1
00:00:06,789 --> 00:00:03,110
station this is houston are you ready

2
00:00:11,270 --> 00:00:08,549
houston this is station we are ready for

3
00:00:15,350 --> 00:00:13,589
okay csu radio this is mission control

4
00:00:18,950 --> 00:00:15,360
houston please call station for a voice

5
00:00:18,960 --> 00:00:24,070
check check check one two three

6
00:00:28,390 --> 00:00:25,750
hey i've got you loud and clear from the

7
00:00:32,549 --> 00:00:28,400
international space station

8
00:00:35,910 --> 00:00:34,310
hey how are you it's very nice to talk

9
00:00:39,990 --> 00:00:35,920
to you

10
00:00:41,670 --> 00:00:40,000
for joining us could you tell us where

11
00:00:45,750 --> 00:00:41,680
are you in the space station right now

12
00:00:50,790 --> 00:00:48,630
yeah so i'm in the u.s laboratory this

13
00:00:53,189 --> 00:00:50,800

is just about the

14
00:00:55,990 --> 00:00:53,199
center forward part of the space station

15
00:00:57,830 --> 00:00:56,000
and as you can tell it's absolutely a

16
00:00:59,189 --> 00:00:57,840
working laboratory we have experiments

17
00:01:00,869 --> 00:00:59,199
all over the place

18
00:01:03,750 --> 00:01:00,879
that's really what we spend a lot of

19
00:01:06,149 --> 00:01:03,760
time on in microgravity is doing all

20
00:01:07,590 --> 00:01:06,159
kinds of scientific experiments and so

21
00:01:09,830 --> 00:01:07,600
the different thing about this

22
00:01:11,750 --> 00:01:09,840
laboratory is instead of just having

23
00:01:13,590 --> 00:01:11,760
experiments on the benches you have it

24
00:01:15,990 --> 00:01:13,600
on the walls and the ceiling as well you

25
00:01:17,270 --> 00:01:16,000
can see that everywhere

26
00:01:19,670 --> 00:01:17,280
absolutely

27
00:01:21,670 --> 00:01:19,680
so what will you be doing today is this

28
00:01:26,870 --> 00:01:21,680
a typical day for you and and what does

29
00:01:30,870 --> 00:01:28,630
yeah a typical day in space is pretty

30
00:01:33,270 --> 00:01:30,880
much anything and everything i'm going

31
00:01:35,990 --> 00:01:33,280
to be doing an experiment right after we

32
00:01:38,950 --> 00:01:36,000
finish chatting actually to

33
00:01:40,469 --> 00:01:38,960
try to understand how fluids move around

34
00:01:42,710 --> 00:01:40,479
in tubes up here

35
00:01:45,749 --> 00:01:42,720
so one of the really fascinating things

36
00:01:48,149 --> 00:01:45,759
in microgravity is that fluids are no

37
00:01:50,710 --> 00:01:48,159
longer subjected to the force of of

38
00:01:51,670 --> 00:01:50,720

gravity pulling them down so they form

39
00:01:52,870 --> 00:01:51,680
balls

40
00:01:55,590 --> 00:01:52,880
they float

41
00:01:57,670 --> 00:01:55,600
and we do have things like surface

42
00:01:59,830 --> 00:01:57,680
tension that still take over as dominant

43
00:02:02,149 --> 00:01:59,840
variables and so we're going to take a

44
00:02:05,429 --> 00:02:02,159
look at some modern molecular biology

45
00:02:07,350 --> 00:02:05,439
tools and try to understand how fluids

46
00:02:08,869 --> 00:02:07,360
are behaving in this weightless

47
00:02:10,949 --> 00:02:08,879
environment

48
00:02:12,710 --> 00:02:10,959
i see i see

49
00:02:14,309 --> 00:02:12,720
we're very interested in the the

50
00:02:16,390 --> 00:02:14,319
experiments that you've been conducting

51
00:02:18,229 --> 00:02:16,400
and the science that goes on i wonder

52
00:02:19,350 --> 00:02:18,239
first if we could just get a little bit

53
00:02:21,110 --> 00:02:19,360
of

54
00:02:22,869 --> 00:02:21,120
information from you about your own path

55
00:02:25,190 --> 00:02:22,879
to becoming an astronaut your your

56
00:02:27,510 --> 00:02:25,200
training was in microbiology what

57
00:02:31,270 --> 00:02:27,520
motivated you to pursue astronaut

58
00:02:35,190 --> 00:02:33,190
yeah so it's um you know i always say

59
00:02:37,030 --> 00:02:35,200
that that astronaut training is not

60
00:02:38,710 --> 00:02:37,040
something that you find

61
00:02:40,390 --> 00:02:38,720
it really it's

62
00:02:43,509 --> 00:02:40,400
are you

63
00:02:45,030 --> 00:02:43,519

just lucky enough eventually to be

64
00:02:47,750 --> 00:02:45,040
chosen for this there's a lot of people

65
00:02:49,589 --> 00:02:47,760
that want to do this job and

66
00:02:51,830 --> 00:02:49,599
it's a little bit i think like winning

67
00:02:54,150 --> 00:02:51,840
the lottery some days to get the chance

68
00:02:56,550 --> 00:02:54,160
to leave the planet i have always wanted

69
00:02:58,949 --> 00:02:56,560
to be a scientist and i was pretty

70
00:03:01,190 --> 00:02:58,959
solidly working towards that as a career

71
00:03:02,710 --> 00:03:01,200
i did my graduate studies at stanford

72
00:03:05,190 --> 00:03:02,720
and then had a lab at the white house

73
00:03:06,070 --> 00:03:05,200
institute at mit and decided to apply

74
00:03:08,070 --> 00:03:06,080
for

75
00:03:09,670 --> 00:03:08,080
astronaut applications

76
00:03:13,030 --> 00:03:09,680
because it was something i wanted to do

77
00:03:14,949 --> 00:03:13,040
ever since i was a small child but

78
00:03:17,190 --> 00:03:14,959
doesn't really seem to fit in that

79
00:03:19,750 --> 00:03:17,200
completely realistic career

80
00:03:22,149 --> 00:03:19,760
possibility path

81
00:03:23,830 --> 00:03:22,159
i think the lesson is take a chance and

82
00:03:25,750 --> 00:03:23,840
and see what you can find you never know

83
00:03:27,110 --> 00:03:25,760
where you're going to end up

84
00:03:29,430 --> 00:03:27,120
right

85
00:03:30,949 --> 00:03:29,440
so you've been in space now

86
00:03:33,910 --> 00:03:30,959
three months

87
00:03:35,589 --> 00:03:33,920
we're wondering what has been easier

88
00:03:40,949 --> 00:03:35,599

than you expected and what has been

89
00:03:45,110 --> 00:03:43,350
so it actually was a lot harder when i

90
00:03:48,710 --> 00:03:45,120
first got up here just to learn how to

91
00:03:50,470 --> 00:03:48,720
move around and stabilize yourself

92
00:03:51,990 --> 00:03:50,480
the mission control folks kind of joke

93
00:03:54,149 --> 00:03:52,000
when you get new astronauts on board

94
00:03:56,070 --> 00:03:54,159
that they end up crawling on the floor

95
00:03:58,470 --> 00:03:56,080
of the space station and i thought well

96
00:04:00,309 --> 00:03:58,480
i'm not going to be a crawler and

97
00:04:02,470 --> 00:04:00,319
it turns out in your first few weeks you

98
00:04:04,309 --> 00:04:02,480
cannot move yourself from one place the

99
00:04:07,030 --> 00:04:04,319
other because the space station is in

100
00:04:08,550 --> 00:04:07,040
free fall you're in free fall um this is

101
00:04:10,070 --> 00:04:08,560
not something that you've ever had in

102
00:04:12,070 --> 00:04:10,080
your human experience and it's a little

103
00:04:13,190 --> 00:04:12,080
bit like learning how to walk again

104
00:04:14,550 --> 00:04:13,200
you end up

105
00:04:16,870 --> 00:04:14,560
at some point you get you get pretty

106
00:04:19,110 --> 00:04:16,880
good motion control so i can i can

107
00:04:21,189 --> 00:04:19,120
control now with my fingertips so i can

108
00:04:24,150 --> 00:04:21,199
float here um i'm sitting in the middle

109
00:04:27,590 --> 00:04:24,160
of the module or i use my feet a lot to

110
00:04:32,150 --> 00:04:27,600
move myself around uh you end up being

111
00:04:38,070 --> 00:04:34,230
sometimes uh you're kind of hanging

112
00:04:42,629 --> 00:04:40,390
and uh we're learning how to do all of

113
00:04:44,150 --> 00:04:42,639

that so that was harder some of the

114
00:04:46,870 --> 00:04:44,160
things that have been easier than

115
00:04:50,390 --> 00:04:46,880
expected were a lot of the things that

116
00:04:53,830 --> 00:04:50,400
we've been just training for years so

117
00:04:55,430 --> 00:04:53,840
things like robotic operations and eva

118
00:04:58,230 --> 00:04:55,440
all of our science experiments none of

119
00:05:00,230 --> 00:04:58,240
those are easy but they are familiar

120
00:05:03,029 --> 00:05:00,240
territory i think it's something that

121
00:05:05,909 --> 00:05:03,039
nasa's job in preparing the astronauts

122
00:05:07,029 --> 00:05:05,919
how to train and how to fly

123
00:05:08,629 --> 00:05:07,039
right

124
00:05:11,110 --> 00:05:08,639
so let's talk about one of those

125
00:05:12,710 --> 00:05:11,120
experiments which really was a milestone

126
00:05:15,830 --> 00:05:12,720
for the first time

127
00:05:17,510 --> 00:05:15,840
you successfully sequenced dna in a

128
00:05:19,909 --> 00:05:17,520
spacecraft

129
00:05:21,670 --> 00:05:19,919
so two questions one why is it so

130
00:05:23,590 --> 00:05:21,680
difficult to do that and why has it

131
00:05:25,510 --> 00:05:23,600
taken this long to do it and what are

132
00:05:30,070 --> 00:05:25,520
the implications of being able to do it

133
00:05:34,310 --> 00:05:31,749
yeah there's a there's a couple reasons

134
00:05:37,350 --> 00:05:34,320
that this is really critical one is that

135
00:05:39,430 --> 00:05:37,360
we're testing out the ability to do

136
00:05:40,310 --> 00:05:39,440
really remote science

137
00:05:44,230 --> 00:05:40,320
and

138
00:05:46,070 --> 00:05:44,240

planet uh this is important actually for

139
00:05:49,430 --> 00:05:46,080
earth i used to work in the democratic

140
00:05:50,469 --> 00:05:49,440
republic of congo i worked on monkey pox

141
00:05:52,390 --> 00:05:50,479
and

142
00:05:54,710 --> 00:05:52,400
also spent a number of years working on

143
00:05:57,270 --> 00:05:54,720
ebola we've we've had outbreaks of both

144
00:06:00,710 --> 00:05:57,280
of these diseases the ability to rapidly

145
00:06:03,270 --> 00:06:00,720
determine viral sequence in a setting

146
00:06:05,590 --> 00:06:03,280
where you have no power grid

147
00:06:07,590 --> 00:06:05,600
almost no internet communication no

148
00:06:09,430 --> 00:06:07,600
infrastructure whatsoever if you can

149
00:06:11,189 --> 00:06:09,440
overcome those kinds of engineering

150
00:06:12,550 --> 00:06:11,199
challenges in order to send something to

151
00:06:14,469 --> 00:06:12,560
the space station

152
00:06:17,909 --> 00:06:14,479
it is very adaptable to these sorts of

153
00:06:19,670 --> 00:06:17,919
remote locations on the planet the other

154
00:06:20,950 --> 00:06:19,680
reason we want to start doing that is to

155
00:06:22,870 --> 00:06:20,960
understand

156
00:06:25,510 --> 00:06:22,880
how sequencing works off the planet and

157
00:06:27,670 --> 00:06:25,520
i i mentioned about fluids behaving

158
00:06:29,510 --> 00:06:27,680
they behave in very unexpected ways up

159
00:06:30,390 --> 00:06:29,520
here

160
00:06:31,909 --> 00:06:30,400
just

161
00:06:34,629 --> 00:06:31,919
basic things

162
00:06:36,070 --> 00:06:34,639
like pushing fluid out of a drink bag

163
00:06:38,230 --> 00:06:36,080

will be

164
00:06:39,189 --> 00:06:38,240
an amazing property that i have never

165
00:06:41,110 --> 00:06:39,199
seen

166
00:06:42,390 --> 00:06:41,120
liquids behave in that way on earth so

167
00:06:44,469 --> 00:06:42,400
it's not

168
00:06:46,309 --> 00:06:44,479
completely well understood how the

169
00:06:48,870 --> 00:06:46,319
liquids were going to behave

170
00:06:51,670 --> 00:06:48,880
in a fluidic system needed for

171
00:06:53,110 --> 00:06:51,680
sequencing uh it's also not completely

172
00:06:54,550 --> 00:06:53,120
understood

173
00:06:56,710 --> 00:06:54,560
if this was even going to work at all

174
00:06:58,790 --> 00:06:56,720
it's actually a pretty complex set of

175
00:07:01,189 --> 00:06:58,800
experiments to get this up here and then

176
00:07:03,830 --> 00:07:01,199
to get the data back down to earth so we

177
00:07:06,629 --> 00:07:03,840
have proven that that we can use this

178
00:07:09,270 --> 00:07:06,639
technology in microgravity

179
00:07:11,029 --> 00:07:09,280
now really the world of

180
00:07:13,110 --> 00:07:11,039
sequencing and molecular biology has

181
00:07:16,469 --> 00:07:13,120
opened up to us on a space station so we

182
00:07:18,950 --> 00:07:16,479
can use this to do real-time analysis

183
00:07:20,629 --> 00:07:18,960
of things like the microbiome on the

184
00:07:23,270 --> 00:07:20,639
space station

185
00:07:25,670 --> 00:07:23,280
cellular function and structure in orbit

186
00:07:26,550 --> 00:07:25,680
you can imagine if cells are in free

187
00:07:28,309 --> 00:07:26,560
fall

188
00:07:30,790 --> 00:07:28,319

rather than sitting at the bottom of a

189
00:07:32,469 --> 00:07:30,800
plastic dish their function may be

190
00:07:34,870 --> 00:07:32,479
greatly affected their structure may be

191
00:07:36,950 --> 00:07:34,880
affected we can study all of those

192
00:07:38,870 --> 00:07:36,960
types of things with modern molecular

193
00:07:40,629 --> 00:07:38,880
biology tools the first thing is you

194
00:07:44,070 --> 00:07:40,639
have to show that this can work off the

195
00:07:47,029 --> 00:07:45,189
thank you

196
00:07:50,070 --> 00:07:47,039
now in august

197
00:07:53,510 --> 00:07:50,080
you conducted your first spacewalk

198
00:07:55,589 --> 00:07:53,520
is there any possible way that you can

199
00:08:01,909 --> 00:07:55,599
try to help our listener

200
00:08:05,909 --> 00:08:03,830
that's pretty hard because i didn't even

201
00:08:08,070 --> 00:08:05,919
have a very good understanding of that

202
00:08:10,150 --> 00:08:08,080
myself before i went out the door and i

203
00:08:12,390 --> 00:08:10,160
worked at nasa and trained

204
00:08:13,589 --> 00:08:12,400
in a giant pool underwater for seven

205
00:08:17,830 --> 00:08:13,599
years first

206
00:08:20,469 --> 00:08:17,840
so it is um i would say more awesome

207
00:08:23,510 --> 00:08:20,479
amazing and terrifying than you can

208
00:08:26,309 --> 00:08:23,520
possibly imagine to be in the vacuum of

209
00:08:27,430 --> 00:08:26,319
space in a spacesuit

210
00:08:31,909 --> 00:08:27,440
the

211
00:08:34,310 --> 00:08:31,919
was

212
00:08:37,269 --> 00:08:34,320
that our spacesuits function like their

213
00:08:39,509 --> 00:08:37,279

own spacecraft and they have

214
00:08:41,509 --> 00:08:39,519
systems that report to us

215
00:08:44,630 --> 00:08:41,519
we have teams of folks on the ground

216
00:08:46,949 --> 00:08:44,640
that are watching you in your spacesuit

217
00:08:48,310 --> 00:08:46,959
perform this really critical work we

218
00:08:50,470 --> 00:08:48,320
installed the international docking

219
00:08:53,190 --> 00:08:50,480
adapter to the front of space station we

220
00:08:55,430 --> 00:08:53,200
retracted a radiator and reduced some of

221
00:08:56,790 --> 00:08:55,440
our risk for orbital debris

222
00:08:59,110 --> 00:08:56,800
and one thing

223
00:09:01,829 --> 00:08:59,120
that folks may be really interested in

224
00:09:03,910 --> 00:09:01,839
is some high definition cameras so we

225
00:09:06,790 --> 00:09:03,920
can actually get some incredible views

226
00:09:08,550 --> 00:09:06,800
of the planet and the space station so

227
00:09:10,310 --> 00:09:08,560
all these tasks were

228
00:09:12,150 --> 00:09:10,320
they were really important and they're

229
00:09:13,430 --> 00:09:12,160
it's absolutely critical to execute that

230
00:09:16,470 --> 00:09:13,440
right

231
00:09:17,350 --> 00:09:16,480
so you're balancing uh doing a perfect

232
00:09:18,310 --> 00:09:17,360
job

233
00:09:20,389 --> 00:09:18,320
and

234
00:09:22,870 --> 00:09:20,399
also looking at the planet through

235
00:09:25,110 --> 00:09:22,880
nothing but your visor and trying to

236
00:09:26,630 --> 00:09:25,120
just take it all in and think how

237
00:09:28,710 --> 00:09:26,640
amazing it is

238
00:09:30,230 --> 00:09:28,720

that you're floating in space hanging on

239
00:09:32,630 --> 00:09:30,240
to the edge of the international space

240
00:09:36,870 --> 00:09:34,470
extraordinary

241
00:09:39,910 --> 00:09:36,880
the space station now has been

242
00:09:43,590 --> 00:09:39,920
occupied continuously for

243
00:09:45,110 --> 00:09:43,600
15 years almost 16 years

244
00:09:47,190 --> 00:09:45,120
can you characterize for us just in a

245
00:09:51,990 --> 00:09:47,200
nutshell why is the space station still

246
00:09:56,230 --> 00:09:54,070
i think the um

247
00:10:00,070 --> 00:09:56,240
simple one sentence answer is this is

248
00:10:02,230 --> 00:10:00,080
the only laboratory where we can study

249
00:10:04,069 --> 00:10:02,240
microgravity as a variable

250
00:10:06,069 --> 00:10:04,079
the other really unique thing about

251
00:10:08,550 --> 00:10:06,079
space station is the radiation

252
00:10:10,790 --> 00:10:08,560
environment we can't perform these some

253
00:10:13,990 --> 00:10:10,800
of these experiments on earth

254
00:10:16,389 --> 00:10:14,000
we have for example beams that will take

255
00:10:18,389 --> 00:10:16,399
a look at one specific heavy particle of

256
00:10:20,470 --> 00:10:18,399
radiation but we can't simulate right

257
00:10:22,630 --> 00:10:20,480
now the complex

258
00:10:24,710 --> 00:10:22,640
radiation environment in low earth orbit

259
00:10:26,069 --> 00:10:24,720
as you get farther into space

260
00:10:27,750 --> 00:10:26,079
and are less protected by earth's

261
00:10:29,430 --> 00:10:27,760
magnetic fields you're subject to even

262
00:10:30,710 --> 00:10:29,440
more and more radiation so it's

263
00:10:35,190 --> 00:10:30,720

interesting

264
00:10:37,269 --> 00:10:35,200
health performance and exploration

265
00:10:38,550 --> 00:10:37,279
standpoint it's really interesting for

266
00:10:41,269 --> 00:10:38,560
people on earth because we are

267
00:10:43,190 --> 00:10:41,279
understanding and making new discoveries

268
00:10:45,829 --> 00:10:43,200
about fundamental

269
00:10:47,509 --> 00:10:45,839
biological

270
00:10:49,829 --> 00:10:47,519
material science

271
00:10:51,430 --> 00:10:49,839
aspects of things

272
00:10:53,670 --> 00:10:51,440
some of these experiments we just can't

273
00:10:55,829 --> 00:10:53,680
do on the planet so this laboratory has

274
00:10:58,069 --> 00:10:55,839
been operated and staffed for an

275
00:10:59,590 --> 00:10:58,079
incredible number of years

276
00:11:03,190 --> 00:10:59,600
and there is still an incredible number

277
00:11:06,870 --> 00:11:04,790
one last question

278
00:11:07,990 --> 00:11:06,880
you'll be back on earth

279
00:11:13,509 --> 00:11:08,000
soon

280
00:11:17,190 --> 00:11:16,150
well i'm really looking forward to uh

281
00:11:20,630 --> 00:11:17,200
landing

282
00:11:23,030 --> 00:11:20,640
seeing the sun a little bit feeling the

283
00:11:25,670 --> 00:11:23,040
uh feel of of wind

284
00:11:27,030 --> 00:11:25,680
there's a lot of things when you

285
00:11:28,389 --> 00:11:27,040
are not on the planet you don't know

286
00:11:31,430 --> 00:11:28,399
that you would miss them

287
00:11:32,470 --> 00:11:31,440
and when you suddenly move to a closed

288
00:11:34,389 --> 00:11:32,480

loop

289
00:11:36,150 --> 00:11:34,399
completely i would say isolated

290
00:11:37,750 --> 00:11:36,160
environment

291
00:11:39,829 --> 00:11:37,760
being on the planet sometimes sounds

292
00:11:41,910 --> 00:11:39,839
pretty good in terms of being able to

293
00:11:43,750 --> 00:11:41,920
experience even things like rain that

294
00:11:46,230 --> 00:11:43,760
you might take for granted and be

295
00:11:47,590 --> 00:11:46,240
annoyed that you're in a rain storm

296
00:11:49,670 --> 00:11:47,600
you know think about astronauts who

297
00:11:51,350 --> 00:11:49,680
don't get rain for quite a few months i

298
00:11:52,310 --> 00:11:51,360
think everything

299
00:11:55,430 --> 00:11:52,320
that

300
00:11:58,150 --> 00:11:55,440
feels like being outside sounds very

301
00:12:03,509 --> 00:12:00,230
station this is houston acr that

302
00:12:05,829 --> 00:12:03,519
concludes the kzsu radio portion of the

303
00:12:07,990 --> 00:12:05,839
event please stand by for a voice check

304
00:12:10,069 --> 00:12:08,000
from npr

305
00:12:13,269 --> 00:12:10,079
station this is ray bichell with npr how

306
00:12:16,550 --> 00:12:14,710
i've got you loud and clear it's great

307
00:12:19,509 --> 00:12:16,560
to be talking to you today

308
00:12:20,870 --> 00:12:19,519
yeah you too thanks so much

309
00:12:22,790 --> 00:12:20,880
so i'm gonna

310
00:12:25,190 --> 00:12:22,800
just fire off the questions here because

311
00:12:27,430 --> 00:12:25,200
we got 10 minutes

312
00:12:29,590 --> 00:12:27,440
um first one up how many days have you

313
00:12:31,430 --> 00:12:29,600

been in space now um and you mentioned

314
00:12:33,030 --> 00:12:31,440
that you're you're floating for people

315
00:12:35,190 --> 00:12:33,040
who can't see you

316
00:12:40,230 --> 00:12:35,200
where you are what

317
00:12:44,389 --> 00:12:42,230
so i've been in space we uh we have a

318
00:12:46,629 --> 00:12:44,399
party when we're in space uh for a

319
00:12:48,310 --> 00:12:46,639
hundred days due to the timing of some

320
00:12:49,829 --> 00:12:48,320
of our launches down the road we're

321
00:12:51,990 --> 00:12:49,839
actually having the party not at 100

322
00:12:54,389 --> 00:12:52,000
days but about 90 days so we're coming

323
00:12:57,190 --> 00:12:54,399
up on 90 days soon that's how i keep

324
00:13:00,069 --> 00:12:57,200
track of time up here and i am floating

325
00:13:02,150 --> 00:13:00,079
right now uh i i mentioned that we are

326
00:13:03,910 --> 00:13:02,160
we're in free fall so the space station

327
00:13:04,870 --> 00:13:03,920
is falling around the earth i'm falling

328
00:13:07,509 --> 00:13:04,880
with it

329
00:13:09,910 --> 00:13:07,519
i can create some local acceleration

330
00:13:12,550 --> 00:13:09,920
here but right now i'm floating in the

331
00:13:14,230 --> 00:13:12,560
middle of the u.s laboratory which is

332
00:13:16,949 --> 00:13:14,240
just about in the center of the space

333
00:13:19,190 --> 00:13:16,959
station and is really our nerve center

334
00:13:21,990 --> 00:13:19,200
it's our epicenter for scientific

335
00:13:24,470 --> 00:13:22,000
investigations uh in this in this space

336
00:13:27,269 --> 00:13:24,480
station which is i have to say enormous

337
00:13:28,710 --> 00:13:27,279
i mean it's the size of a 747 it's it's

338
00:13:31,030 --> 00:13:28,720

far bigger

339
00:13:34,389 --> 00:13:31,040
and more impressive than i expected in

340
00:13:35,829 --> 00:13:34,399
my years of working at nasa

341
00:13:38,150 --> 00:13:35,839
gotcha

342
00:13:39,750 --> 00:13:38,160
what moments during your time on the iss

343
00:13:45,269 --> 00:13:39,760
have made you

344
00:13:50,310 --> 00:13:48,389
that is a great question because

345
00:13:52,870 --> 00:13:50,320
gasping out loud is actually the

346
00:13:55,750 --> 00:13:52,880
reaction you have quite a bit there's a

347
00:13:57,670 --> 00:13:55,760
lot of things up here that

348
00:13:59,350 --> 00:13:57,680
you've just never seen in your human

349
00:14:02,550 --> 00:13:59,360
experience before

350
00:14:03,509 --> 00:14:02,560
there's things that uh you know in

351
00:14:06,310 --> 00:14:03,519
theory

352
00:14:08,629 --> 00:14:06,320
but have never actually witnessed

353
00:14:10,949 --> 00:14:08,639
and uh when you when you encounter those

354
00:14:12,870 --> 00:14:10,959
kinds of phenomenon it really just makes

355
00:14:14,629 --> 00:14:12,880
your jaw drop so i'd never seen the

356
00:14:18,550 --> 00:14:14,639
aurora before

357
00:14:20,710 --> 00:14:18,560
i'm from california fairly low latitude

358
00:14:23,750 --> 00:14:20,720
and uh never seen the aurora from the

359
00:14:26,870 --> 00:14:23,760
planet uh so when i saw the aurora for

360
00:14:28,230 --> 00:14:26,880
the first time over the entire globe i

361
00:14:30,389 --> 00:14:28,240
almost couldn't talk for a couple

362
00:14:31,990 --> 00:14:30,399
minutes it was so fantastic i had a

363
00:14:34,710 --> 00:14:32,000

wonderful

364
00:14:36,790 --> 00:14:34,720
sighting the other day

365
00:14:39,509 --> 00:14:36,800
some very complicated

366
00:14:41,350 --> 00:14:39,519
rules about orbital motion and what beta

367
00:14:42,629 --> 00:14:41,360
angle you're at but i was able to see

368
00:14:44,550 --> 00:14:42,639
the moon

369
00:14:46,949 --> 00:14:44,560
while we're on the space station

370
00:14:48,790 --> 00:14:46,959
uh so we were in the in dark and the

371
00:14:50,150 --> 00:14:48,800
moon was lit by the sun i couldn't see

372
00:14:52,069 --> 00:14:50,160
the sun the sun was on the other side of

373
00:14:54,629 --> 00:14:52,079
the planet um

374
00:14:57,670 --> 00:14:54,639
so it it actually

375
00:15:00,629 --> 00:14:57,680
showed me planetary motion uh

376
00:15:03,030 --> 00:15:00,639
obviously i believe that kepler is right

377
00:15:05,110 --> 00:15:03,040
but to see that kind of thing really

378
00:15:07,910 --> 00:15:05,120
makes your jaw drop

379
00:15:10,069 --> 00:15:07,920
hmm okay and um can you tell me a little

380
00:15:11,990 --> 00:15:10,079
bit more about the heart cells the stem

381
00:15:15,269 --> 00:15:12,000
cells that you grew what was that like

382
00:15:19,670 --> 00:15:17,350
yeah absolutely that was an experiment

383
00:15:22,949 --> 00:15:19,680
out of the cardiology lab at stanford

384
00:15:26,629 --> 00:15:22,959
and their goal was to use programmed

385
00:15:28,230 --> 00:15:26,639
adult stem cells so ips cells that are

386
00:15:32,550 --> 00:15:28,240
that are

387
00:15:34,790 --> 00:15:32,560
be heart cells cardiomyocytes

388
00:15:38,069 --> 00:15:34,800

and see if we could grow those on orbit

389
00:15:41,189 --> 00:15:38,079
and how microgravity might affect

390
00:15:43,189 --> 00:15:41,199
the cellular organization the structure

391
00:15:45,590 --> 00:15:43,199
and the function so part of it was a

392
00:15:47,269 --> 00:15:45,600
technical challenge can we launch cells

393
00:15:49,269 --> 00:15:47,279
ins into space

394
00:15:52,310 --> 00:15:49,279
grow them in culture for a long period

395
00:15:54,150 --> 00:15:52,320
of time and then return them to earth uh

396
00:15:55,509 --> 00:15:54,160
that was a pretty incredible experience

397
00:15:57,749 --> 00:15:55,519
i've done a lot of cell culture in my

398
00:16:00,790 --> 00:15:57,759
life there's something about seeing

399
00:16:04,069 --> 00:16:00,800
beating heart cells in space that was

400
00:16:06,310 --> 00:16:04,079
very uh inspiring and i think really

401
00:16:09,749 --> 00:16:06,320
speaks to the scientific potential of

402
00:16:11,509 --> 00:16:09,759
space station as a laboratory

403
00:16:14,389 --> 00:16:11,519
i'm curious to know how has being in

404
00:16:19,030 --> 00:16:14,399
space made you think differently about

405
00:16:23,430 --> 00:16:21,430
the physiology is incredibly changed up

406
00:16:26,069 --> 00:16:23,440
here and that's a really interesting

407
00:16:28,470 --> 00:16:26,079
thing to see firsthand so one of the

408
00:16:30,150 --> 00:16:28,480
things that changes is on the planet

409
00:16:32,710 --> 00:16:30,160
when you're walking around in your daily

410
00:16:34,790 --> 00:16:32,720
life all of your blood is drawn by the

411
00:16:37,509 --> 00:16:34,800
force of gravity down into your feet and

412
00:16:38,710 --> 00:16:37,519
your legs and humans have evolved uh

413
00:16:40,629 --> 00:16:38,720

with this

414
00:16:42,949 --> 00:16:40,639
constant force of gravity so that's how

415
00:16:44,710 --> 00:16:42,959
our physiology has evolved

416
00:16:46,870 --> 00:16:44,720
when all of a sudden we build rockets

417
00:16:48,710 --> 00:16:46,880
and send people into space which is

418
00:16:51,990 --> 00:16:48,720
quite unexpected from an evolutionary

419
00:16:54,310 --> 00:16:52,000
perspective that fluid then shifts up to

420
00:16:56,470 --> 00:16:54,320
your head so you actually lose a lot of

421
00:16:58,550 --> 00:16:56,480
your blood plasma volume

422
00:17:00,310 --> 00:16:58,560
it's better in space to have slightly

423
00:17:03,350 --> 00:17:00,320
less blood volume that's what

424
00:17:05,669 --> 00:17:03,360
homeostasis is up here and

425
00:17:07,350 --> 00:17:05,679
you do get this feeling of head fullness

426
00:17:08,949 --> 00:17:07,360
sort of like you're hanging upside down

427
00:17:10,870 --> 00:17:08,959
off the end of your bed that never

428
00:17:12,710 --> 00:17:10,880
completely goes away

429
00:17:15,350 --> 00:17:12,720
there's some really interesting effects

430
00:17:18,150 --> 00:17:15,360
that we're studying on arterial function

431
00:17:21,189 --> 00:17:18,160
we have a slightly high higher exposure

432
00:17:22,630 --> 00:17:21,199
to constant levels of co2 up here and

433
00:17:24,710 --> 00:17:22,640
we're living in a closed-loop

434
00:17:26,230 --> 00:17:24,720
environment so we recycle all of our air

435
00:17:28,789 --> 00:17:26,240
in our water all of those things have

436
00:17:30,830 --> 00:17:28,799
profound physiology effects and we're

437
00:17:33,270 --> 00:17:30,840
participating in about 200 different

438
00:17:35,590 --> 00:17:33,280

experiments to analyze all of those

439
00:17:38,230 --> 00:17:35,600
effects on the human body

440
00:17:40,549 --> 00:17:38,240
does it make you feel like your body is

441
00:17:43,990 --> 00:17:40,559
stronger or weaker than than it felt on

442
00:17:48,390 --> 00:17:45,510
well one of the things we get to do up

443
00:17:50,070 --> 00:17:48,400
here is uh weightlifting so we can't

444
00:17:52,950 --> 00:17:50,080
actually lifts weights there's there's

445
00:17:56,390 --> 00:17:52,960
no weight here just mass we work against

446
00:17:58,710 --> 00:17:56,400
vacuum and uh i have set a few records

447
00:18:01,750 --> 00:17:58,720
that are higher than i can lift on earth

448
00:18:02,710 --> 00:18:01,760
so i think overall the time we spend

449
00:18:05,190 --> 00:18:02,720
actually

450
00:18:07,510 --> 00:18:05,200
making sure astronauts stay healthy

451
00:18:09,750 --> 00:18:07,520
is incredible contribution towards

452
00:18:11,350 --> 00:18:09,760
maintaining our physiology and i would

453
00:18:13,990 --> 00:18:11,360
say i'm right now i'm a little stronger

454
00:18:15,190 --> 00:18:14,000
in space than i am on the planet

455
00:18:18,310 --> 00:18:15,200
okay cool

456
00:18:21,029 --> 00:18:18,320
um so as a biologist on earth you were

457
00:18:23,750 --> 00:18:21,039
studying some really nasty viruses

458
00:18:26,549 --> 00:18:23,760
um what was motivating your work on

459
00:18:32,870 --> 00:18:26,559
earth uh and i'm interested to know what

460
00:18:37,669 --> 00:18:34,870
yeah so on earth i started out in

461
00:18:39,029 --> 00:18:37,679
undergraduate on hiv actually and i was

462
00:18:40,150 --> 00:18:39,039
interested in that from a public health

463
00:18:42,310 --> 00:18:40,160

perspective

464
00:18:44,470 --> 00:18:42,320
at first and then got very interested in

465
00:18:46,630 --> 00:18:44,480
the virology and

466
00:18:47,990 --> 00:18:46,640
where hiv integrates in the genome and

467
00:18:51,510 --> 00:18:48,000
potentially

468
00:18:52,549 --> 00:18:51,520
drugs to treat hiv infection

469
00:18:54,070 --> 00:18:52,559
from there

470
00:18:56,310 --> 00:18:54,080
i promised my mom i would work on a

471
00:18:59,590 --> 00:18:56,320
different virus and fortunately i chose

472
00:19:02,230 --> 00:18:59,600
ebola and monkey pox and smallpox

473
00:19:05,830 --> 00:19:02,240
the interest there is trying to

474
00:19:07,750 --> 00:19:05,840
understand how the virus and

475
00:19:10,230 --> 00:19:07,760
the human genome interact

476
00:19:11,990 --> 00:19:10,240
what we might do to prevent future

477
00:19:15,190 --> 00:19:12,000
outbreaks

478
00:19:17,990 --> 00:19:15,200
what is it about viruses that can

479
00:19:20,390 --> 00:19:18,000
come in and cause such lethal infections

480
00:19:22,710 --> 00:19:20,400
to humans so we're obviously not working

481
00:19:24,390 --> 00:19:22,720
on any of those kinds of viruses up here

482
00:19:26,070 --> 00:19:24,400
on the space station but the sorts of

483
00:19:28,710 --> 00:19:26,080
techniques that we would use for example

484
00:19:31,590 --> 00:19:28,720
the the whole genome sequencing

485
00:19:33,909 --> 00:19:31,600
any kind of pcr molecular techniques

486
00:19:36,070 --> 00:19:33,919
looking at gene expression looking at

487
00:19:38,470 --> 00:19:36,080
cellular structure all of those are

488
00:19:40,470 --> 00:19:38,480

things that we use on the space station

489
00:19:43,110 --> 00:19:40,480
to try to understand

490
00:19:45,190 --> 00:19:43,120
a different variable here and that is

491
00:19:48,470 --> 00:19:45,200
human physiology in space

492
00:19:50,789 --> 00:19:48,480
cellular function and structure in

493
00:19:53,029 --> 00:19:50,799
microgravity and the radiation effects

494
00:19:55,590 --> 00:19:53,039
on orbit

495
00:19:57,029 --> 00:19:55,600
so in all these experiments i mean

496
00:20:00,150 --> 00:19:57,039
understanding how medicine works in

497
00:20:01,669 --> 00:20:00,160
space how heart cells hold up

498
00:20:03,590 --> 00:20:01,679
what is

499
00:20:05,590 --> 00:20:03,600
who who are you thinking in the back of

500
00:20:07,270 --> 00:20:05,600
your head will benefit from this is it

501
00:20:09,830 --> 00:20:07,280
people on earth

502
00:20:12,630 --> 00:20:09,840
or is it people who would be

503
00:20:17,190 --> 00:20:12,640
in the future living in space or on a

504
00:20:21,270 --> 00:20:19,909
i think the answer is both uh

505
00:20:22,630 --> 00:20:21,280
these experiments there's a lot of

506
00:20:23,990 --> 00:20:22,640
experiments here obviously that nasa

507
00:20:26,390 --> 00:20:24,000
does because they're interested in

508
00:20:27,830 --> 00:20:26,400
exploration we're going beyond low earth

509
00:20:29,590 --> 00:20:27,840
orbit

510
00:20:32,310 --> 00:20:29,600
we have to start somewhere in terms of

511
00:20:34,070 --> 00:20:32,320
of understanding what happens to human

512
00:20:36,070 --> 00:20:34,080
beings long term in space and we've been

513
00:20:37,669 --> 00:20:36,080

doing a lot of those experiments there's

514
00:20:39,750 --> 00:20:37,679
a whole lot more

515
00:20:41,830 --> 00:20:39,760
left to learn i'm surprised by the

516
00:20:43,430 --> 00:20:41,840
physiology every day