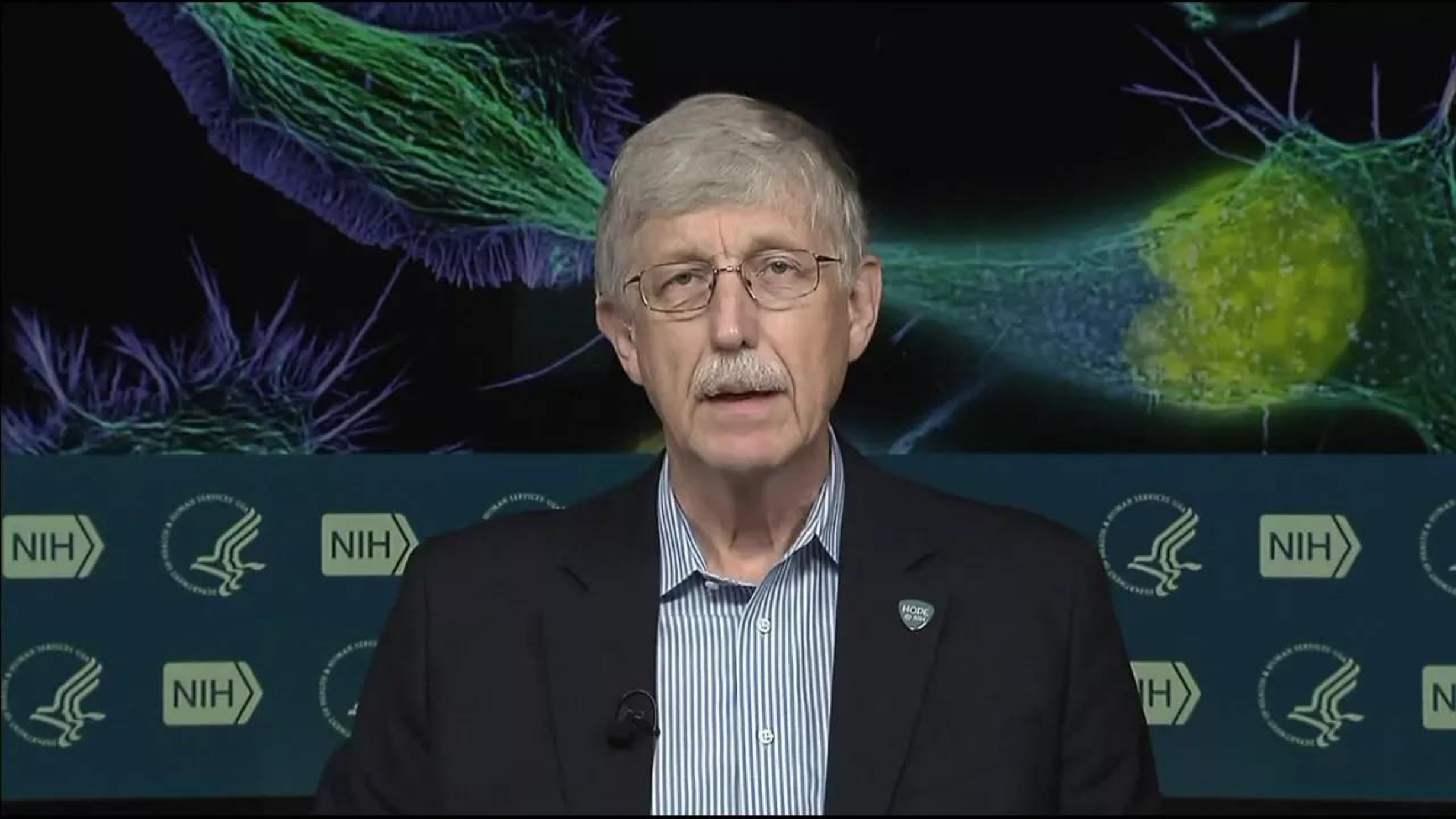
NIH
NIH
NIH
NIH

1
00:00:07,510 --> 00:00:03,590
station this is houston are you ready

2
00:00:13,110 --> 00:00:09,589
houston station we are ready for the

3
00:00:17,910 --> 00:00:15,430
all right national institutes of health

4
00:00:21,029 --> 00:00:17,920
this is mission control houston please

5
00:00:23,509 --> 00:00:21,039
call the station for a voice check

6
00:00:25,029 --> 00:00:23,519
wow well this is dr francis collins uh

7
00:00:27,269 --> 00:00:25,039
director of the national institutes of

8
00:00:28,710 --> 00:00:27,279
health and i'm here on earth to have a

9
00:00:31,269 --> 00:00:28,720
conversation

10
00:00:34,389 --> 00:00:31,279
with dr kate rubins astronaut and

11
00:00:36,229 --> 00:00:34,399
researcher who's actually in space and

12
00:00:40,069 --> 00:00:36,239
kate it is great to meet you via

13
00:00:43,910 --> 00:00:41,750

it is pretty fantastic and we're

14
00:00:46,069 --> 00:00:43,920
actually bouncing off a satellite in low

15
00:00:47,830 --> 00:00:46,079
earth orbit from the space station

16
00:00:49,910 --> 00:00:47,840
sending that down to the planet and

17
00:00:53,510 --> 00:00:49,920
beaming that out to you guys so

18
00:00:58,470 --> 00:00:55,830
it is indeed incredible and it seems to

19
00:01:01,029 --> 00:00:58,480
be working which is just amazing well

20
00:01:02,310 --> 00:01:01,039
you know it's been 13 years since i had

21
00:01:04,390 --> 00:01:02,320
the privilege of leading the human

22
00:01:05,350 --> 00:01:04,400
genome project that read out that very

23
00:01:08,390 --> 00:01:05,360
first

24
00:01:11,030 --> 00:01:08,400
reference sequence of the human genome

25
00:01:12,870 --> 00:01:11,040
and now here we are rocketing forward if

26
00:01:15,030 --> 00:01:12,880
you'll pardon the use of the word uh

27
00:01:17,590 --> 00:01:15,040
with lots of other advances that take

28
00:01:19,030 --> 00:01:17,600
advantage of our ability to read out dna

29
00:01:21,910 --> 00:01:19,040
and rna

30
00:01:24,070 --> 00:01:21,920
and you're up there in space doing dna

31
00:01:26,390 --> 00:01:24,080
sequencing for the first time

32
00:01:28,390 --> 00:01:26,400
here on earth we're in the process of

33
00:01:30,870 --> 00:01:28,400
launching a project that will invite a

34
00:01:34,069 --> 00:01:30,880
million people to take part in an

35
00:01:36,870 --> 00:01:34,079
unprecedented study to understand how

36
00:01:40,230 --> 00:01:36,880
dna as well as environmental experiences

37
00:01:42,550 --> 00:01:40,240
and health practices lifestyle diet

38
00:01:43,910 --> 00:01:42,560

exercise all of that plays out in human

39
00:01:45,830 --> 00:01:43,920
health and disease something that's

40
00:01:47,670 --> 00:01:45,840
called the precision medicine initiative

41
00:01:49,109 --> 00:01:47,680
and i hope some of the people watching

42
00:01:51,109 --> 00:01:49,119
today will read more about that and

43
00:01:53,270 --> 00:01:51,119
think about signing up when we launch

44
00:01:55,429 --> 00:01:53,280
this in three or four months

45
00:01:57,109 --> 00:01:55,439
but kate if i may call you kaden please

46
00:01:59,030 --> 00:01:57,119
call me frances

47
00:02:01,670 --> 00:01:59,040
really delighted to have a chance to

48
00:02:05,109 --> 00:02:01,680
hear about your experiences up there

49
00:02:06,310 --> 00:02:05,119
doing dna sequencing uh in zero gravity

50
00:02:07,670 --> 00:02:06,320
in space

51
00:02:12,229 --> 00:02:07,680
tell us a little bit about that

52
00:02:16,869 --> 00:02:14,550
yeah this was truly an experiment in all

53
00:02:18,470 --> 00:02:16,879
senses of the word we did not know if it

54
00:02:21,110 --> 00:02:18,480
was going to work uh the first time we

55
00:02:23,110 --> 00:02:21,120
were doing sequencing in space and

56
00:02:24,869 --> 00:02:23,120
like every lab experiment

57
00:02:27,830 --> 00:02:24,879
you put your pipettor down and you give

58
00:02:29,910 --> 00:02:27,840
it a try and it actually was a fantastic

59
00:02:30,790 --> 00:02:29,920
technology demonstration

60
00:02:32,869 --> 00:02:30,800
we have

61
00:02:35,430 --> 00:02:32,879
bubbles and fluidic changes in

62
00:02:37,750 --> 00:02:35,440
microgravity and we were able to show

63
00:02:39,350 --> 00:02:37,760

that we can successfully do sequencing

64
00:02:41,350 --> 00:02:39,360
in space and we've sequenced over a

65
00:02:43,509 --> 00:02:41,360
billion base pairs at this point so we

66
00:02:47,270 --> 00:02:43,519
have this capability now in low earth

67
00:02:52,229 --> 00:02:50,150
a billion base pairs already that is

68
00:02:54,309 --> 00:02:52,239
pretty phenomenal so that's like one

69
00:02:56,550 --> 00:02:54,319
third of a human genome

70
00:02:58,869 --> 00:02:56,560
and you're doing this on a dna

71
00:03:01,430 --> 00:02:58,879
sequencing instrument that is extremely

72
00:03:04,070 --> 00:03:01,440
compact many of us who do dna sequencing

73
00:03:06,070 --> 00:03:04,080
here on earth we use machines that are

74
00:03:08,070 --> 00:03:06,080
pretty good size not quite the same as

75
00:03:10,309 --> 00:03:08,080
they used to be but they still occupy a

76
00:03:12,390 --> 00:03:10,319
big chunk of lab bench space

77
00:03:16,390 --> 00:03:12,400
yours sounds like it's about the size of

78
00:03:21,670 --> 00:03:19,509
it is it's incredibly compact and that's

79
00:03:23,830 --> 00:03:21,680
one of the things that's a unique

80
00:03:27,670 --> 00:03:23,840
aspect of space flight is that we need

81
00:03:28,949 --> 00:03:27,680
to get machines to be compact portable

82
00:03:31,509 --> 00:03:28,959
robust

83
00:03:33,990 --> 00:03:31,519
independent of of much power generation

84
00:03:36,550 --> 00:03:34,000
we generate all of our power up here

85
00:03:38,789 --> 00:03:36,560
from solar rays these are all the kinds

86
00:03:41,350 --> 00:03:38,799
of challenges that we faced when i was

87
00:03:43,750 --> 00:03:41,360
doing uh ebola and monkey pox

88
00:03:45,830 --> 00:03:43,760

experiments in congo so the kinds of

89
00:03:48,229 --> 00:03:45,840
things that we find in the most remote

90
00:03:50,949 --> 00:03:48,239
corners of the planet are some of the

91
00:03:53,190 --> 00:03:50,959
similar technologies and engineering

92
00:03:58,630 --> 00:03:53,200
advances that we're solving

93
00:04:03,830 --> 00:04:00,869
so tell me a little bit about what you

94
00:04:07,429 --> 00:04:03,840
might anticipate dna sequencing would be

95
00:04:08,309 --> 00:04:07,439
used for uh in space travel what kinds

96
00:04:11,429 --> 00:04:08,319
of

97
00:04:16,710 --> 00:04:11,439
organisms would you be looking to try to

98
00:04:19,990 --> 00:04:18,629
so i'm a little bit biased because i'm a

99
00:04:22,710 --> 00:04:20,000
virologist

100
00:04:24,790 --> 00:04:22,720
and have studied genomics of microbiome

101
00:04:26,870 --> 00:04:24,800
and immune system and viruses for a long

102
00:04:28,790 --> 00:04:26,880
time but i do think that the microbiome

103
00:04:31,189 --> 00:04:28,800
of the space station is incredibly

104
00:04:32,629 --> 00:04:31,199
fascinating we live in a closed-loop

105
00:04:35,110 --> 00:04:32,639
environment here

106
00:04:36,230 --> 00:04:35,120
so we recycle all of our air and all of

107
00:04:38,870 --> 00:04:36,240
our water

108
00:04:40,950 --> 00:04:38,880
this being nasa you can bet that every

109
00:04:43,030 --> 00:04:40,960
piece of equipment that comes off of the

110
00:04:46,629 --> 00:04:43,040
planet is incredibly well controlled and

111
00:04:48,710 --> 00:04:46,639
documented the uh the fairly cooperative

112
00:04:51,030 --> 00:04:48,720
human subjects on the space station are

113
00:04:52,629 --> 00:04:51,040

well controlled and documented

114
00:04:56,710 --> 00:04:52,639
so we actually have an excellent

115
00:04:59,270 --> 00:04:56,720
opportunity to study the microbiome of a

116
00:05:01,990 --> 00:04:59,280
closed-loop system that's off the planet

117
00:05:04,550 --> 00:05:02,000
i think we can also use this technology

118
00:05:06,629 --> 00:05:04,560
when we're starting to look for signs of

119
00:05:08,629 --> 00:05:06,639
life in the solar system beyond the

120
00:05:11,189 --> 00:05:08,639
planet and we can also start to

121
00:05:14,950 --> 00:05:11,199
understand human health and disease most

122
00:05:17,510 --> 00:05:14,960
of our disease research is taking a

123
00:05:19,110 --> 00:05:17,520
variable and looking at human physiology

124
00:05:21,909 --> 00:05:19,120
under different conditions we have the

125
00:05:23,909 --> 00:05:21,919
opportunity to look at human physiology

126
00:05:26,469 --> 00:05:23,919
as it's floating here so this is

127
00:05:28,230 --> 00:05:26,479
obviously quite a unique laboratory if

128
00:05:33,110 --> 00:05:28,240
i'm talking to you from the ceiling or

129
00:05:37,670 --> 00:05:35,670
that was a nice demonstration

130
00:05:39,830 --> 00:05:37,680
so we've collected a few questions from

131
00:05:41,670 --> 00:05:39,840
social media and we'll also be taking a

132
00:05:43,270 --> 00:05:41,680
few live questions

133
00:05:45,029 --> 00:05:43,280
and i'll be looking at them in a screen

134
00:05:46,710 --> 00:05:45,039
in front of me and i see one here from

135
00:05:48,870 --> 00:05:46,720
dieter perkover

136
00:05:50,629 --> 00:05:48,880
who's asking maybe relevant to what you

137
00:05:52,870 --> 00:05:50,639
were just saying is it possible to get

138
00:05:57,029 --> 00:05:52,880

the flu on the international space

139
00:06:01,110 --> 00:05:58,469
so that's actually one of the great

140
00:06:02,790 --> 00:06:01,120
things about being up here is that

141
00:06:04,390 --> 00:06:02,800
all of the astronauts who launched to

142
00:06:06,309 --> 00:06:04,400
the space station we have a couple of

143
00:06:09,350 --> 00:06:06,319
crew members who are launching in just a

144
00:06:11,110 --> 00:06:09,360
few days from kazakhstan are quarantined

145
00:06:13,350 --> 00:06:11,120
and screened so

146
00:06:15,510 --> 00:06:13,360
we we don't have the possibility to

147
00:06:17,189 --> 00:06:15,520
transmit a cold up here

148
00:06:19,430 --> 00:06:17,199
you certainly could have

149
00:06:22,150 --> 00:06:19,440
other microbiological foodborne illness

150
00:06:24,629 --> 00:06:22,160
that kind of thing but we uh we find

151
00:06:26,469 --> 00:06:24,639
that when we isolate humans from other

152
00:06:28,870 --> 00:06:26,479
human beings that's actually very

153
00:06:34,070 --> 00:06:28,880
incredibly effective antiviral

154
00:06:38,469 --> 00:06:35,990
so i want to ask you a few other things

155
00:06:41,430 --> 00:06:38,479
about the relationship between space

156
00:06:44,469 --> 00:06:41,440
travel and human health and i'm happy to

157
00:06:46,790 --> 00:06:44,479
say that nih and nasa have long-standing

158
00:06:48,469 --> 00:06:46,800
collaborations in this particular area

159
00:06:50,629 --> 00:06:48,479
and we're excited about some of the

160
00:06:53,189 --> 00:06:50,639
things that are now possible

161
00:06:55,909 --> 00:06:53,199
so for instance astronauts like you are

162
00:06:58,550 --> 00:06:55,919
up there exposed in many ways to various

163
00:07:00,710 --> 00:06:58,560

types of radiation that we don't get on

164
00:07:03,510 --> 00:07:00,720
planet earth because of the protective

165
00:07:06,390 --> 00:07:03,520
shield of the atmosphere just yesterday

166
00:07:09,270 --> 00:07:06,400
vice president joe biden in announcing

167
00:07:11,909 --> 00:07:09,280
the latest plan for the cancer moon shot

168
00:07:14,790 --> 00:07:11,919
highlighted a partnership between nasa

169
00:07:16,550 --> 00:07:14,800
and nih and other agencies specifically

170
00:07:18,469 --> 00:07:16,560
looking at whether we could learn more

171
00:07:21,510 --> 00:07:18,479
about the effects of various types of

172
00:07:23,749 --> 00:07:21,520
radiation on human cells by doing those

173
00:07:24,870 --> 00:07:23,759
experiments in places like the space

174
00:07:26,309 --> 00:07:24,880
station

175
00:07:27,990 --> 00:07:26,319
is that something that you could say

176
00:07:32,790 --> 00:07:28,000
something about is are any of those

177
00:07:37,830 --> 00:07:35,189
yeah absolutely uh that's one of the the

178
00:07:40,150 --> 00:07:37,840
microgravity environment in in cells

179
00:07:41,270 --> 00:07:40,160
floating is obviously a incredibly

180
00:07:43,430 --> 00:07:41,280
interesting thing to study but the

181
00:07:46,070 --> 00:07:43,440
radiation environment i think is the

182
00:07:48,390 --> 00:07:46,080
second major factor on the space station

183
00:07:50,629 --> 00:07:48,400
we just can't simulate the low earth

184
00:07:51,510 --> 00:07:50,639
orbit radiation environment on the earth

185
00:07:53,670 --> 00:07:51,520
with

186
00:07:57,189 --> 00:07:53,680
the beams and the accelerators that we

187
00:08:00,150 --> 00:07:57,199
have on earth don't give us the same

188
00:08:02,469 --> 00:08:00,160

mix of particles that are currently

189
00:08:04,629 --> 00:08:02,479
bombarding human physiology in low earth

190
00:08:05,749 --> 00:08:04,639
orbit so we can study that up here we

191
00:08:08,150 --> 00:08:05,759
have

192
00:08:09,589 --> 00:08:08,160
had long-standing partnerships with nih

193
00:08:11,990 --> 00:08:09,599
to understand

194
00:08:13,990 --> 00:08:12,000
what's going on with cell physiology on

195
00:08:15,510 --> 00:08:14,000
orbit and we can study this at a

196
00:08:17,430 --> 00:08:15,520
cellular level

197
00:08:19,670 --> 00:08:17,440
we can grow cultured cells up here we

198
00:08:23,110 --> 00:08:19,680
just group cardiomyocytes from

199
00:08:27,110 --> 00:08:23,120
programmed adult stem cells for 42 days

200
00:08:29,430 --> 00:08:27,120
in orbit and we can study rodent models

201
00:08:31,430 --> 00:08:29,440
we can study humans as models so we

202
00:08:33,750 --> 00:08:31,440
really have all of the tools at this

203
00:08:35,269 --> 00:08:33,760
point to understand

204
00:08:36,550 --> 00:08:35,279
how radiation

205
00:08:39,350 --> 00:08:36,560
dna

206
00:08:41,190 --> 00:08:39,360
damage and all the kinds of cellular

207
00:08:42,310 --> 00:08:41,200
stress that contribute to aging and

208
00:08:44,389 --> 00:08:42,320
cancer

209
00:08:49,030 --> 00:08:44,399
we have some a lot of tools to start to

210
00:08:53,509 --> 00:08:51,350
that's very impressive i've been reading

211
00:08:56,150 --> 00:08:53,519
about the twin study that's going on

212
00:08:58,230 --> 00:08:56,160
right now this unique opportunity to

213
00:09:01,509 --> 00:08:58,240

look at identical twins

214
00:09:05,269 --> 00:09:01,519
uh scott and mark kelly where scott was

215
00:09:07,990 --> 00:09:05,279
in orbit for 340 days while his

216
00:09:10,870 --> 00:09:08,000
identical twin mark who's previously

217
00:09:13,269 --> 00:09:10,880
been an astronaut was here on earth

218
00:09:15,430 --> 00:09:13,279
and i guess because scott thought it was

219
00:09:17,829 --> 00:09:15,440
a good idea a whole bunch of plans were

220
00:09:20,710 --> 00:09:17,839
made to see what would be the difference

221
00:09:23,829 --> 00:09:20,720
in their biology based upon that long

222
00:09:26,630 --> 00:09:23,839
time that scott spent in space with sort

223
00:09:28,550 --> 00:09:26,640
of the perfect control here because he

224
00:09:31,269 --> 00:09:28,560
and his brother have exactly the same

225
00:09:32,870 --> 00:09:31,279
genomes i know that work is ongoing

226
00:09:34,790 --> 00:09:32,880
right now and i guess maybe we'll hear

227
00:09:36,230 --> 00:09:34,800
something in the coming months but i

228
00:09:38,470 --> 00:09:36,240
thought that was a particularly

229
00:09:40,710 --> 00:09:38,480
interesting and creative way

230
00:09:45,590 --> 00:09:40,720
to look at the effects of what space

231
00:09:50,790 --> 00:09:47,910
absolutely and that allows you to look

232
00:09:53,030 --> 00:09:50,800
at both the genomic effects as well as

233
00:09:55,350 --> 00:09:53,040
there's transcriptional studies there's

234
00:09:57,990 --> 00:09:55,360
epigenomic studies going on as part of

235
00:10:00,949 --> 00:09:58,000
that and there's complete environmental

236
00:10:02,230 --> 00:10:00,959
analysis as well so understanding of the

237
00:10:03,350 --> 00:10:02,240
influence of genes and and the

238
00:10:05,670 --> 00:10:03,360

environment

239
00:10:07,350 --> 00:10:05,680
we've got this very very unique

240
00:10:09,350 --> 00:10:07,360
environment in space

241
00:10:12,470 --> 00:10:09,360
but one of the benefits is that it's

242
00:10:15,990 --> 00:10:12,480
also incredibly well controlled and so

243
00:10:17,430 --> 00:10:16,000
we can understand uh how human health

244
00:10:20,470 --> 00:10:17,440
and and

245
00:10:23,590 --> 00:10:20,480
genomic responses are influenced in this

246
00:10:25,670 --> 00:10:23,600
uh this very bizarre uh place that we

247
00:10:29,350 --> 00:10:25,680
call orbiting our planet in low earth

248
00:10:33,509 --> 00:10:31,110
so kate you mentioned one of the

249
00:10:35,509 --> 00:10:33,519
applications of the dna sequencer might

250
00:10:37,829 --> 00:10:35,519
be at some point to look and see if

251
00:10:39,509 --> 00:10:37,839
other life forms exist out there and

252
00:10:41,509 --> 00:10:39,519
could be characterized

253
00:10:43,829 --> 00:10:41,519
but of course that raises the question

254
00:10:45,509 --> 00:10:43,839
would those other life forms have dna or

255
00:10:48,230 --> 00:10:45,519
would they have some other means of

256
00:10:49,590 --> 00:10:48,240
propagating information obviously nobody

257
00:10:53,990 --> 00:10:49,600
knows the answer to that question but

258
00:10:57,829 --> 00:10:56,389
absolutely and one of the one of the

259
00:11:00,230 --> 00:10:57,839
interesting things about the technology

260
00:11:01,430 --> 00:11:00,240
that we're using the nanopart technology

261
00:11:03,670 --> 00:11:01,440
is that

262
00:11:06,630 --> 00:11:03,680
it can be uh

263
00:11:07,509 --> 00:11:06,640

it can have some capabilities

264
00:11:09,430 --> 00:11:07,519
for

265
00:11:11,350 --> 00:11:09,440
nucleic acids that are slightly modified

266
00:11:13,590 --> 00:11:11,360
so you're really looking

267
00:11:14,949 --> 00:11:13,600
at something that's got capability uh

268
00:11:15,990 --> 00:11:14,959
potentially

269
00:11:20,069 --> 00:11:16,000
to

270
00:11:23,190 --> 00:11:20,079
analyze things that are nucleic acid-ish

271
00:11:25,910 --> 00:11:23,200
uh that might not be exactly resembling

272
00:11:27,829 --> 00:11:25,920
a human dna on the planet and obviously

273
00:11:29,990 --> 00:11:27,839
we're going to use an entire suite of

274
00:11:31,990 --> 00:11:30,000
tools when we are

275
00:11:35,430 --> 00:11:32,000
building our mars missions

276
00:11:37,590 --> 00:11:35,440
but to be able to test out microfluidics

277
00:11:40,069 --> 00:11:37,600
how these kinds of molecular biology

278
00:11:42,069 --> 00:11:40,079
tools work and function and to do a lot

279
00:11:44,310 --> 00:11:42,079
of the troubleshooting on the space

280
00:11:46,470 --> 00:11:44,320
station in low earth orbit as we're

281
00:11:51,829 --> 00:11:46,480
building our plans to go deeper into the

282
00:11:56,629 --> 00:11:54,310
so i see a question uh from kokak

283
00:11:59,350 --> 00:11:56,639
retrato about what are the expected

284
00:12:01,269 --> 00:11:59,360
effects of gravity on sequencing and i

285
00:12:03,110 --> 00:12:01,279
think you've mentioned something about

286
00:12:05,030 --> 00:12:03,120
the issue about the bubbles are there

287
00:12:06,870 --> 00:12:05,040
any other things that you would expect

288
00:12:12,470 --> 00:12:06,880

would be different about sequencing in

289
00:12:17,350 --> 00:12:14,629
yeah luckily surface tension really

290
00:12:19,829 --> 00:12:17,360
works uh in our favor here and in uh

291
00:12:22,550 --> 00:12:19,839
the bubbles in space issue i don't i i

292
00:12:24,790 --> 00:12:22,560
think the best way is to show it uh and

293
00:12:25,990 --> 00:12:24,800
i've got i've got a packet here and you

294
00:12:29,269 --> 00:12:26,000
can see

295
00:12:32,389 --> 00:12:29,279
that that bubbles form in in our fluids

296
00:12:34,629 --> 00:12:32,399
here and they form in a very odd way uh

297
00:12:37,190 --> 00:12:34,639
and and just even understanding the

298
00:12:38,790 --> 00:12:37,200
fluidics and and the bubbles

299
00:12:41,990 --> 00:12:38,800
at a molecular biology scale is

300
00:12:44,389 --> 00:12:42,000
incredibly important in terms of other

301
00:12:46,069 --> 00:12:44,399
in terms of other effects of gravity

302
00:12:48,790 --> 00:12:46,079
i think mostly that's going to be on

303
00:12:50,790 --> 00:12:48,800
cellular function how cells organize

304
00:12:52,949 --> 00:12:50,800
themselves in tissues

305
00:12:54,949 --> 00:12:52,959
how cells might behave in cell culture

306
00:12:57,750 --> 00:12:54,959
when they're no longer forced to the

307
00:13:00,389 --> 00:12:57,760
bottom of the plate the actual molecular

308
00:13:04,949 --> 00:13:00,399
composition analysis should be pretty

309
00:13:09,269 --> 00:13:07,590
so phoebe kinselman is asking along the

310
00:13:11,590 --> 00:13:09,279
lines of what you just mentioned what's

311
00:13:13,829 --> 00:13:11,600
the main difference that you saw between

312
00:13:15,509 --> 00:13:13,839
the way heart cells interact in space

313
00:13:18,150 --> 00:13:15,519

rather than on earth did that

314
00:13:22,949 --> 00:13:18,160
gravitational absence make a difference

315
00:13:27,110 --> 00:13:24,550
yeah and that's uh that's what the

316
00:13:28,949 --> 00:13:27,120
researchers are looking at right now so

317
00:13:30,629 --> 00:13:28,959
i think they are they're writing a paper

318
00:13:32,069 --> 00:13:30,639
about this and are going to publish it

319
00:13:34,470 --> 00:13:32,079
soon

320
00:13:36,069 --> 00:13:34,480
at least for me analyzing the cell

321
00:13:37,350 --> 00:13:36,079
culture up here

322
00:13:39,590 --> 00:13:37,360
is actually

323
00:13:43,030 --> 00:13:39,600
it's not stuck to a tissue culture plate

324
00:13:45,509 --> 00:13:43,040
so the cells were allowed to build on

325
00:13:48,069 --> 00:13:45,519
top of each other and start to form

326
00:13:50,550 --> 00:13:48,079
three-dimensional structures and this

327
00:13:52,389 --> 00:13:50,560
changes obviously the changes the way

328
00:13:54,710 --> 00:13:52,399
the cells are going to interact when

329
00:13:56,230 --> 00:13:54,720
they don't have that constant force of

330
00:13:58,629 --> 00:13:56,240
gravity so one of the things that we

331
00:14:01,590 --> 00:13:58,639
could see was how the cells organize

332
00:14:03,750 --> 00:14:01,600
themselves without gravity how they're

333
00:14:08,710 --> 00:14:03,760
communicating and some of the cellular

334
00:14:13,430 --> 00:14:10,310
so that's very cool

335
00:14:16,310 --> 00:14:13,440
nih has a program on building tissue

336
00:14:19,110 --> 00:14:16,320
chips where on a biochip you would have

337
00:14:22,069 --> 00:14:19,120
various cells that represent heart and

338
00:14:24,389 --> 00:14:22,079

lung and kidney and brain all derived by

339
00:14:26,629 --> 00:14:24,399
the magic of stem cell biology which has

340
00:14:28,710 --> 00:14:26,639
come so far so fast

341
00:14:30,949 --> 00:14:28,720
and i know we have a plan to have those

342
00:14:33,030 --> 00:14:30,959
tissue chips up there in space and use

343
00:14:35,350 --> 00:14:33,040
them as ways of assessing what are some

344
00:14:37,829 --> 00:14:35,360
of these biological effects as for

345
00:14:40,069 --> 00:14:37,839
instance that radiation might create in

346
00:14:41,590 --> 00:14:40,079
a way that doesn't actually do any harm

347
00:14:43,910 --> 00:14:41,600
to humans but you can do a lot of

348
00:14:45,110 --> 00:14:43,920
measurement on those cells sitting there

349
00:14:46,710 --> 00:14:45,120
on that chip

350
00:14:47,910 --> 00:14:46,720
let me ask you in terms of the dna

351
00:14:49,910 --> 00:14:47,920
sequencer

352
00:14:52,150 --> 00:14:49,920
you know because you're a very highly

353
00:14:54,949 --> 00:14:52,160
trained molecular biologist that the

354
00:14:57,189 --> 00:14:54,959
sequencer needs fairly pure dna in order

355
00:14:59,590 --> 00:14:57,199
to do its thing there's this question in

356
00:15:02,310 --> 00:14:59,600
my mind then how would you in space go

357
00:15:03,990 --> 00:15:02,320
about preparing the sample to get it

358
00:15:06,870 --> 00:15:04,000
ready for the sequence or how would you

359
00:15:11,430 --> 00:15:06,880
identify the dna in your environment for

360
00:15:15,110 --> 00:15:13,590
and that was uh basically exactly my

361
00:15:17,269 --> 00:15:15,120
question before i launched so we're

362
00:15:19,750 --> 00:15:17,279
allowed to fly a few things

363
00:15:20,949 --> 00:15:19,760

and uh one of the things i decided to

364
00:15:22,790 --> 00:15:20,959
fly was

365
00:15:25,430 --> 00:15:22,800
in my personal allocation was a whole

366
00:15:27,430 --> 00:15:25,440
series of pipetters so in my free time

367
00:15:29,990 --> 00:15:27,440
i've been doing some experiments about

368
00:15:31,829 --> 00:15:30,000
how you would do library prep

369
00:15:32,710 --> 00:15:31,839
and actually have found

370
00:15:35,350 --> 00:15:32,720
that

371
00:15:38,150 --> 00:15:35,360
pipetting and the standard methods of

372
00:15:38,870 --> 00:15:38,160
moving things around in eppendorf tubes

373
00:15:44,949 --> 00:15:38,880
and

374
00:15:46,710 --> 00:15:44,959
microliters or 50 microliters works very

375
00:15:48,230 --> 00:15:46,720
well up here which was extremely

376
00:15:51,350 --> 00:15:48,240
surprising to me that was not my

377
00:15:53,910 --> 00:15:51,360
hypothesis so i think the library prep

378
00:15:57,269 --> 00:15:53,920
is going to be very similar to what we

379
00:15:58,790 --> 00:15:57,279
see on earth it's just the input

380
00:16:00,150 --> 00:15:58,800
is going to be incredibly different so

381
00:16:08,790 --> 00:16:00,160
we can sample

382
00:16:10,790 --> 00:16:08,800
sent up any number of biological inputs

383
00:16:12,710 --> 00:16:10,800
and we're going to be able to do

384
00:16:14,790 --> 00:16:12,720
we're working on that right now to be

385
00:16:19,110 --> 00:16:14,800
able to do some of the library prep to

386
00:16:22,550 --> 00:16:20,870
that's pretty amazing i guess i would

387
00:16:24,629 --> 00:16:22,560
have thought that without gravity you'd

388
00:16:26,790 --> 00:16:24,639

have bits of material floating all

389
00:16:28,150 --> 00:16:26,800
around that you'd try to pipet and it

390
00:16:30,069 --> 00:16:28,160
would go down in the tube and then it

391
00:16:31,910 --> 00:16:30,079
wasn't there anymore but surface tension

392
00:16:35,189 --> 00:16:31,920
comes to the rescue is that what what

393
00:16:39,509 --> 00:16:37,350
it absolutely does and so it's very

394
00:16:41,269 --> 00:16:39,519
strange to uh to hold a reaction and

395
00:16:43,110 --> 00:16:41,279
pipette it just as you would on earth

396
00:16:43,990 --> 00:16:43,120
and then be able to flip the tube upside

397
00:16:46,150 --> 00:16:44,000
down

398
00:16:49,189 --> 00:16:46,160
and the all of the liquid stays in there

399
00:16:51,670 --> 00:16:49,199
so it is both identical to bench

400
00:16:55,030 --> 00:16:51,680
research on the planet and completely

401
00:16:59,030 --> 00:16:57,110
so kate you've had an amazing career

402
00:17:00,550 --> 00:16:59,040
already i know you were a fellow at the

403
00:17:02,829 --> 00:17:00,560
white house institute one of the most

404
00:17:05,829 --> 00:17:02,839
cutting edge places that does molecular

405
00:17:07,270 --> 00:17:05,839
biology there's a question here from the

406
00:17:09,510 --> 00:17:07,280
the live feed

407
00:17:11,189 --> 00:17:09,520
what would you tell young students about

408
00:17:12,630 --> 00:17:11,199
your experience with science because i

409
00:17:17,590 --> 00:17:12,640
hope a lot of them are watching i think

410
00:17:22,789 --> 00:17:20,390
i would tell them uh to find something

411
00:17:23,909 --> 00:17:22,799
that they care a great deal about

412
00:17:27,510 --> 00:17:23,919
something that they're incredibly

413
00:17:29,669 --> 00:17:27,520

passionate about and uh i have not

414
00:17:32,070 --> 00:17:29,679
particularly tried to go in any

415
00:17:34,310 --> 00:17:32,080
direction in my career

416
00:17:36,789 --> 00:17:34,320
i actually applied to be an astronaut

417
00:17:39,750 --> 00:17:36,799
while procrastinating a little bit on

418
00:17:42,710 --> 00:17:39,760
writing a r01 grant application so i

419
00:17:44,549 --> 00:17:42,720
think i would say probably thank you

420
00:17:47,510 --> 00:17:44,559
directly because

421
00:17:50,310 --> 00:17:47,520
i i have found myself in some

422
00:17:52,870 --> 00:17:50,320
extraordinary and unexpected places

423
00:17:55,270 --> 00:17:52,880
because i have done whatever seems to be

424
00:18:01,029 --> 00:17:55,280
the most fascinating interesting and

425
00:18:05,110 --> 00:18:03,190
i love that answer and that's certainly

426
00:18:07,669 --> 00:18:05,120
the answer i would give as well to

427
00:18:08,630 --> 00:18:07,679
people asking how do i plan my life

428
00:18:10,710 --> 00:18:08,640
career

429
00:18:13,190 --> 00:18:10,720
it means a lot of it is keeping yourself

430
00:18:14,950 --> 00:18:13,200
open to unexpected opportunities it

431
00:18:16,230 --> 00:18:14,960
sounds like being an austrian astronaut

432
00:18:18,310 --> 00:18:16,240
was one of those

433
00:18:20,150 --> 00:18:18,320
for you and not expect that you can

434
00:18:21,190 --> 00:18:20,160
actually plan things out over many

435
00:18:22,950 --> 00:18:21,200
decades

436
00:18:24,630 --> 00:18:22,960
things are changing too fast there are

437
00:18:26,549 --> 00:18:24,640
too many exciting things happening in

438
00:18:28,789 --> 00:18:26,559

science but if you have a passion to

439
00:18:30,470 --> 00:18:28,799
make a discovery to make a difference in

440
00:18:33,190 --> 00:18:30,480
the world to add to the knowledge of the

441
00:18:35,110 --> 00:18:33,200
universe science is a great place to be

442
00:18:38,150 --> 00:18:35,120
right now never been a better time than

443
00:18:40,150 --> 00:18:38,160
right now to get engaged

444
00:18:42,150 --> 00:18:40,160
so let me ask because i think we're

445
00:18:43,830 --> 00:18:42,160
probably getting near the end of the

446
00:18:46,310 --> 00:18:43,840
time are there other things kate that

447
00:18:47,750 --> 00:18:46,320
you wanted to be sure to share with the

448
00:18:53,190 --> 00:18:47,760
people watching this

449
00:18:58,789 --> 00:18:55,990
well i wanted to let folks know how

450
00:19:01,270 --> 00:18:58,799
amazing it is that we're sending human

451
00:19:03,190 --> 00:19:01,280
beings into low earth orbit and i'm

452
00:19:05,990 --> 00:19:03,200
incredibly excited you mentioned some of

453
00:19:08,710 --> 00:19:06,000
the nih nasa partnerships the things

454
00:19:12,950 --> 00:19:08,720
that we are able to do right now

455
00:19:14,789 --> 00:19:12,960
are both fantastic for where we are

456
00:19:17,029 --> 00:19:14,799
with launching human beings off the

457
00:19:19,270 --> 00:19:17,039
planet we are just starting to send

458
00:19:22,070 --> 00:19:19,280
people into the solar system i think as

459
00:19:24,230 --> 00:19:22,080
we look back on this in 50 years and 100

460
00:19:27,510 --> 00:19:24,240
years you're right this is a very very

461
00:19:29,990 --> 00:19:27,520
exciting time to be alive and to be

462
00:19:32,870 --> 00:19:30,000
involved in science and engineering and

463
00:19:34,630 --> 00:19:32,880

technology and i also want to say that i

464
00:19:37,990 --> 00:19:34,640
think this is an incredibly exciting

465
00:19:40,870 --> 00:19:38,000
time for molecular biology and research

466
00:19:42,950 --> 00:19:40,880
i think the places that we're going with

467
00:19:45,430 --> 00:19:42,960
the world of sequencing the world of

468
00:19:47,830 --> 00:19:45,440
starting to understand our microbiome

469
00:19:50,150 --> 00:19:47,840
and human health and disease are very

470
00:19:51,510 --> 00:19:50,160
very exciting and so i'm really looking

471
00:19:54,310 --> 00:19:51,520
forward to

472
00:19:56,630 --> 00:19:54,320
future opportunities to work uh with nih

473
00:19:59,830 --> 00:19:56,640
with academic researchers and with nasa

474
00:20:01,590 --> 00:19:59,840
to explore all of these

475
00:20:04,390 --> 00:20:01,600
well thank you kate it's been great to

476
00:20:06,070 --> 00:20:04,400
talk with you you deserve our applause

477
00:20:08,310 --> 00:20:06,080
and our prayers you're an inspiration to

478
00:20:10,710 --> 00:20:08,320
everybody we'll be archiving this video

479
00:20:12,549 --> 00:20:10,720
for anybody who wants to view it later

480
00:20:20,870 --> 00:20:12,559
and we look forward to kate's safe

481
00:20:27,430 --> 00:20:22,390
station this is houston acr that

482
00:20:31,110 --> 00:20:29,590
and thank you dr collins in the national

483
00:20:33,270 --> 00:20:31,120
institutes of health