
to get salmonella 22 protectively

531
00:22:01,139 --> 00:21:58,539
robustly elicits a protective immune

532
00:22:03,359 --> 00:22:01,149
response that is done without a needle

533
00:22:06,869 --> 00:22:03,369
okay which is a major advantage of other

534
00:22:08,729 --> 00:22:06,879
vaccines and can confer as close to a

535
00:22:11,489 --> 00:22:08,739
hundred percent immunity as possible an

536
00:22:14,970 --> 00:22:11,499
advantage of using Salmonella to do this

537
00:22:16,950 --> 00:22:14,980
is it elicits one of the three arms of

538
00:22:19,739 --> 00:22:16,960

the immune response that you miss when

539
00:22:21,239 --> 00:22:19,749
you go by a needle and that's called the

540
00:22:24,229 --> 00:22:21,249
mucosal immune response because this

541
00:22:26,970 --> 00:22:24,239
vaccine will be given orally and so

542
00:22:28,590 --> 00:22:26,980
because you're working with a crippled

543
00:22:30,359 --> 00:22:28,600
version of Salmonella if you will of

544
00:22:32,190 --> 00:22:30,369
course we can't give a version of that

545
00:22:33,419 --> 00:22:32,200
story that would cause disease so kind

546
00:22:35,639 --> 00:22:33,429
of view it as we've it's been

547
00:22:38,129 --> 00:22:35,649
genetically engineered to have one arm

548
00:22:40,049 --> 00:22:38,139
tied behind its back so it can go in and

549
00:22:42,269 --> 00:22:40,059
punch it's got a punch but it can't

550
00:22:44,879 --> 00:22:42,279
punch enough to cause disease and that's

551
00:22:47,009 --> 00:22:44,889
a very very thin line that you're

552
00:22:49,109 --> 00:22:47,019
walking because if you attenuate or

553
00:22:51,509 --> 00:22:49,119
reduce that ability to punch too much it

554
00:22:54,570 --> 00:22:51,519
won't elicit a good ramune response if

555
00:22:56,940 --> 00:22:54,580
you don't if you don't nu it enough it's

556
00:22:58,649 --> 00:22:56,950
going to cause disease and it were

557
00:23:01,109 --> 00:22:58,659
fortunate that our investigators have

558
00:23:03,029 --> 00:23:01,119
had decades of experience in engineering

559
00:23:05,159 --> 00:23:03,039
this particular vaccine strain we just

560
00:23:07,409 --> 00:23:05,169
need to make it a little better okay so

561
00:23:08,860 --> 00:23:07,419
I just want to make sure I'm clear so as

562
00:23:11,799 --> 00:23:08,870
far as the

563
00:23:14,370 --> 00:23:11,809

the salmonella it's all right that's not

564
00:23:16,990 --> 00:23:14,380
that part is not the Tinker it's the

565
00:23:19,330 --> 00:23:17,000
just the pneumococcus part that you're

566
00:23:24,010 --> 00:23:19,340
trying to improve and I'm trying in

567
00:23:27,160 --> 00:23:24,020
terms of efficacy what is it now and so

568
00:23:29,470 --> 00:23:27,170
you know Yorkers yeah what kind of

569
00:23:31,540 --> 00:23:29,480
virulent you know what what kind of

570
00:23:33,940 --> 00:23:31,550
effectiveness or however you measure it

571
00:23:36,580 --> 00:23:33,950
what is it now with what you've got and

572
00:23:39,220 --> 00:23:36,590
what is your goal to try to get to the

573
00:23:41,680 --> 00:23:39,230
goal is to get to a single oral dose

574
00:23:45,520 --> 00:23:41,690
that requires no boosters that confers

575
00:23:47,350 --> 00:23:45,530
100% protection long-term that's always

576
00:23:49,630 --> 00:23:47,360
the goal of any vaccine having said that

577
00:23:52,720 --> 00:23:49,640
current anti pneumococcal vaccines are

578
00:23:54,820 --> 00:23:52,730
either subunit vaccines that are

579
00:23:57,000 --> 00:23:54,830
composed of just capsular the outer

580
00:24:00,850 --> 00:23:57,010
covering of streptococcus pneumonia or

581
00:24:02,549 --> 00:24:00,860
and or they have a protein attached to

582
00:24:05,070 --> 00:24:02,559
them to make them more immunogenic

583
00:24:08,410 --> 00:24:05,080
unfortunately those particular vaccines

584
00:24:10,270 --> 00:24:08,420
and there mr. by needle in the newborn

585
00:24:13,750 --> 00:24:10,280
and elderly population there only about

586
00:24:16,090 --> 00:24:13,760
sixty percent effective and so the goal

587
00:24:18,340 --> 00:24:16,100
for the current vaccine is by taking it

588
00:24:20,500 --> 00:24:18,350

orally and having Salmonella there to

589
00:24:22,630 --> 00:24:20,510
stimulate a strong protective mucosal

590
00:24:24,040 --> 00:24:22,640
immunity we anticipate that we're going

591
00:24:27,160 --> 00:24:24,050
to get protection against salmonella

592
00:24:30,730 --> 00:24:27,170
that's already been shown we now want to

593
00:24:32,549 --> 00:24:30,740
use Salmonella as this vector to provide

594
00:24:35,770 --> 00:24:32,559
protection against against other

595
00:24:38,410 --> 00:24:35,780
pathogens including in addition to

596
00:24:40,360 --> 00:24:38,420
streptococcus pneumoniae and the first

597
00:24:43,060 --> 00:24:40,370
date has just come back from the

598
00:24:45,370 --> 00:24:43,070
clinical trials from this work and again

599
00:24:47,290 --> 00:24:45,380
it is showing exciting promise I don't

600
00:24:48,940 --> 00:24:47,300
want to release numbers because we need

601
00:24:51,130 --> 00:24:48,950
to go back with our team and look at

602
00:24:53,290 --> 00:24:51,140
those it's showing exciting promise no

603
00:24:54,850 --> 00:24:53,300
negative side effects okay but it's

604
00:24:57,130 --> 00:24:54,860
showing excited for ability to protect

605
00:24:59,549 --> 00:24:57,140
but it we need to make that protection

606
00:25:01,660 --> 00:24:59,559
better so it can do it with one dose

607
00:25:03,910 --> 00:25:01,670
from the I know you don't want to give

608
00:25:05,500 --> 00:25:03,920
numbers from the clinical trial but

609
00:25:07,830 --> 00:25:05,510
there's still a gap between what you're

610
00:25:10,870 --> 00:25:07,840
seeing on the ground clinical trial and

611
00:25:14,020 --> 00:25:10,880
a hundred percent will otherwise I guess

612
00:25:15,549 --> 00:25:14,030
my point is are you if it's really good

613
00:25:17,500 --> 00:25:15,559

right now in the ground why bother doing

614
00:25:19,150 --> 00:25:17,510
this you're correct there's a gap it

615
00:25:23,460 --> 00:25:19,160
needs to be better it's not good enough

616
00:25:26,380 --> 00:25:23,470
yet but we believe we can get it there

617
00:25:27,790 --> 00:25:26,390
right here in the front row hi Emily

618
00:25:30,310 --> 00:25:27,800
Baldwin from astronomy now with a

619
00:25:32,410 --> 00:25:30,320
question for dr. Robinson and whenever I

620
00:25:34,210 --> 00:25:32,420
bring up the topic of the International

621
00:25:35,710 --> 00:25:34,220
Space Station with people back home with

622
00:25:36,940 --> 00:25:35,720
whether it's a general public and also

623
00:25:39,250 --> 00:25:36,950
other members of the science community

624
00:25:40,870 --> 00:25:39,260
I'm also i'm often sort of met with a

625
00:25:43,060 --> 00:25:40,880
lot of cynicism with people saying it's

626
00:25:44,470 --> 00:25:43,070
very expensive science laboratory and we

627
00:25:46,090 --> 00:25:44,480
don't actually see that much from it now

628
00:25:48,040 --> 00:25:46,100
we've heard some fantastic examples of

629
00:25:49,570 --> 00:25:48,050
experiments already I was wondering if

630
00:25:52,180 --> 00:25:49,580
you had a message for those people

631
00:25:53,500 --> 00:25:52,190
perhaps sort of commenting on how the

632
00:25:57,010 --> 00:25:53,510
International Space Station you know

633
00:25:58,480 --> 00:25:57,020
what it can do for you basically well so

634
00:26:00,400 --> 00:25:58,490
you have to put those kinds of

635
00:26:03,760 --> 00:26:00,410
perspectives in a historical context

636
00:26:05,020 --> 00:26:03,770
because 15 years ago scientists there

637
00:26:06,520 --> 00:26:05,030
were some scientists who said well I

638
00:26:08,350 --> 00:26:06,530

only think I do a couple of experiments

639
00:26:10,660 --> 00:26:08,360
there and that isn't that important to

640
00:26:13,120 --> 00:26:10,670
me they were imagining should we build

641
00:26:15,550 --> 00:26:13,130
the space station or not in the u.s. we

642
00:26:17,260 --> 00:26:15,560
made the decision that assembling the

643
00:26:19,330 --> 00:26:17,270
space station was important to us for a

644
00:26:21,460 --> 00:26:19,340
number of reasons for our space

645
00:26:23,770 --> 00:26:21,470
technology development for building

646
00:26:25,120 --> 00:26:23,780
peaceful partnerships in space and the

647
00:26:27,250 --> 00:26:25,130
Assembly of the space station has

648
00:26:29,860 --> 00:26:27,260
achieved those two objectives

649
00:26:31,900 --> 00:26:29,870
beautifully now we're shifting from the

650
00:26:33,640 --> 00:26:31,910
decade of assembly to the decade of

651
00:26:35,080 --> 00:26:33,650
research and during that decade of

652
00:26:36,490 --> 00:26:35,090
research is when the scientists will get

653
00:26:37,900 --> 00:26:36,500
the chance to do all of those

654
00:26:39,850 --> 00:26:37,910
experiments that have been envisioned

655
00:26:41,740 --> 00:26:39,860
you're seeing some of the life

656
00:26:42,910 --> 00:26:41,750
scientists the biologists and the

657
00:26:44,560 --> 00:26:42,920
different creative things that they're

658
00:26:47,110 --> 00:26:44,570
doing but we also have the Alpha

659
00:26:49,120 --> 00:26:47,120
Magnetic Spectrometer which has been on

660
00:26:51,400 --> 00:26:49,130
orbit for a little less than a couple

661
00:26:53,290 --> 00:26:51,410
months now and already got its billionth

662
00:26:55,270 --> 00:26:53,300
observation of galactic cosmic rays

663
00:26:56,830 --> 00:26:55,280

that's addressing a completely different

664
00:26:59,380 --> 00:26:56,840
community the community of fundamental

665
00:27:02,080 --> 00:26:59,390
physicists we have human physiologists

666
00:27:03,970 --> 00:27:02,090
we have fluid physicists and we have a

667
00:27:05,860 --> 00:27:03,980
variety of technologies so that breadth

668
00:27:07,960 --> 00:27:05,870
of application now that the laboratories

669
00:27:10,570 --> 00:27:07,970
built it's really time and in fact a

670
00:27:11,920 --> 00:27:10,580
nature magazine said this in a recent

671
00:27:13,360 --> 00:27:11,930
editorial about four months ago they

672
00:27:14,740 --> 00:27:13,370
said now it's time for scientists to put

673
00:27:19,990 --> 00:27:14,750
their best experiments forward and use

674
00:27:22,720 --> 00:27:20,000
the laboratory thanks I'm Kerri Sheridan

675
00:27:25,900 --> 00:27:22,730
from agency france-presse for dr.

676
00:27:27,760 --> 00:27:25,910
Almeida could you describe you mentioned

677
00:27:29,440 --> 00:27:27,770
that there's been some knowledge that

678
00:27:31,120 --> 00:27:29,450
wound healing doesn't happen very well

679
00:27:33,490 --> 00:27:31,130
in space can you give us a few examples

680
00:27:35,620 --> 00:27:33,500
of how that's been learned

681
00:27:38,710 --> 00:27:35,630
and if stem cells aren't acting properly

682
00:27:40,540 --> 00:27:38,720
in space how are we going to overcome

683
00:27:42,820 --> 00:27:40,550
that hurdle is it something that could

684
00:27:46,080 --> 00:27:42,830
potentially prevent humans from spending

685
00:27:50,500 --> 00:27:46,090
long long time longer periods in space

686
00:27:53,950 --> 00:27:50,510
well a lot of the the physiology data

687
00:27:56,230 --> 00:27:53,960
for wound healing is anecdotal from

688
00:27:59,380 --> 00:27:56,240

astronauts that have that experience and

689
00:28:02,650 --> 00:27:59,390
it's not a controlled study it's just

690
00:28:06,070 --> 00:28:02,660
medical data collected over the years so

691
00:28:08,140 --> 00:28:06,080
you know on the ground we would use an

692
00:28:09,820 --> 00:28:08,150
animal model a mouse for instance we

693
00:28:13,870 --> 00:28:09,830
would do a study would compare the

694
00:28:16,930 --> 00:28:13,880
factors objectively we do have a lot of

695
00:28:19,720 --> 00:28:16,940
anecdotal evidence from medical records

696
00:28:22,660 --> 00:28:19,730
that this is a problem and so we're

697
00:28:24,730 --> 00:28:22,670
following up on that kind of hint that

698
00:28:27,040 --> 00:28:24,740
there is a problem there and trying to

699
00:28:29,790 --> 00:28:27,050
determine if the one of the key

700
00:28:33,220 --> 00:28:29,800
components of wound healing in this case

701
00:28:35,710 --> 00:28:33,230
the keratinocyte is able to

702
00:28:38,980 --> 00:28:35,720
differentiate normally in space and we

703
00:28:42,970 --> 00:28:38,990
already have a lot of evidence that that

704
00:28:45,220 --> 00:28:42,980
it's not so that that's what we're

705
00:28:47,770 --> 00:28:45,230
working with in your space you know it

706
00:28:50,050 --> 00:28:47,780
takes ten years to do in space what you

707
00:28:53,140 --> 00:28:50,060
could do in the laboratory in less than

708
00:28:55,780 --> 00:28:53,150
six months so we have to be patient and

709
00:28:57,970 --> 00:28:55,790
we have to go on hints for a lot of

710
00:29:02,620 --> 00:28:57,980
things but this is something that we are

711
00:29:05,950 --> 00:29:02,630
we seeing it as a unifying theme the

712
00:29:09,310 --> 00:29:05,960
fact that stem cells in general may not

713
00:29:12,430 --> 00:29:09,320

be progressing normally to regenerate

714
00:29:16,170 --> 00:29:12,440
tissues in the body and so what could we

715
00:29:19,090 --> 00:29:16,180
do to improve this well the obvious

716
00:29:21,190 --> 00:29:19,100
answer is to restore mechanical

717
00:29:22,990 --> 00:29:21,200
stimulation of the body and this would

718
00:29:26,320 --> 00:29:23,000
be done with artificial gravity with the

719
00:29:29,740 --> 00:29:26,330
centrifuge of sorts that would impart

720
00:29:31,960 --> 00:29:29,750
again and the mechanical pressure from

721
00:29:34,390 --> 00:29:31,970
from Hydra stuff of gravity generating

722
00:29:36,430 --> 00:29:34,400
hydrostatic pressure the heart pumping

723
00:29:38,410 --> 00:29:36,440
more strongly all that creates a

724
00:29:40,660 --> 00:29:38,420
mechanical environment in the body that

725
00:29:42,850 --> 00:29:40,670
is necessary to stimulate cell growth

726
00:29:46,740 --> 00:29:42,860
and we actually know a lot about how

727
00:29:50,010 --> 00:29:46,750
this happens we know that this growth

728
00:29:53,700 --> 00:29:50,020
promoting signaling in cells is the

729
00:29:57,660 --> 00:29:53,710
result of signaling from interactions

730
00:30:00,540 --> 00:29:57,670
between integrins the extracellular

731
00:30:03,870 --> 00:30:00,550
matrix things like collagen through

732
00:30:06,300 --> 00:30:03,880
kinase cascades that promote cell cycle

733
00:30:09,840 --> 00:30:06,310
progression and on the ground we can put

734
00:30:13,680 --> 00:30:09,850
cells on a centrifuge let's say at 10 g

735
00:30:16,020 --> 00:30:13,690
vs 1 g and we at the end of a day or two

736
00:30:19,230 --> 00:30:16,030
we find that one hundred and fifty

737
00:30:21,690 --> 00:30:19,240
percent increase in cell proliferation

738
00:30:25,980 --> 00:30:21,700

just as a response to increase gravity

739
00:30:30,300 --> 00:30:25,990
so we know that we we can promote cell

740
00:30:32,430 --> 00:30:30,310
growth and this proliferative part of

741
00:30:36,390 --> 00:30:32,440
regeneration of tissues simply by

742
00:30:39,030 --> 00:30:36,400
restoring gravity now from a technical

743
00:30:41,340 --> 00:30:39,040
point of view engineering a centrifuge

744
00:30:45,350 --> 00:30:41,350
and the cost of it it's fairly expensive

745
00:30:48,810 --> 00:30:45,360
and for short stays in space the benefit

746
00:30:50,550 --> 00:30:48,820
balance with cost has been such that we

747
00:30:52,980 --> 00:30:50,560
take the risk of not having that

748
00:30:54,540 --> 00:30:52,990
mechanical stimulation but from what

749
00:30:56,930 --> 00:30:54,550
we're learning it may very well be that

750
00:30:59,130 --> 00:30:56,940
long-term space travel may require

751
00:31:04,620 --> 00:30:59,140
restoring some sort of artificial

752
00:31:07,770 --> 00:31:04,630
gravity gentlemen in the rear Doug

753
00:31:10,470 --> 00:31:07,780
moaning TMC satellite spotlight can the

754
00:31:13,500 --> 00:31:10,480
three of you address how long your

755
00:31:15,840 --> 00:31:13,510
experiments need to go on in space

756
00:31:18,990 --> 00:31:15,850
before you see a result is there a magic

757
00:31:21,620 --> 00:31:19,000
number for instance where you want to

758
00:31:25,490 --> 00:31:21,630
have a virus you want to have them the

759
00:31:28,410 --> 00:31:25,500
bacteria up there for two weeks two days

760
00:31:30,120 --> 00:31:28,420
sub Z right there any way to quantify

761
00:31:32,100 --> 00:31:30,130
that there seems to be like some sort of

762
00:31:34,710 --> 00:31:32,110
magic number that's not magic number but

763
00:31:37,230 --> 00:31:34,720

but you know it seems like the longer

764
00:31:39,680 --> 00:31:37,240
exposure is good shorter exposure bad

765
00:31:43,020 --> 00:31:39,690
when it comes to seeing these results

766
00:31:45,540 --> 00:31:43,030
it's a good question it depends on what

767
00:31:48,270 --> 00:31:45,550
is the question you're asking for

768
00:31:52,350 --> 00:31:48,280
example our experiment will be activated

769
00:31:53,820 --> 00:31:52,360
to grow for only three days because

770
00:31:55,860 --> 00:31:53,830
we're interested in more of the

771
00:31:57,240 --> 00:31:55,870
short-term effects for the study and

772
00:31:59,250 --> 00:31:57,250
also because our hardware is not

773
00:32:00,240 --> 00:31:59,260
designed to allow these cells to grow

774
00:32:02,370 --> 00:32:00,250
for longer

775
00:32:04,410 --> 00:32:02,380
of time if you're more interested in

776
00:32:06,870 --> 00:32:04,420
looking at which is just as important

777
00:32:09,780 --> 00:32:06,880
the long-term effects of culturing cells

778
00:32:11,310 --> 00:32:09,790
in the microgravity environment that is

779
00:32:13,740 --> 00:32:11,320
addressing a different question that

780
00:32:15,510 --> 00:32:13,750
what we need to answer for our immediate

781
00:32:17,580 --> 00:32:15,520
efforts for this for this pneumococcal

782
00:32:18,960 --> 00:32:17,590
vaccine both of those questions are

783
00:32:21,000 --> 00:32:18,970
important to understand the effects of

784
00:32:24,750 --> 00:32:21,010
microgravity during long-term or

785
00:32:26,190 --> 00:32:24,760
short-term culture growth I strongly

786
00:32:27,960 --> 00:32:26,200
suspect and I would like to hear their

787
00:32:29,910 --> 00:32:27,970
what my colleagues think that you're

788
00:32:32,070 --> 00:32:29,920

going to get much different responses

789
00:32:33,690 --> 00:32:32,080
long-term then then you would short term

790
00:32:36,680 --> 00:32:33,700
as the cells begin to adapt and change

791
00:32:38,940 --> 00:32:36,690
and learn to live in that environment

792
00:32:40,440 --> 00:32:38,950
our previous experiments were done

793
00:32:42,690 --> 00:32:40,450
short-term where and we showed

794
00:32:45,480 --> 00:32:42,700
Salmonella became a much better pathogen

795
00:32:47,190 --> 00:32:45,490
in flight and and it uniquely changed

796
00:32:48,420 --> 00:32:47,200
the expression of these genes which are

797
00:32:49,920 --> 00:32:48,430
important for causing disease

798
00:32:52,920 --> 00:32:49,930
differently than what we see on earth

799
00:32:55,590 --> 00:32:52,930
that's what gave us the impetus to move

800
00:32:57,690 --> 00:32:55,600
forward with this rasa vaccine strain to

801
00:33:00,420 --> 00:32:57,700
basically replicate those additions for

802
00:33:02,700 --> 00:33:00,430
a shorter term flight again it just

803
00:33:05,420 --> 00:33:02,710
depends on what your application is to

804
00:33:07,560 --> 00:33:05,430
whether you going to go shorter long

805
00:33:11,430 --> 00:33:07,570
you're not going to get the same results

806
00:33:13,230 --> 00:33:11,440
by doing a suborbital run for like five

807
00:33:15,090 --> 00:33:13,240
minutes you're going to need a long you

808
00:33:17,010 --> 00:33:15,100
need a minimum period of time we need a

809
00:33:18,540 --> 00:33:17,020
generation time for our particular

810
00:33:20,580 --> 00:33:18,550
experiment we need to have multiple

811
00:33:23,190 --> 00:33:20,590
generations so the cells can adapt and

812
00:33:25,080 --> 00:33:23,200
grow and respond so we definitely need

813
00:33:28,800 --> 00:33:25,090

something like a minute a few minutes

814
00:33:31,200 --> 00:33:28,810
whatever we need a few days so let me

815
00:33:32,610 --> 00:33:31,210
address your question too there are it

816
00:33:34,410 --> 00:33:32,620
really depends on what you're doing

817
00:33:36,810 --> 00:33:34,420
scientifically there are some

818
00:33:38,970 --> 00:33:36,820
experiments that you only need a few

819
00:33:41,220 --> 00:33:38,980
minutes for instance the interaction

820
00:33:44,100 --> 00:33:41,230
between two cells like for instance an

821
00:33:46,290 --> 00:33:44,110
antibody presenting cell that can be

822
00:33:50,130 --> 00:33:46,300
done in a very short period of exposure

823
00:33:52,200 --> 00:33:50,140
to microgravity but in general we have

824
00:33:56,520 --> 00:33:52,210
already done a lot of those experiments

825
00:33:59,220 --> 00:33:56,530
and the scientific community now is more

826
00:34:01,850 --> 00:33:59,230
interested in the long term so we've

827
00:34:05,340 --> 00:34:01,860
been doing for 50 years almost

828
00:34:07,590 --> 00:34:05,350
experiments limited to low-earth orbits

829
00:34:09,629 --> 00:34:07,600
and two short periods of time up to two

830
00:34:12,540 --> 00:34:09,639
weeks while we now know want to know

831
00:34:13,800 --> 00:34:12,550
what happens with one month in space

832
00:34:16,380 --> 00:34:13,810
with two months since

833
00:34:18,690 --> 00:34:16,390
and the limits that we have are the

834
00:34:21,090 --> 00:34:18,700
hardware we cannot keep things alive for

835
00:34:23,610 --> 00:34:21,100
that long we need to build better cell

836
00:34:25,770 --> 00:34:23,620
culture machines that will go for longer

837
00:34:27,930 --> 00:34:25,780
we need to build better habitats from

838
00:34:30,600 --> 00:34:27,940

mice and other organisms that will let

839
00:34:32,940 --> 00:34:30,610
us do an experiment for many months from

840
00:34:35,850 --> 00:34:32,950
my own point of view from my research in

841
00:34:38,250 --> 00:34:35,860
stem cells you know you have a variety

842
00:34:40,050 --> 00:34:38,260
of speed of regeneration if you look at

843
00:34:42,840 --> 00:34:40,060
the lining of the intestine that has

844
00:34:45,000 --> 00:34:42,850
been regenerating extremely fast in a

845
00:34:47,550 --> 00:34:45,010
few days you have turnover of the whole

846
00:34:49,620 --> 00:34:47,560
lining the same is true for blood but

847
00:34:52,770 --> 00:34:49,630
other tissues are much much much slower

848
00:34:55,410 --> 00:34:52,780
in regenerating so if you're looking at

849
00:34:57,510 --> 00:34:55,420
repair of a heart muscle for instance or

850
00:35:00,180 --> 00:34:57,520
between for instance formation of memory

851
00:35:03,090 --> 00:35:00,190
in the brain from from neural stem cells

852
00:35:05,790 --> 00:35:03,100
all those things are very long-term

853
00:35:08,220 --> 00:35:05,800
processes so if you want to study those

854
00:35:11,460 --> 00:35:08,230
you have to have animals like small

855
00:35:13,620 --> 00:35:11,470
rodents in orbit for months in order to

856
00:35:15,690 --> 00:35:13,630
be able to get good good data so that's

857
00:35:18,330 --> 00:35:15,700
why the ISS is so important for us

858
00:35:20,550 --> 00:35:18,340
because will let us get to that set of

859
00:35:26,280 --> 00:35:20,560
experiments that we have not never

860
00:35:28,800 --> 00:35:26,290
gotten to before 4i experiment 2 I

861
00:35:30,570 --> 00:35:28,810
wouldn't say it's totally long term it's

862
00:35:32,190 --> 00:35:30,580
probably sort of intermediate because

863
00:35:34,020 --> 00:35:32,200

we're not going for a whole life cycle

864
00:35:36,590 --> 00:35:34,030
but we are germinating the seed and

865
00:35:39,150 --> 00:35:36,600
growing them for about five to six days

866
00:35:41,100 --> 00:35:39,160
again we have a limitation with the

867
00:35:42,810 --> 00:35:41,110
hardware store how long we can grow them

868
00:35:46,110 --> 00:35:42,820
so because these are really small seed

869
00:35:48,900 --> 00:35:46,120
cassettes by about six days they're

870
00:35:53,940 --> 00:35:48,910
going to get too big to be in this

871
00:35:56,310 --> 00:35:53,950
confined space okay gentlemen in the

872
00:35:59,130 --> 00:35:56,320
green shirt here G michalka for talking

873
00:36:00,450 --> 00:35:59,140
space this is for Julie Robinson could

874
00:36:02,190 --> 00:36:00,460
you take us through the process of how

875
00:36:04,890 --> 00:36:02,200
an experiment is selected to fly on the

876
00:36:06,720 --> 00:36:04,900
International Space Station Thanks sure

877
00:36:08,580 --> 00:36:06,730
one of the really interesting things

878
00:36:10,650 --> 00:36:08,590
about the space station as it exists

879
00:36:13,470 --> 00:36:10,660
today is it's really a model of the way

880
00:36:15,360 --> 00:36:13,480
that scientists in the United States do

881
00:36:16,890 --> 00:36:15,370
research on the ground as well so there

882
00:36:20,070 --> 00:36:16,900
are a variety of different sources of

883
00:36:21,900 --> 00:36:20,080
funding from NASA funding national

884
00:36:24,600 --> 00:36:21,910
institutes of health funding National

885
00:36:26,670 --> 00:36:24,610
Science Foundation there are

886
00:36:27,630 --> 00:36:26,680
corporations that fund research on the

887
00:36:30,900 --> 00:36:27,640
space station as part

888
00:36:33,780 --> 00:36:30,910

of their rd program and then there are

889
00:36:35,640 --> 00:36:33,790
and those all those different selection

890
00:36:37,380 --> 00:36:35,650
processes come into play when a

891
00:36:39,060 --> 00:36:37,390
scientists like dr. Nickerson comes

892
00:36:42,000 --> 00:36:39,070
forward her early research was funded by

893
00:36:44,280 --> 00:36:42,010
NASA her later research now has she's

894
00:36:45,900 --> 00:36:44,290
raised that money privately because of

895
00:36:48,360 --> 00:36:45,910
the important application on earth and

896
00:36:49,890 --> 00:36:48,370
so there's not a single process for how

897
00:36:52,350 --> 00:36:49,900
research comes under the space station

898
00:36:53,430 --> 00:36:52,360
but if it's selected by nasa it comes in

899
00:36:55,500 --> 00:36:53,440
through that nasa sponsoring

900
00:36:57,630 --> 00:36:55,510
organization at nasa headquarters if it

901
00:36:59,490 --> 00:36:57,640
comes in some other way such as dr.

902
00:37:00,660 --> 00:36:59,500
Nickerson's work then it comes in

903
00:37:02,610 --> 00:37:00,670
through a space act agreement through

904
00:37:04,230 --> 00:37:02,620
our national laboratory office and then

905
00:37:05,730 --> 00:37:04,240
both kinds of research come together in

906
00:37:07,860 --> 00:37:05,740
space so it's really outstanding because

907
00:37:09,600 --> 00:37:07,870
it matches that same pattern of

908
00:37:12,030 --> 00:37:09,610
innovation that has made the United

909
00:37:14,160 --> 00:37:12,040
States such a great scientific power and

910
00:37:17,850 --> 00:37:14,170
we have all of those opportunities open

911
00:37:19,890 --> 00:37:17,860
for great ideas to get to space hey

912
00:37:23,280 --> 00:37:19,900
right here hi I'm Catherine Qualtrough

913
00:37:25,830 --> 00:37:23,290

with Kiwi Space Foundation and UNCC I

914
00:37:27,960 --> 00:37:25,840
have two questions I'm first for dr.

915
00:37:29,670 --> 00:37:27,970
almeida you talked about how stem cells

916
00:37:32,490 --> 00:37:29,680
don't function properly under

917
00:37:34,170 --> 00:37:32,500
microgravity specifically the failure of

918
00:37:37,200 --> 00:37:34,180
the stem cell to move into an adult

919
00:37:38,940 --> 00:37:37,210
differentiated form I know that nASA has

920
00:37:40,710 --> 00:37:38,950
a long track record of using space

921
00:37:43,350 --> 00:37:40,720
science to help our health here on earth

922
00:37:45,420 --> 00:37:43,360
are the effects of microgravity that

923
00:37:48,150 --> 00:37:45,430
you've seen do they show any similarity

924
00:37:50,330 --> 00:37:48,160
to possible stem cell dysfunction and

925
00:37:53,550 --> 00:37:50,340
diseases on earth autoimmune diseases

926
00:37:58,580 --> 00:37:53,560
yes absolutely I think the best analogy

927
00:38:01,170 --> 00:37:58,590
is a physical inactivity with aging so

928
00:38:03,210 --> 00:38:01,180
being physically active is it's really

929
00:38:06,150 --> 00:38:03,220
important for health and now we're

930
00:38:08,280 --> 00:38:06,160
starting to realize that that physical

931
00:38:12,150 --> 00:38:08,290
activity that mechanical stimulation of

932
00:38:15,030 --> 00:38:12,160
the body helps regenerate tissues for

933
00:38:18,420 --> 00:38:15,040
instance there's a study about memory

934
00:38:21,150 --> 00:38:18,430
and elderly persons and if you are

935
00:38:23,190 --> 00:38:21,160
physically active that promotes you know

936
00:38:24,780 --> 00:38:23,200
for instance walking that increases

937
00:38:26,510 --> 00:38:24,790
blood pressure while you're walking and

938
00:38:32,790 --> 00:38:26,520

that blood pressure in the brain

939
00:38:35,160 --> 00:38:32,800
promotes the proliferation of of neural

940
00:38:38,010 --> 00:38:35,170
stem cells that are necessary to form

941
00:38:41,880 --> 00:38:38,020
new memories the same is true for

942
00:38:44,440 --> 00:38:41,890
instance for bone health you know if you

943
00:38:47,220 --> 00:38:44,450
mechanically load your bones by walking

944
00:38:50,410 --> 00:38:47,230
or running the proliferation of

945
00:38:52,900 --> 00:38:50,420
osteoblasts is promoted as well as

946
00:38:55,240 --> 00:38:52,910
chondrocytes to form both mineralized

947
00:38:58,330 --> 00:38:55,250
bone as well as cartilage and then you

948
00:39:00,880 --> 00:38:58,340
repair and rebuild bones and as a result

949
00:39:05,170 --> 00:39:00,890
of that physical activity so all these

950
00:39:07,840 --> 00:39:05,180
cells their adult stem cells they're not

951
00:39:09,850 --> 00:39:07,850
they're not in their formal functional

952
00:39:12,310 --> 00:39:09,860
form they're sitting there they're still

953
00:39:14,070 --> 00:39:12,320
capable of dividing and so their adult

954
00:39:17,080 --> 00:39:14,080
stem cells and their growth

955
00:39:18,900 --> 00:39:17,090
proliferation is stimulated by this

956
00:39:22,120 --> 00:39:18,910
mechanical stimulus and I was telling

957
00:39:24,850 --> 00:39:22,130
early about the mechanism involving how

958
00:39:26,280 --> 00:39:24,860
the cell attached to them too in bone

959
00:39:28,810 --> 00:39:26,290
for instance to the collagen matrix

960
00:39:31,840 --> 00:39:28,820
promotes kinase signaling than then

961
00:39:36,010 --> 00:39:31,850
promotes entry into the cell cycle so

962
00:39:37,990 --> 00:39:36,020
that whole process is not we're starting

963
00:39:40,210 --> 00:39:38,000

to understand it and absolutely it has a

964
00:39:43,660 --> 00:39:40,220
great deal of relevance for health on

965
00:39:45,490 --> 00:39:43,670
earth because it is a parallel to what's

966
00:39:50,320 --> 00:39:45,500
happening with physical inactivity

967
00:39:52,660 --> 00:39:50,330
specially in aging and if we are able to

968
00:39:56,020 --> 00:39:52,670
experimentally take out gravity we

969
00:39:58,630 --> 00:39:56,030
really have a unique ability to study

970
00:40:00,880 --> 00:39:58,640
the problem and to come up with novel

971
00:40:03,930 --> 00:40:00,890
therapies and novel ways of

972
00:40:07,900 --> 00:40:03,940
understanding and solving the problem

973
00:40:09,490 --> 00:40:07,910
and just add to what he said we work on

974
00:40:11,620 --> 00:40:09,500
these processes at multiple different

975
00:40:13,540 --> 00:40:11,630
levels so dr. Almeida's work is working

976
00:40:16,180 --> 00:40:13,550
at the cellular level we also have

977
00:40:18,310 --> 00:40:16,190
researchers that are looking at the

978
00:40:19,660 --> 00:40:18,320
organismal level either using rodents as

979
00:40:21,280 --> 00:40:19,670
models and then we have researchers

980
00:40:23,320 --> 00:40:21,290
using the astronauts as their subjects

981
00:40:25,300 --> 00:40:23,330
to understand the processes of bone loss

982
00:40:27,010 --> 00:40:25,310
that are going on and and so there's a

983
00:40:28,930 --> 00:40:27,020
real power to having this long term

984
00:40:30,820 --> 00:40:28,940
laboratory where you can take the

985
00:40:32,800 --> 00:40:30,830
information from each level and put it

986
00:40:34,780 --> 00:40:32,810
into the follow-on investigation six

987
00:40:37,210 --> 00:40:34,790
months later or a year later to really

988
00:40:39,070 --> 00:40:37,220

move things forward so i would add just

989
00:40:43,050 --> 00:40:39,080
one more thing to that so we actually

990
00:40:47,200 --> 00:40:43,060
did some nasa Russian space agency

991
00:40:52,360 --> 00:40:47,210
collaborative studies with the photon m2

992
00:40:54,630 --> 00:40:52,370
and Foton m3 flights and 2005 and seven

993
00:40:56,840 --> 00:40:54,640
and in that in those

994
00:41:00,030 --> 00:40:56,850
we did animal studies in which we

995
00:41:03,150 --> 00:41:00,040
surgically removed the tip of the tail

996
00:41:04,740 --> 00:41:03,160
in the newt and as you may know these

997
00:41:07,410 --> 00:41:04,750
amphibians have the ability to

998
00:41:10,920 --> 00:41:07,420
regenerate their tail and so we studied

999
00:41:13,650 --> 00:41:10,930
in the whole animal how well the tail

1000
00:41:15,810 --> 00:41:13,660
regeneration could occur in space and we

1001
00:41:18,240 --> 00:41:15,820
found that there was a deficit so that

1002
00:41:20,310 --> 00:41:18,250
was the whole animal so when I wrote the

1003
00:41:22,680 --> 00:41:20,320
grant that supported this current work

1004
00:41:24,900 --> 00:41:22,690
that data was there and so we had a

1005
00:41:27,930 --> 00:41:24,910
basis for believing that in a whole

1006
00:41:31,830 --> 00:41:27,940
organism a regenerative process that

1007
00:41:35,490 --> 00:41:31,840
depends on stem cells was failing in

1008
00:41:37,800 --> 00:41:35,500
space and so we went on to focus on the

1009
00:41:39,930 --> 00:41:37,810
cellular mechanisms and now we're going

1010
00:41:41,400 --> 00:41:39,940
through the molecular mechanism so we

1011
00:41:43,470 --> 00:41:41,410
started by looking at the whole

1012
00:41:45,390 --> 00:41:43,480
biological process in the organism and

1013
00:41:47,490 --> 00:41:45,400

stand start to narrow it down to

1014
00:41:49,170 --> 00:41:47,500
understand those molecular mechanisms

1015
00:41:50,730 --> 00:41:49,180
that will let us come up with

1016
00:41:57,690 --> 00:41:50,740
therapeutical interventions and

1017
00:42:00,240 --> 00:41:57,700
understand what the process is sep seth

1018
00:42:02,820 --> 00:42:00,250
borenstein again and from AP for dr.

1019
00:42:04,890 --> 00:42:02,830
Robinson I know this might be a little

1020
00:42:07,440 --> 00:42:04,900
unfair to ask and may be premature but

1021
00:42:10,260 --> 00:42:07,450
since microgravity missions been flying

1022
00:42:13,470 --> 00:42:10,270
for now 20-some years you know including

1023
00:42:16,230 --> 00:42:13,480
shuttle I don't know how many times I've

1024
00:42:18,030 --> 00:42:16,240
heard this you know this study and that

1025
00:42:21,480 --> 00:42:18,040
study going up there and then you never

1026
00:42:25,230 --> 00:42:21,490
really hear much about the results is

1027
00:42:27,510 --> 00:42:25,240
there sort of a figure percentage on

1028
00:42:29,970 --> 00:42:27,520
obviously I know you there's figures on

1029
00:42:33,330 --> 00:42:29,980
how many articles have been written in

1030
00:42:36,720 --> 00:42:33,340
scientific journals but in terms of how

1031
00:42:42,360 --> 00:42:36,730
often the research has paid off into a

1032
00:42:46,620 --> 00:42:42,370
actual change in in understanding and or

1033
00:42:50,100 --> 00:42:46,630
therapy here on earth of something as

1034
00:42:51,150 --> 00:42:50,110
opposed to finding an nil response you

1035
00:42:53,100 --> 00:42:51,160
know finding that there was no

1036
00:42:56,190 --> 00:42:53,110
difference here or that and how does

1037
00:42:57,840 --> 00:42:56,200
that compare to earthbound studies right

1038
00:43:00,180 --> 00:42:57,850

so let me let me address the question in

1039
00:43:02,940 --> 00:43:00,190
two ways first of all you have to look

1040
00:43:04,650 --> 00:43:02,950
at how limited really the scientific

1041
00:43:07,320 --> 00:43:04,660
opportunity has been in human space

1042
00:43:08,370 --> 00:43:07,330
flight to date in a shuttle mission you

1043
00:43:10,470 --> 00:43:08,380
might have

1044
00:43:12,839 --> 00:43:10,480
several dozen investigators they only

1045
00:43:14,519 --> 00:43:12,849
had two weeks they had one experiment it

1046
00:43:16,349 --> 00:43:14,529
was carefully choreographed if anything

1047
00:43:18,180 --> 00:43:16,359
went wrong they might not have another

1048
00:43:20,279 --> 00:43:18,190
opportunity to fly for five years if

1049
00:43:22,470 --> 00:43:20,289
anything went right they also didn't

1050
00:43:25,319 --> 00:43:22,480
have another opportunity to fly for five

1051
00:43:26,549 --> 00:43:25,329
years and so the the rate of progress in

1052
00:43:30,059 --> 00:43:26,559
the disciplines has been extraordinarily

1053
00:43:31,710 --> 00:43:30,069
slow during ISS assembly once again we

1054
00:43:33,660 --> 00:43:31,720
had to get this shuttle assembled as

1055
00:43:35,279 --> 00:43:33,670
rapidly as possible or the space station

1056
00:43:38,339 --> 00:43:35,289
assembled as rapidly as possible and

1057
00:43:41,430 --> 00:43:38,349
then in in proceeding toward that goal

1058
00:43:43,529 --> 00:43:41,440
we did research on the side to try and

1059
00:43:45,660 --> 00:43:43,539
optimize any little bit of extra crew

1060
00:43:47,370 --> 00:43:45,670
time any little bit of extra up mass we

1061
00:43:49,769 --> 00:43:47,380
we did that for pathfinding

1062
00:43:53,490 --> 00:43:49,779
investigations if you add all of that

1063
00:43:55,740 --> 00:43:53,500

research up to date the and you look at

1064
00:43:58,470 --> 00:43:55,750
edit just in terms of the crew as a

1065
00:44:00,930 --> 00:43:58,480
laboratory technician we have basically

1066
00:44:04,529 --> 00:44:00,940
accomplished about fifteen to twenty

1067
00:44:06,660 --> 00:44:04,539
percent of the research that lies ahead

1068
00:44:08,970 --> 00:44:06,670
of us on the space station in the next

1069
00:44:11,309 --> 00:44:08,980
decade so we've really hardly scratched

1070
00:44:12,450 --> 00:44:11,319
the surface and that's a really

1071
00:44:13,799 --> 00:44:12,460
important thing to understand because

1072
00:44:15,299 --> 00:44:13,809
the way that scientists do their

1073
00:44:17,220 --> 00:44:15,309
research is they do something in the

1074
00:44:19,230 --> 00:44:17,230
laboratory they see the result they turn

1075
00:44:20,670 --> 00:44:19,240
it around and they do it again and what

1076
00:44:23,009 --> 00:44:20,680
you're starting to see on the space

1077
00:44:24,960 --> 00:44:23,019
station now is that pattern of research

1078
00:44:26,940 --> 00:44:24,970
is the way that things are working for

1079
00:44:29,220 --> 00:44:26,950
investigators we don't select somebody

1080
00:44:30,930 --> 00:44:29,230
for a single flight opportunity anymore

1081
00:44:33,299 --> 00:44:30,940
we select them for a series of flight

1082
00:44:35,069 --> 00:44:33,309
Opportunities we build in so that we're

1083
00:44:36,779 --> 00:44:35,079
ready to do the next experiment that

1084
00:44:39,029 --> 00:44:36,789
derives from the information they learn

1085
00:44:40,950 --> 00:44:39,039
on their immediate experiment and that's

1086
00:44:42,720 --> 00:44:40,960
really transforming the ability to get

1087
00:44:44,190 --> 00:44:42,730
results out of the platform we could

1088
00:44:46,589 --> 00:44:44,200

only do that when space station assembly

1089
00:44:49,380 --> 00:44:46,599
was complete this year and when its

1090
00:44:51,839 --> 00:44:49,390
primary purpose was was then for for the

1091
00:44:53,249 --> 00:44:51,849
research and technology testing the

1092
00:44:55,380 --> 00:44:53,259
other thing the other way I want to

1093
00:44:57,900 --> 00:44:55,390
address that question is in terms of the

1094
00:45:00,059 --> 00:44:57,910
time it takes to get from a clinical

1095
00:45:02,069 --> 00:45:00,069
research result or from from a

1096
00:45:03,930 --> 00:45:02,079
laboratory research result to a clinical

1097
00:45:05,519 --> 00:45:03,940
research result the National Institutes

1098
00:45:07,910 --> 00:45:05,529
of Health calls this the valley of death

1099
00:45:10,650 --> 00:45:07,920
because it can take a really long time

1100
00:45:13,140 --> 00:45:10,660
for a de scientific discovery to make

1101
00:45:14,940 --> 00:45:13,150
its way across when dr. Nickerson was

1102
00:45:17,849 --> 00:45:14,950
talking about her work she mentioned

1103
00:45:20,549 --> 00:45:17,859
that the the vaccine that she's flying

1104
00:45:21,400 --> 00:45:20,559
has been used in research for a decade

1105
00:45:23,020 --> 00:45:21,410
already

1106
00:45:25,150 --> 00:45:23,030
and they're still working to improve it

1107
00:45:27,700 --> 00:45:25,160
and I may have I may have misstated so

1108
00:45:30,220 --> 00:45:27,710
she may want to correct that but we most

1109
00:45:32,680 --> 00:45:30,230
of our researchers we see working with

1110
00:45:33,640 --> 00:45:32,690
strains incrementally doing making

1111
00:45:35,530 --> 00:45:33,650
different kinds of incremental

1112
00:45:37,300 --> 00:45:35,540
improvements that shift to clinical

1113
00:45:39,250 --> 00:45:37,310

trials doesn't happen the day after you

1114
00:45:41,710 --> 00:45:39,260
return from flight and so we have a

1115
00:45:43,540 --> 00:45:41,720
number of ISS early research results

1116
00:45:46,060 --> 00:45:43,550
that are at the clinical trial stage

1117
00:45:48,520 --> 00:45:46,070
either with investigational new drugs

1118
00:45:50,560 --> 00:45:48,530
approved or with investigational dune

1119
00:45:53,260 --> 00:45:50,570
drugs at the interim testing stage

1120
00:45:54,700 --> 00:45:53,270
before they go to clinical trials so I

1121
00:45:57,220 --> 00:45:54,710
think that that gives us a sense of how

1122
00:45:58,930 --> 00:45:57,230
these early results are going to play

1123
00:46:00,550 --> 00:45:58,940
out over the long term but really our

1124
00:46:03,400 --> 00:46:00,560
future is still ahead of us we're just

1125
00:46:05,230 --> 00:46:03,410
starting this is an issue I feel very

1126
00:46:08,470 --> 00:46:05,240
strongly about and passionately about

1127
00:46:10,410 --> 00:46:08,480
and you know a lot of people look at it

1128
00:46:13,270 --> 00:46:10,420
from this perspective that you just

1129
00:46:15,730 --> 00:46:13,280
enunciated thee you know you look at the

1130
00:46:18,070 --> 00:46:15,740
aggregate of the results from space

1131
00:46:19,990 --> 00:46:18,080
research and you ask the question well

1132
00:46:22,690 --> 00:46:20,000
was it this really worth all the

1133
00:46:24,880 --> 00:46:22,700
investment and I think you have to take

1134
00:46:27,480 --> 00:46:24,890
a step back and look at it from a

1135
00:46:31,090 --> 00:46:27,490
slightly different perspective you know

1136
00:46:36,160 --> 00:46:31,100
science always stands on the shoulders

1137
00:46:39,220 --> 00:46:36,170
of giants that came before and you know

1138
00:46:41,680 --> 00:46:39,230

what you do is a stepwise building of

1139
00:46:45,010 --> 00:46:41,690
knowledge and what the space environment

1140
00:46:49,690 --> 00:46:45,020
does is to offer a totally new

1141
00:46:52,030 --> 00:46:49,700
perspective on how biological systems

1142
00:46:54,490 --> 00:46:52,040
physical systems chemical systems work

1143
00:46:57,460 --> 00:46:54,500
we cannot replicate microgravity on

1144
00:47:01,150 --> 00:46:57,470
earth and so just to be able to go

1145
00:47:03,700 --> 00:47:01,160
outside and outside of Earth's gravity

1146
00:47:06,040 --> 00:47:03,710
and do those experiments even if there

1147
00:47:09,820 --> 00:47:06,050
are a few experiments it gives us

1148
00:47:12,010 --> 00:47:09,830
results that inspire enormous amount of

1149
00:47:15,310 --> 00:47:12,020
research on the ground so one experiment

1150
00:47:18,250 --> 00:47:15,320
in space will result into a huge amount

1151
00:47:20,950 --> 00:47:18,260
of ground research and i'll give you a

1152
00:47:24,580 --> 00:47:20,960
specific example and that's the field of

1153
00:47:28,180 --> 00:47:24,590
mechanobiology so this whole field that

1154
00:47:31,990 --> 00:47:28,190
started in the 1990s of understanding

1155
00:47:34,090 --> 00:47:32,000
what is the importance of mechanical

1156
00:47:35,259 --> 00:47:34,100
stimulation in cell biology and tissue

1157
00:47:38,289 --> 00:47:35,269
biology and organism

1158
00:47:41,289 --> 00:47:38,299
biology that whole field flourished

1159
00:47:44,259 --> 00:47:41,299
because of the initial support for a

1160
00:47:47,199 --> 00:47:44,269
NASA investigator Donald ingber that

1161
00:47:51,339 --> 00:47:47,209
made some key discoveries on how those

1162
00:47:53,439 --> 00:47:51,349
mechanical forces were were being

1163
00:47:56,139 --> 00:47:53,449

transmitted by cells and so that is a

1164
00:47:58,089 --> 00:47:56,149
field now that's inspired that that has

1165
00:48:00,489 --> 00:47:58,099
thousands and thousands and thousands of

1166
00:48:02,169 --> 00:48:00,499
publications and key results you are

1167
00:48:07,029 --> 00:48:02,179
extremely important in medicine and

1168
00:48:09,609 --> 00:48:07,039
cancer that was started the ideas that

1169
00:48:11,949 --> 00:48:09,619
seeded that field came from that

1170
00:48:15,789 --> 00:48:11,959
perspective that we got in microgravity

1171
00:48:18,039 --> 00:48:15,799
so even if by the numbers the science

1172
00:48:20,649 --> 00:48:18,049
that is done in space it does not appear

1173
00:48:23,289 --> 00:48:20,659
to be very productive and that's not

1174
00:48:25,120 --> 00:48:23,299
always true it's actually you know given

1175
00:48:26,769 --> 00:48:25,130
the few few opportunities that are

1176
00:48:29,109 --> 00:48:26,779
available the results are pretty good

1177
00:48:31,749 --> 00:48:29,119
but still it has a multiplicative effect

1178
00:48:33,969 --> 00:48:31,759
it's it's a unique opportunity something

1179
00:48:36,309 --> 00:48:33,979
and seen anywhere else so that that

1180
00:48:39,489 --> 00:48:36,319
inspires more research and just for that

1181
00:48:42,639 --> 00:48:39,499
I think the value is immeasurable I

1182
00:48:45,429 --> 00:48:42,649
would also add to that something i think

1183
00:48:47,769 --> 00:48:45,439
that's often overlooked and just keep in

1184
00:48:50,319 --> 00:48:47,779
mind that any time you think outside of

1185
00:48:52,239 --> 00:48:50,329
the box any thought time you push the

1186
00:48:54,459 --> 00:48:52,249
frontiers and you challenged paradigms

1187
00:48:57,609 --> 00:48:54,469
you're met with skepticism in any field

1188
00:49:00,189 --> 00:48:57,619

but especially science I mean when when

1189
00:49:01,389 --> 00:49:00,199
computers were first invented there was

1190
00:49:02,979 --> 00:49:01,399
no thought of them having any use

1191
00:49:05,469 --> 00:49:02,989
whatsoever for the general public and

1192
00:49:07,599 --> 00:49:05,479
all of us in this room can list about a

1193
00:49:09,819 --> 00:49:07,609
hundred of it other discoveries the same

1194
00:49:11,919 --> 00:49:09,829
way as well you're often met with

1195
00:49:15,009 --> 00:49:11,929
criticism and skepticism when you're

1196
00:49:16,689 --> 00:49:15,019
challenging paradigms and as every

1197
00:49:18,879 --> 00:49:16,699
investigator at this table has just told

1198
00:49:21,039 --> 00:49:18,889
you you have a new paradigm it's

1199
00:49:23,499 --> 00:49:21,049
relatively untapped you have a new

1200
00:49:25,029 --> 00:49:23,509
platform to understand how cells are

1201
00:49:26,709 --> 00:49:25,039
behaving differently whether we're

1202
00:49:29,409 --> 00:49:26,719
studying infectious disease whether

1203
00:49:31,239 --> 00:49:29,419
we're studying stem cell and tissue

1204
00:49:33,159 --> 00:49:31,249
regeneration whether we're understanding

1205
00:49:34,629 --> 00:49:33,169
how plants develop normally whether

1206
00:49:36,489 --> 00:49:34,639
we're studying aging whether they're

1207
00:49:38,319 --> 00:49:36,499
standing muscle weighs muscle wasting

1208
00:49:39,999 --> 00:49:38,329
diseases bone loss does this sound

1209
00:49:41,819 --> 00:49:40,009
familiar to everyone because these are

1210
00:49:44,919 --> 00:49:41,829
the major problems we face here on earth

1211
00:49:46,689 --> 00:49:44,929
but we're thinking in a new way about

1212
00:49:48,489 --> 00:49:46,699
how to address these issues and in some

1213
00:49:49,180 --> 00:49:48,499

of these fields we've kind of pushed

1214
00:49:51,040 --> 00:49:49,190
convention

1215
00:49:52,720 --> 00:49:51,050
methods about as far as we can well

1216
00:49:55,210 --> 00:49:52,730
certainly an infectious disease research

1217
00:49:56,700 --> 00:49:55,220
the pathogens are winning antibiotic

1218
00:49:59,740 --> 00:49:56,710
resistance is on the increase

1219
00:50:02,470 --> 00:49:59,750
antimicrobial therapies are not on the

1220
00:50:05,829 --> 00:50:02,480
increase okay they're smarter than we

1221
00:50:08,920 --> 00:50:05,839
are so we need to use new ways new

1222
00:50:12,010 --> 00:50:08,930
platforms new methods to get them to

1223
00:50:14,290 --> 00:50:12,020
unveil their secrets so we can better

1224
00:50:16,569 --> 00:50:14,300
understand how they're functioning and

1225
00:50:19,450 --> 00:50:16,579
this is it shouldn't really surprise

1226
00:50:21,760 --> 00:50:19,460
anybody we do this all the time we put

1227
00:50:23,079 --> 00:50:21,770
cells in extreme heat conditions oh look

1228
00:50:24,339 --> 00:50:23,089
at that response I didn't know I could

1229
00:50:26,460 --> 00:50:24,349
do that well now I've just advanced

1230
00:50:29,650 --> 00:50:26,470
forensics medicine and I've advanced

1231
00:50:31,690 --> 00:50:29,660
cloning and DNA sequencing well well

1232
00:50:34,210 --> 00:50:31,700
let's put them in this very low pH what

1233
00:50:36,220 --> 00:50:34,220
can they do my gosh stress doesn't cause

1234
00:50:38,559 --> 00:50:36,230
ulcers a bacteria that can survive in a

1235
00:50:41,559 --> 00:50:38,569
pH below one causes ulcers and stomach

1236
00:50:42,970 --> 00:50:41,569
cancers you see the pattern here so it

1237
00:50:45,970 --> 00:50:42,980
always kind of surprises me as a

1238
00:50:47,950 --> 00:50:45,980

scientist is in terms of why some people

1239
00:50:50,140 --> 00:50:47,960
seem to just want to shut the doors oh

1240
00:50:52,420 --> 00:50:50,150
no value you just dismiss something as

1241
00:50:54,250 --> 00:50:52,430
having no value without really looking

1242
00:50:57,099 --> 00:50:54,260
at what's been done there and true as

1243
00:50:59,109 --> 00:50:57,109
dr. Robinson said we have begun to touch

1244
00:51:00,940 --> 00:50:59,119
the tip of using this platform we

1245
00:51:04,180 --> 00:51:00,950
haven't had a lot of time to do science

1246
00:51:06,370 --> 00:51:04,190
up there but that's why I think you're

1247
00:51:08,200 --> 00:51:06,380
seeing a mounting interest i know i have

1248
00:51:11,020 --> 00:51:08,210
been seeing it from the commercial side

1249
00:51:13,839 --> 00:51:11,030
from the academia side okay and from the

1250
00:51:16,390 --> 00:51:13,849
government side about what what kind of

1251
00:51:18,190 --> 00:51:16,400
new secrets can this platform really

1252
00:51:20,859 --> 00:51:18,200
unveil to us what kind of potential and

1253
00:51:22,780 --> 00:51:20,869
it is significant to really start to

1254
00:51:25,660 --> 00:51:22,790
translationally advance those results

1255
00:51:27,730 --> 00:51:25,670
from the bench okay in the lab and now

1256
00:51:29,309 --> 00:51:27,740
on the bench on the ISS and bring it

1257
00:51:31,150 --> 00:51:29,319
back down here on earth to

1258
00:51:32,710 --> 00:51:31,160
translationally advance our quality of

1259
00:51:35,770 --> 00:51:32,720
life and human health nasa has been

1260
00:51:37,569 --> 00:51:35,780
doing this since day one okay now is the

1261
00:51:38,950 --> 00:51:37,579
opportunity now is the time to move you

1262
00:51:40,839 --> 00:51:38,960
have the lab built you have the

1263
00:51:45,170 --> 00:51:40,849

structure up there we got a rock and

1264
00:51:48,890 --> 00:51:47,030
thank you more than anything I'm just

1265
00:51:52,190 --> 00:51:48,900
looking for data points which I assume a

1266
00:51:54,020 --> 00:51:52,200
scientist you appreciate when you I've

1267
00:51:56,329 --> 00:51:54,030
been here forever yeah four years

1268
00:51:59,240 --> 00:51:56,339
hearing how this will do you know this

1269
00:52:04,250 --> 00:51:59,250
is doing this and I just looking for

1270
00:52:06,680 --> 00:52:04,260
some data to support this if you go to

1271
00:52:08,180 --> 00:52:06,690
nasa gov under ISS research you can

1272
00:52:09,589 --> 00:52:08,190
click on benefits that will give you

1273
00:52:11,480 --> 00:52:09,599
some of the top stories you can also

1274
00:52:13,579 --> 00:52:11,490
click on publications and get a complete

1275
00:52:16,579 --> 00:52:13,589
list of the publications that we know of

1276
00:52:20,630 --> 00:52:16,589
from ISS research to date roughly 400 or

1277
00:52:22,130 --> 00:52:20,640
so publications well I mean that that's

1278
00:52:24,200 --> 00:52:22,140
the facts about the scientific

1279
00:52:26,150 --> 00:52:24,210
publications I would say the bulk of the

1280
00:52:28,099 --> 00:52:26,160
work on ISS because it takes three to

1281
00:52:29,720 --> 00:52:28,109
five years for many publications to come

1282
00:52:31,370 --> 00:52:29,730
out from space flight the bulk of the

1283
00:52:34,130 --> 00:52:31,380
publications are far ahead of us even

1284
00:52:36,290 --> 00:52:34,140
from the assembly work but you can read

1285
00:52:38,660 --> 00:52:36,300
about the patents you can read about the

1286
00:52:40,309 --> 00:52:38,670
new products that have been developed

1287
00:52:43,190 --> 00:52:40,319
and are in the commercial marketplace

1288
00:52:44,690 --> 00:52:43,200

based on ISS research so and we can give

1289
00:52:50,359 --> 00:52:44,700
you more information on that afterward

1290
00:52:53,000 --> 00:52:50,369
as well in the back here gene michalka

1291
00:52:55,849 --> 00:52:53,010
with talking space for dr. Alameda your

1292
00:52:59,720 --> 00:52:55,859
research deals in cell regeneration and

1293
00:53:01,220 --> 00:52:59,730
so on right now to get rid of a really

1294
00:53:02,960 --> 00:53:01,230
troublesome wound do you have people

1295
00:53:04,910 --> 00:53:02,970
spending hours and hours and hours and

1296
00:53:07,579 --> 00:53:04,920
hyperbaric chambers to try to heal this

1297
00:53:09,920 --> 00:53:07,589
which what you're doing sort of possibly

1298
00:53:12,049 --> 00:53:09,930
negate that possibility of an individual

1299
00:53:14,900 --> 00:53:12,059
as a particularly troublesome wound that

1300
00:53:18,430 --> 00:53:14,910
just can't heal of spending like hours

1301
00:53:21,170 --> 00:53:18,440
in a hyperbaric chamber say yeah well

1302
00:53:22,819 --> 00:53:21,180
the question of wound healing is is

1303
00:53:27,440 --> 00:53:22,829
particularly important from a medical

1304
00:53:32,930 --> 00:53:27,450
point of view and the reason is that i

1305
00:53:36,890 --> 00:53:32,940
talked about newts earlier humans like

1306
00:53:41,539 --> 00:53:36,900
newt have the regenerative ability so if

1307
00:53:45,140 --> 00:53:41,549
you we lose it around birth so if for

1308
00:53:47,960 --> 00:53:45,150
instance if a birth defect is discovered

1309
00:53:51,559 --> 00:53:47,970
in utero surgeons nowadays can go in and

1310
00:53:54,980 --> 00:53:51,569
perform an in utero surgery and wound

1311
00:53:57,530 --> 00:53:54,990
healing occurs perfectly regenerative

1312
00:53:58,550 --> 00:53:57,540
Lee you know like as in a newt when you

1313
00:54:00,620 --> 00:53:58,560

cut a tail

1314
00:54:02,960 --> 00:54:00,630
or leg it grows back and it's fully

1315
00:54:06,410 --> 00:54:02,970
functional the patterning of development

1316
00:54:08,060 --> 00:54:06,420
occurs normally so the newts are amazing

1317
00:54:10,580 --> 00:54:08,070
you can cut the spinal cord and they'll

1318
00:54:12,410 --> 00:54:10,590
grow it back and they'll walk again you

1319
00:54:13,970 --> 00:54:12,420
can take out a third of the heart some

1320
00:54:17,030 --> 00:54:13,980
of these experiments are quite barbaric

1321
00:54:18,980 --> 00:54:17,040
but they were done over the years and

1322
00:54:21,860 --> 00:54:18,990
the interest of science and these

1323
00:54:24,710 --> 00:54:21,870
animals have a full regenerative ability

1324
00:54:27,170 --> 00:54:24,720
if the animal survives it will grow it

1325
00:54:29,450 --> 00:54:27,180
back it can even cut the lens the retina

1326
00:54:31,400 --> 00:54:29,460
all it all grows back humans are like

1327
00:54:35,000 --> 00:54:31,410
that too we have exactly the same jeans

1328
00:54:38,390 --> 00:54:35,010
and a human being in utero can do the

1329
00:54:40,040 --> 00:54:38,400
same tricks biologically and so part of

1330
00:54:42,860 --> 00:54:40,050
the results of this research that is

1331
00:54:44,330 --> 00:54:42,870
ongoing is understanding this field in

1332
00:54:47,480 --> 00:54:44,340
the field of regenerative medicine is

1333
00:54:50,120 --> 00:54:47,490
just exploding and some of the work and

1334
00:54:51,890 --> 00:54:50,130
regeneration is being done in space the

1335
00:54:53,930 --> 00:54:51,900
Russians in particular have done a long

1336
00:54:56,390 --> 00:54:53,940
string of experiments with regeneration

1337
00:54:59,870 --> 00:54:56,400
in space and how microgravity might

1338
00:55:03,590 --> 00:54:59,880

affect that so absolutely so if we learn

1339
00:55:05,600 --> 00:55:03,600
that the now the key difference why

1340
00:55:07,610 --> 00:55:05,610
don't why do we lose that ability I

1341
00:55:11,270 --> 00:55:07,620
think evolutionarily human beings

1342
00:55:16,070 --> 00:55:11,280
switched from regenerating to making a

1343
00:55:18,350 --> 00:55:16,080
quick fix a clot and then a provisional

1344
00:55:21,080 --> 00:55:18,360
repair and so that doesn't repattern

1345
00:55:26,390 --> 00:55:21,090
development so we need to learn how to

1346
00:55:28,370 --> 00:55:26,400
turn off the genes that make that quick

1347
00:55:34,030 --> 00:55:28,380
repair that allows us to survive even

1348
00:55:38,930 --> 00:55:34,040
though our wound is there and we need to

1349
00:55:41,330 --> 00:55:38,940
learn to regenerate the the tissue that

1350
00:55:45,260 --> 00:55:41,340
was damaged and so what microgravity is

1351
00:55:47,090 --> 00:55:45,270
doing is keeping those stem cells from

1352
00:55:50,060 --> 00:55:47,100
differentiating so that might be a way

1353
00:55:52,750 --> 00:55:50,070
of letting those cells grow enough so

1354
00:55:56,480 --> 00:55:52,760
that the the tissue can be regenerated

1355
00:55:58,850 --> 00:55:56,490
instead of having a wound healing

1356
00:56:00,920 --> 00:55:58,860
response so there's a lot of insight

1357
00:56:02,630 --> 00:56:00,930
that can be gained from doing the

1358
00:56:04,940 --> 00:56:02,640
experiments in microgravity that can

1359
00:56:07,640 --> 00:56:04,950
probably be used in the field of

1360
00:56:10,340 --> 00:56:07,650
regeneration and wound healing but you

1361
00:56:11,520 --> 00:56:10,350
know science is quite serendipitous you

1362
00:56:14,730 --> 00:56:11,530
know sometimes

1363
00:56:16,910 --> 00:56:14,740

very often we don't find the things that

1364
00:56:20,820 --> 00:56:16,920
we set out to find in our grants and

1365
00:56:22,680 --> 00:56:20,830
it's somebody else that wanted to

1366
00:56:25,650 --> 00:56:22,690
discover something totally unrelated

1367
00:56:27,780 --> 00:56:25,660
that comes up with the breakthrough so

1368
00:56:32,040 --> 00:56:27,790
you know that that you know the

1369
00:56:34,320 --> 00:56:32,050
accounting mentality of seeing asking

1370
00:56:36,420 --> 00:56:34,330
the question you know what did you get

1371
00:56:38,730 --> 00:56:36,430
for you know did you reach your goal

1372
00:56:40,650 --> 00:56:38,740
science doesn't quite work like that you

1373
00:56:43,410 --> 00:56:40,660
know you have an aggregate of scientists

1374
00:56:46,230 --> 00:56:43,420
doing research and you know it's very

1375
00:56:49,290 --> 00:56:46,240
rare for the people that seek to fix a

1376
00:56:50,760 --> 00:56:49,300
particular disease to actually fix that

1377
00:56:53,280 --> 00:56:50,770
disease somebody else will do it by

1378
00:56:55,740 --> 00:56:53,290
accident even the pharma companies

1379
00:56:58,320 --> 00:56:55,750
nowadays they are cutting down their

1380
00:57:00,600 --> 00:56:58,330
research departments and instead because

1381
00:57:02,460 --> 00:57:00,610
they've figured out that trying to fix

1382
00:57:04,050 --> 00:57:02,470
some disease in their own research

1383
00:57:06,270 --> 00:57:04,060
department is just doesn't work it's not

1384
00:57:08,850 --> 00:57:06,280
productive they will go and they'll buy

1385
00:57:11,700 --> 00:57:08,860
out a specific company startup company

1386
00:57:14,490 --> 00:57:11,710
that that has bumped into the answer for

1387
00:57:16,020 --> 00:57:14,500
that for their problem and so in general

1388
00:57:19,260 --> 00:57:16,030

that's all science goes you know you

1389
00:57:22,170 --> 00:57:19,270
cannot expect you know a neat follow up

1390
00:57:24,720 --> 00:57:22,180
from grant to result you support

1391
00:57:26,700 --> 00:57:24,730
research in general and you know it in

1392
00:57:28,590 --> 00:57:26,710
general there's a good outcome but it's

1393
00:57:32,040 --> 00:57:28,600
not entirely predictable and it's not

1394
00:57:34,020 --> 00:57:32,050
entirely entirely accountable for you

1395
00:57:37,110 --> 00:57:34,030
using you know normal rules of

1396
00:57:39,260 --> 00:57:37,120
accounting okay we'll wrap it up by

1397
00:57:42,090 --> 00:57:39,270
taking one last question from Katherine

1398
00:57:45,180 --> 00:57:42,100
Qualtrough with Kiwi Space Foundation

1399
00:57:47,130 --> 00:57:45,190
and this for dr. Robinson as a physicist

1400
00:57:49,050 --> 00:57:47,140
so I'm kind of interested in the end the

1401
00:57:50,910 --> 00:57:49,060
Alpha Magnetic Spectrometer is there any

1402
00:57:53,160 --> 00:57:50,920
indication on when we can expect and it

1403
00:57:56,850 --> 00:57:53,170
is a deluge of data obviously when we

1404
00:57:59,730 --> 00:57:56,860
can expect a major publication of of the

1405
00:58:01,770 --> 00:57:59,740
data certainly is a dulwich of data and

1406
00:58:02,880 --> 00:58:01,780
there is also a deluge of investigators

1407
00:58:05,670 --> 00:58:02,890
involved in the Alpha Magnetic

1408
00:58:07,200 --> 00:58:05,680
Spectrometer roughly 500 investigators

1409
00:58:09,300 --> 00:58:07,210
from around the world so it will take

1410
00:58:11,880 --> 00:58:09,310
them some time to analyze their data and

1411
00:58:13,680 --> 00:58:11,890
I'm suspecting that that they're going

1412
00:58:14,490 --> 00:58:13,690
to be capturing you know one of the

1413
00:58:16,790 --> 00:58:14,500

things that they're doing in that

1414
00:58:19,100 --> 00:58:16,800
experiment is really looking for

1415
00:58:21,660 --> 00:58:19,110
specific signs of antimatter

1416
00:58:24,150 --> 00:58:21,670
matter-antimatter flux and also looking

1417
00:58:25,290 --> 00:58:24,160
for certain signs of specific kinds of

1418
00:58:27,330 --> 00:58:25,300
particles called neutrally no

1419
00:58:29,910 --> 00:58:27,340
that helped validate theories of

1420
00:58:31,530 --> 00:58:29,920
subatomic particles I'm suspecting that

1421
00:58:32,910 --> 00:58:31,540
when they start getting that data

1422
00:58:34,830 --> 00:58:32,920
they're going to take a little bit of

1423
00:58:36,480 --> 00:58:34,840
time to be absolutely sure they've got

1424
00:58:37,800 --> 00:58:36,490
it right and the first thing you'll hear

1425
00:58:40,140 --> 00:58:37,810
about that is when it's published in a

1426
00:58:42,600 --> 00:58:40,150
major scientific journal given the the

1427
00:58:44,760 --> 00:58:42,610
caliber of the scientists and Nobel

1428
00:58:46,440 --> 00:58:44,770
laureates samting and then the other 500

1429
00:58:49,650 --> 00:58:46,450
team members i'm expecting that's how

1430
00:58:51,090 --> 00:58:49,660
it's going to roll out all right that's

1431
00:58:52,860 --> 00:58:51,100
all the time we have for questions will

1432
00:58:56,280 --> 00:58:52,870
close with some closing comments from

1433
00:58:58,050 --> 00:58:56,290
dr. Robinson so today you heard a lot

1434
00:59:00,360 --> 00:58:58,060
about some biotechnology applications

1435
00:59:01,800 --> 00:59:00,370
that are really relevant for life here

1436
00:59:03,390 --> 00:59:01,810
on earth as well and especially for

1437
00:59:04,890 --> 00:59:03,400
improving human health on earth I just

1438
00:59:07,290 --> 00:59:04,900

want to emphasize that you're seeing

1439
00:59:09,060 --> 00:59:07,300
three of a hundred US investigators that

1440
00:59:10,860 --> 00:59:09,070
we could have brought to you today the

1441
00:59:12,540 --> 00:59:10,870
amount of throughput going through the

1442
00:59:13,860 --> 00:59:12,550
laboratory on the space station now that

1443
00:59:16,500 --> 00:59:13,870
we're in our full research and

1444
00:59:18,510 --> 00:59:16,510
technology development phase is amazing

1445
00:59:20,550 --> 00:59:18,520
and we're just beginning the first of at

1446
00:59:22,140 --> 00:59:20,560
least ten years of this kind of research

1447
00:59:24,240 --> 00:59:22,150
so I want to share with you that

1448
00:59:26,880 --> 00:59:24,250
enthusiasm that we have on the road

1449
00:59:28,830 --> 00:59:26,890
forward ahead of us and in a very

1450
00:59:30,600 --> 00:59:28,840
different type of flavor we do have

1451
00:59:32,610 --> 00:59:30,610
technology tests going on on the

1452
00:59:35,670 --> 00:59:32,620
International Space Station tests of

1453
00:59:37,980 --> 00:59:35,680
human physiology tests of physics

1454
00:59:40,710 --> 00:59:37,990
fundamental physical processes fluid

1455
00:59:42,870 --> 00:59:40,720
physics we have instruments to observe

1456
00:59:44,550 --> 00:59:42,880
the earth going up we have instruments

1457
00:59:46,350 --> 00:59:44,560
to observe the cosmos such as the Alpha

1458
00:59:47,910 --> 00:59:46,360
Magnetic Spectrometer it's an

1459
00:59:49,650 --> 00:59:47,920
extraordinary diversity there's never

1460
00:59:52,920 --> 00:59:49,660
been a laboratory with this kind of

1461
00:59:55,080 --> 00:59:52,930
diversity of scientific use so go to

1462
00:59:56,700 --> 00:59:55,090
nasa gov you can read information about

1463
00:59:58,350 --> 00:59:56,710

all of the experiments going on right

1464
01:00:01,590 --> 00:59:58,360
now and everything that's happened in

1465
01:00:03,870 --> 01:00:01,600
the past and on NASA TV at two thirty

1466
01:00:05,730 --> 01:00:03,880
eastern time today and also for those of

1467
01:00:07,560 --> 01:00:05,740
you in the room here locally at KSC

1468
01:00:09,360 --> 01:00:07,570
you'll have the opportunity to have a

1469
01:00:11,310 --> 01:00:09,370
demonstration of the robotic refueling

1470
01:00:13,230 --> 01:00:11,320
mission hardware and see how that

1471
01:00:17,580 --> 01:00:13,240
hardware will be testing our ability to

1472
01:00:20,220 --> 01:00:17,590
refuel future spacecraft in space all

1473
01:00:21,510 --> 01:00:20,230
right thank you very much we also want

1474
01:00:23,490 --> 01:00:21,520
to invite you to check out the NASA

1475
01:00:25,950 --> 01:00:23,500
website to keep up on the status of the

1476
01:00:30,960 --> 01:00:25,960
countdown for shuttle mission sts-135