1
00:00:16,550 --> 00:00:14,950
the international space station is a

2
00:00:18,310 --> 00:00:16,560
state-of-the-art research laboratory

3
00:00:21,269 --> 00:00:18,320
that allows scientific research to be

4
00:00:23,189 --> 00:00:21,279
performed in the microgravity of space

5
00:00:24,870 --> 00:00:23,199
research in this unique microgravity

6
00:00:27,189 --> 00:00:24,880
environment is advancing our knowledge

7
00:00:29,029 --> 00:00:27,199
of biology chemistry physics and

8
00:00:30,550 --> 00:00:29,039
physiology

9
00:00:32,389 --> 00:00:30,560
scientists from all over the world are

10
00:00:34,389 --> 00:00:32,399
using facilities on this high-flying

11
00:00:35,830 --> 00:00:34,399
international laboratory that is packed

12
00:00:38,069 --> 00:00:35,840
with some of the most sophisticated

13
00:00:39,670 --> 00:00:38,079

technologies ever designed

14
00:00:41,510 --> 00:00:39,680
space station research brings new

15
00:00:43,430 --> 00:00:41,520
discoveries furthers technology

16
00:00:44,389 --> 00:00:43,440
development expands our limits of

17
00:00:49,830 --> 00:00:44,399
exploration

18
00:00:53,830 --> 00:00:51,830
hi i'm mark gott i work here at the

19
00:00:56,389 --> 00:00:53,840
johnson space center in the microbiology

20
00:00:58,549 --> 00:00:56,399
lab our job in the microbiology lab is

21
00:01:00,110 --> 00:00:58,559
to protect the crew from possible

22
00:01:02,790 --> 00:01:00,120
problems that could occur due to

23
00:01:05,350 --> 00:01:02,800
microorganisms so we take a look at the

24
00:01:07,910 --> 00:01:05,360
environment the crew themselves and the

25
00:01:10,710 --> 00:01:07,920
food they eat just to make sure that

26
00:01:12,870 --> 00:01:10,720
they're safe during a mission

27
00:01:14,550 --> 00:01:12,880
we know a lot about what goes on in

28
00:01:16,550 --> 00:01:14,560
space flight with the international

29
00:01:19,749 --> 00:01:16,560
space station we've learned a tremendous

30
00:01:22,070 --> 00:01:19,759
amount about how the crew responds what

31
00:01:23,350 --> 00:01:22,080
it takes to keep them healthy and what

32
00:01:25,749 --> 00:01:23,360
kind of problems you have in the

33
00:01:28,149 --> 00:01:25,759
environment that may occur over time

34
00:01:29,910 --> 00:01:28,159
however we haven't always known a lot

35
00:01:33,030 --> 00:01:29,920
and we still have a lot of questions to

36
00:01:34,710 --> 00:01:33,040
ask that's why we do a lot of research

37
00:01:37,109 --> 00:01:34,720
one of the challenges we face with

38
00:01:39,510 --> 00:01:37,119

astronauts in space flight is that we

39
00:01:41,830 --> 00:01:39,520
found with some of our research that

40
00:01:43,270 --> 00:01:41,840
their immune system is regulated in a

41
00:01:44,870 --> 00:01:43,280
different way and we're worried it could

42
00:01:46,230 --> 00:01:44,880
be dysfunctional

43
00:01:47,749 --> 00:01:46,240
what does this mean

44
00:01:51,350 --> 00:01:47,759
it's possible that the crew could be

45
00:01:53,429 --> 00:01:51,360
more susceptible to infectious disease

46
00:01:55,670 --> 00:01:53,439
good morning my name is dr cheryl

47
00:01:57,830 --> 00:01:55,680
nickerson i'm a professor in the center

48
00:01:59,670 --> 00:01:57,840
for infectious diseases and vaccinology

49
00:02:01,270 --> 00:01:59,680
at the biodesign institute at arizona

50
00:02:03,350 --> 00:02:01,280
state university

51
00:02:05,830 --> 00:02:03,360
so research in my laboratory here is

52
00:02:07,429 --> 00:02:05,840
focused on two main things first of all

53
00:02:09,990 --> 00:02:07,439
we're interested in understanding how

54
00:02:11,990 --> 00:02:10,000
space flight alters the infectious

55
00:02:14,869 --> 00:02:12,000
disease risk because we want to keep the

56
00:02:16,150 --> 00:02:14,879
crew the astronauts safe and mitigate

57
00:02:19,190 --> 00:02:16,160
their risk for infection when they're

58
00:02:21,110 --> 00:02:19,200
flying but likewise it turns out through

59
00:02:23,670 --> 00:02:21,120
the studies we've done in my laboratory

60
00:02:25,750 --> 00:02:23,680
and with dr ott we have been able to

61
00:02:27,830 --> 00:02:25,760
show that there are aspects of that

62
00:02:29,510 --> 00:02:27,840
microgravity environment that cells

63
00:02:31,430 --> 00:02:29,520

encounter when they're cultured in space

64
00:02:33,270 --> 00:02:31,440
flight that are directly relevant to

65
00:02:34,790 --> 00:02:33,280
what those same microbial pathogens

66
00:02:36,710 --> 00:02:34,800
encounter when they're in your body

67
00:02:39,670 --> 00:02:36,720
during an infection well it all got

68
00:02:41,350 --> 00:02:39,680
started several years ago when mark ott

69
00:02:43,509 --> 00:02:41,360
at the nasa johnson space center called

70
00:02:45,110 --> 00:02:43,519
me up on the phone and said that the

71
00:02:46,790 --> 00:02:45,120
astronauts were aiming to compromise

72
00:02:48,710 --> 00:02:46,800
during space flight now that means their

73
00:02:50,550 --> 00:02:48,720
immune system doesn't function quite as

74
00:02:52,550 --> 00:02:50,560
well as it does when they're down here

75
00:02:54,390 --> 00:02:52,560
on earth on a daily basis and this

76
00:02:56,470 --> 00:02:54,400
intrigued me because my background in

77
00:02:59,670 --> 00:02:56,480
career training was in microbial

78
00:03:01,750 --> 00:02:59,680
pathogenesis in other words i study how

79
00:03:03,910 --> 00:03:01,760
microbes cause disease the cellular and

80
00:03:05,990 --> 00:03:03,920
molecular mechanisms that they use to

81
00:03:08,869 --> 00:03:06,000
cause disease in your body by studying

82
00:03:10,869 --> 00:03:08,879
those mechanisms we can then apply that

83
00:03:12,869 --> 00:03:10,879
knowledge to develop new vaccines and

84
00:03:14,869 --> 00:03:12,879
therapeutics and treatments to prevent

85
00:03:17,030 --> 00:03:14,879
you from getting sick from infection

86
00:03:18,869 --> 00:03:17,040
so i realized we knew half of the

87
00:03:21,030 --> 00:03:18,879
equation we knew that spaceflight

88
00:03:23,350 --> 00:03:21,040

altered the immune system but we didn't

89
00:03:24,949 --> 00:03:23,360
know the other half of the equation and

90
00:03:26,869 --> 00:03:24,959
the other half of the equation is also

91
00:03:28,550 --> 00:03:26,879
very important to determine whether or

92
00:03:30,869 --> 00:03:28,560
not you're going to get sick after you

93
00:03:33,270 --> 00:03:30,879
get infected and that has to do with the

94
00:03:35,350 --> 00:03:33,280
virulence of the pathogen of virulence

95
00:03:37,030 --> 00:03:35,360
means disease-causing potential but

96
00:03:39,509 --> 00:03:37,040
nobody had looked at the effect of space

97
00:03:42,869 --> 00:03:39,519
flight on the disease-causing potential

98
00:03:44,390 --> 00:03:42,879
so i immediately asked dr ott what i

99
00:03:45,910 --> 00:03:44,400
thought at the time might be a very

100
00:03:48,470 --> 00:03:45,920
silly question and this should always

101
00:03:50,229 --> 00:03:48,480
teach you always ask questions no

102
00:03:52,470 --> 00:03:50,239
question is ever silly no question is

103
00:03:54,229 --> 00:03:52,480
ever done so i asked him i said well

104
00:03:56,070 --> 00:03:54,239
this is amazing i said

105
00:03:57,670 --> 00:03:56,080
we have to look at the effect of space

106
00:03:59,509 --> 00:03:57,680
flight on the infectious disease

107
00:04:01,509 --> 00:03:59,519
potential the pathogen has anybody ever

108
00:04:03,429 --> 00:04:01,519
done that and his response was no they

109
00:04:05,509 --> 00:04:03,439
haven't so i immediately followed that

110
00:04:07,589 --> 00:04:05,519
question was well we have to do this can

111
00:04:09,670 --> 00:04:07,599
we fly an experiment now

112
00:04:11,270 --> 00:04:09,680
that was my naivete because i didn't

113
00:04:13,670 --> 00:04:11,280

realize you had to go through a very

114
00:04:16,069 --> 00:04:13,680
long series of ground-based studies to

115
00:04:18,229 --> 00:04:16,079
validate that you really needed to use

116
00:04:20,390 --> 00:04:18,239
the space flight experiment to to

117
00:04:23,430 --> 00:04:20,400
address your potential question i said

118
00:04:25,590 --> 00:04:23,440
okay until we can fly is there some way

119
00:04:27,189 --> 00:04:25,600
that we can mimic some system that we

120
00:04:29,749 --> 00:04:27,199
can use to mimic to culture these

121
00:04:32,150 --> 00:04:29,759
bacterial cells here in the laboratory

122
00:04:34,629 --> 00:04:32,160
on earth under conditions which mimic

123
00:04:37,350 --> 00:04:34,639
space flight so this is that special

124
00:04:39,909 --> 00:04:37,360
bioreactor that nasa design that allows

125
00:04:42,150 --> 00:04:39,919
scientists like me to culture ourselves

126
00:04:43,749 --> 00:04:42,160
in the laboratory under conditions which

127
00:04:46,150 --> 00:04:43,759
both simulate aspects of the

128
00:04:48,469 --> 00:04:46,160
microgravity environment and stimulate

129
00:04:50,230 --> 00:04:48,479
aspects of inside our human bodies

130
00:04:52,390 --> 00:04:50,240
so we have been able to use this

131
00:04:54,150 --> 00:04:52,400
bioreactor to grow pathogens under

132
00:04:56,950 --> 00:04:54,160
conditions in ways that they actually

133
00:04:59,590 --> 00:04:56,960
experience in your body in addition to

134
00:05:01,270 --> 00:04:59,600
similar ways in space light and find new

135
00:05:03,909 --> 00:05:01,280
ways that they're causing disease in the

136
00:05:06,070 --> 00:05:03,919
body for example my laboratory in

137
00:05:07,670 --> 00:05:06,080
collaboration with dr oz laboratory has

138
00:05:10,070 --> 00:05:07,680

shown that when we culture pathogens in

139
00:05:13,029 --> 00:05:10,080
this bioreactor especially salmonella a

140
00:05:14,710 --> 00:05:13,039
major human foodborne pathogen it causes

141
00:05:17,110 --> 00:05:14,720
disease not only differently but it

142
00:05:18,150 --> 00:05:17,120
globally changes its gene expression

143
00:05:20,150 --> 00:05:18,160
profile

144
00:05:22,150 --> 00:05:20,160
it becomes a better pathogen it can

145
00:05:25,590 --> 00:05:22,160
cause disease more effectively it's more

146
00:05:27,830 --> 00:05:25,600
robust pathogen and it can also be more

147
00:05:29,430 --> 00:05:27,840
resistant to being killed by stresses

148
00:05:32,469 --> 00:05:29,440
that your body normally challenges it

149
00:05:34,150 --> 00:05:32,479
with so armed with this information this

150
00:05:36,070 --> 00:05:34,160
new insight we've been able to provide

151
00:05:38,550 --> 00:05:36,080
about how salmonella could cause disease

152
00:05:41,189 --> 00:05:38,560
in the body by culturing it under space

153
00:05:43,670 --> 00:05:41,199
flight like conditions we were awarded a

154
00:05:46,550 --> 00:05:43,680
grant from nasa our first one to fly a

155
00:05:48,950 --> 00:05:46,560
space flight experiment

156
00:05:50,950 --> 00:05:48,960
so this is the experiment we were funded

157
00:05:52,469 --> 00:05:50,960
in a grant with nasa to fly what is the

158
00:05:54,150 --> 00:05:52,479
effect of true space flight on

159
00:05:56,309 --> 00:05:54,160
salmonella gene expression and

160
00:05:58,629 --> 00:05:56,319
disease-causing potential or virulence

161
00:06:00,710 --> 00:05:58,639
now one thing to keep in mind is that

162
00:06:02,550 --> 00:06:00,720
space flight doing experiments in space

163
00:06:04,469 --> 00:06:02,560

flight is very different than doing them

164
00:06:06,309 --> 00:06:04,479
here on the bench on earth you have to

165
00:06:08,070 --> 00:06:06,319
think differently and there's a whole

166
00:06:09,670 --> 00:06:08,080
lot of constraints that you're going to

167
00:06:11,990 --> 00:06:09,680
have to consider

168
00:06:13,830 --> 00:06:12,000
one of them to think about is we wanted

169
00:06:15,590 --> 00:06:13,840
to study the effect of space flight on

170
00:06:16,790 --> 00:06:15,600
the infectious disease potential of a

171
00:06:17,749 --> 00:06:16,800
pathogen

172
00:06:19,350 --> 00:06:17,759
well

173
00:06:21,590 --> 00:06:19,360
the problem is

174
00:06:24,070 --> 00:06:21,600
nasa at the time did not allow anything

175
00:06:27,029 --> 00:06:24,080
to be infected in flight so you could

176
00:06:28,790 --> 00:06:27,039
only grow the bacteria up there and

177
00:06:30,550 --> 00:06:28,800
activate them and prepare them for the

178
00:06:32,390 --> 00:06:30,560
experiment but the actual infections

179
00:06:34,070 --> 00:06:32,400
have to be done back down here so

180
00:06:37,110 --> 00:06:34,080
something to keep in mind when you're

181
00:06:38,469 --> 00:06:37,120
when you're designing your experiment

182
00:06:40,309 --> 00:06:38,479
now that you've heard the background

183
00:06:41,510 --> 00:06:40,319
from dr cheryl nickerson about this

184
00:06:43,510 --> 00:06:41,520
project

185
00:06:45,270 --> 00:06:43,520
i'd like you to try to set up the

186
00:06:48,469 --> 00:06:45,280
experiment

187
00:06:51,110 --> 00:06:48,479
and what would your hypothesis be

188
00:06:52,950 --> 00:06:51,120

i'd like you to design an experiment

189
00:06:54,950 --> 00:06:52,960
that will investigate the effect of

190
00:06:56,870 --> 00:06:54,960
space flight on the genetic responses

191
00:07:00,309 --> 00:06:56,880
and disease-causing potential or

192
00:07:02,629 --> 00:07:00,319
virulence of salmonella typhomerium

193
00:07:04,150 --> 00:07:02,639
when designing this experiment

194
00:07:06,390 --> 00:07:04,160
don't forget

195
00:07:08,710 --> 00:07:06,400
proper containment of the experiment

196
00:07:11,909 --> 00:07:08,720
needs to be maintained to pose no threat

197
00:07:14,469 --> 00:07:11,919
to crude during or after spaceflight

198
00:07:16,950 --> 00:07:14,479
the experiment must be activated in the

199
00:07:20,710 --> 00:07:16,960
in space flight and coordinated with

200
00:07:23,189 --> 00:07:20,720
activation of ground-based controls

201
00:07:25,110 --> 00:07:23,199
strict timelines must be designed into

202
00:07:28,390 --> 00:07:25,120
your experiment to coordinate with the

203
00:07:33,189 --> 00:07:30,469
experimental return to the investigator

204
00:07:36,230 --> 00:07:33,199
post-flight must be rapid to ensure

205
00:07:38,950 --> 00:07:36,240
sample integrity for analysis on earth

206
00:07:41,589 --> 00:07:38,960
and as with all spaceflight experiments

207
00:07:44,390 --> 00:07:41,599
try to use very little crew time and

208
00:07:54,950 --> 00:07:44,400
minimize the hardware volume

209
00:08:00,390 --> 00:07:57,830
so the hypothesis of this experiment is

210
00:08:02,390 --> 00:08:00,400
that space flight will affect gene

211
00:08:04,469 --> 00:08:02,400
expression and virulence of

212
00:08:06,150 --> 00:08:04,479
salmonella-type femorium you were given

213
00:08:07,830 --> 00:08:06,160

a series of constraints that you had to

214
00:08:09,909 --> 00:08:07,840
give careful consideration to in

215
00:08:12,230 --> 00:08:09,919
designing your experiment proper

216
00:08:13,990 --> 00:08:12,240
containment of the experiment to pose no

217
00:08:15,749 --> 00:08:14,000
threat to the crew during space flight

218
00:08:17,830 --> 00:08:15,759
our hardware or the containers that we

219
00:08:20,309 --> 00:08:17,840
used to fly this experiment that would

220
00:08:21,909 --> 00:08:20,319
actually activate the work in space had

221
00:08:24,070 --> 00:08:21,919
to have what we call triple levels of

222
00:08:26,309 --> 00:08:24,080
containment so that there were three

223
00:08:28,469 --> 00:08:26,319
barriers between the crew who are

224
00:08:30,070 --> 00:08:28,479
performing the experiment and them ever

225
00:08:32,310 --> 00:08:30,080
having any risk of it coming into

226
00:08:33,909 --> 00:08:32,320
contact with it the experiment has to be

227
00:08:35,350 --> 00:08:33,919
activated in space flight and

228
00:08:37,750 --> 00:08:35,360
coordinated with activation of

229
00:08:40,230 --> 00:08:37,760
ground-based controls my entire team was

230
00:08:42,149 --> 00:08:40,240
at the kennedy space flight center and

231
00:08:44,710 --> 00:08:42,159
that's where we prepared the experiment

232
00:08:46,550 --> 00:08:44,720
and we prepared two duplicate sets of it

233
00:08:48,949 --> 00:08:46,560
we had two identical sets of our flight

234
00:08:51,509 --> 00:08:48,959
hardware and we loaded them at the same

235
00:08:53,990 --> 00:08:51,519
exact time with all reagents including

236
00:08:55,910 --> 00:08:54,000
our strain of salmonella

237
00:08:57,829 --> 00:08:55,920
the fixative reagents which would be for

238
00:09:00,150 --> 00:08:57,839

gene expression and then the growth

239
00:09:02,389 --> 00:09:00,160
medium and everybody was loaded at the

240
00:09:03,990 --> 00:09:02,399
same time and half of that hardware flew

241
00:09:05,590 --> 00:09:04,000
and the other half stayed on the ground

242
00:09:06,710 --> 00:09:05,600
for the timing to activate the

243
00:09:08,230 --> 00:09:06,720
experiment

244
00:09:10,310 --> 00:09:08,240
we were linked in real time with

245
00:09:12,470 --> 00:09:10,320
astronauts so when the astronauts were

246
00:09:14,790 --> 00:09:12,480
activating our experiment on orbit they

247
00:09:17,350 --> 00:09:14,800
called down to us we were in that room

248
00:09:19,190 --> 00:09:17,360
at the same time and we activated and

249
00:09:21,430 --> 00:09:19,200
did everything to our controls in that

250
00:09:24,230 --> 00:09:21,440
special room at the same time that they

251
00:09:25,430 --> 00:09:24,240
did on orbit strict timelines must be

252
00:09:27,110 --> 00:09:25,440
designed in your experiment to

253
00:09:29,190 --> 00:09:27,120
coordinate with the astronaut schedules

254
00:09:31,350 --> 00:09:29,200
so you have to design a space flight

255
00:09:33,430 --> 00:09:31,360
experiment and your biological system

256
00:09:34,630 --> 00:09:33,440
has to be adaptable and and your

257
00:09:36,790 --> 00:09:34,640
experiment

258
00:09:38,630 --> 00:09:36,800
can't fail if it's performed a little

259
00:09:40,550 --> 00:09:38,640
bit outside of the timeline of what

260
00:09:42,630 --> 00:09:40,560
would be ideal so you have to tell the

261
00:09:45,430 --> 00:09:42,640
crew i want my experiment to be

262
00:09:48,389 --> 00:09:45,440
activated at this time but i can take

263
00:09:50,389 --> 00:09:48,399

this much time ahead or behind it so

264
00:09:52,310 --> 00:09:50,399
plus or minus a certain number of hours

265
00:09:54,949 --> 00:09:52,320
or minutes that you can allow for your

266
00:09:57,350 --> 00:09:54,959
experiment the experiment is returned to

267
00:10:00,790 --> 00:09:57,360
the investigator post-flight it has to

268
00:10:02,870 --> 00:10:00,800
be returned to us very rapidly to ensure

269
00:10:06,310 --> 00:10:02,880
two things sample integrity for earth

270
00:10:08,150 --> 00:10:06,320
and also that the bacteria are are not

271
00:10:09,910 --> 00:10:08,160
re-adapting to being back in earth's

272
00:10:12,069 --> 00:10:09,920
gravity because we were testing two

273
00:10:14,710 --> 00:10:12,079
things remember our hypothesis is that

274
00:10:18,150 --> 00:10:14,720
space flight affects gene expression and

275
00:10:20,949 --> 00:10:18,160
expects severe it affects virulence so

276
00:10:22,710 --> 00:10:20,959
two things happen to our samples on

277
00:10:25,269 --> 00:10:22,720
orbit and obviously on the ground as

278
00:10:27,670 --> 00:10:25,279
well half of the samples after the

279
00:10:29,190 --> 00:10:27,680
bacteria were activated for growth they

280
00:10:31,430 --> 00:10:29,200
grew to a certain period of time and

281
00:10:32,870 --> 00:10:31,440
then the astronauts terminated that half

282
00:10:35,750 --> 00:10:32,880
of the experiment they fixed it with a

283
00:10:37,910 --> 00:10:35,760
chemical to preserve the the uh the

284
00:10:39,590 --> 00:10:37,920
experiment for gene expression analysis

285
00:10:41,750 --> 00:10:39,600
the other half of the bacteria for

286
00:10:43,350 --> 00:10:41,760
virulence that half of the bacterium

287
00:10:45,829 --> 00:10:43,360
after they were growing they were

288
00:10:48,470 --> 00:10:45,839

brought back live so as soon as the

289
00:10:50,870 --> 00:10:48,480
shuttle landed we had a special

290
00:10:52,710 --> 00:10:50,880
requirement for what we call first off

291
00:10:54,630 --> 00:10:52,720
which means that after the crew comes

292
00:10:56,310 --> 00:10:54,640
off the shuttle our experiment is

293
00:10:57,829 --> 00:10:56,320
unloaded immediately

294
00:10:59,750 --> 00:10:57,839
and then we had to try to use very

295
00:11:02,870 --> 00:10:59,760
little crew time so

296
00:11:05,509 --> 00:11:02,880
astronaut time is incredibly valuable

297
00:11:07,110 --> 00:11:05,519
and you don't get very much of it so you

298
00:11:09,509 --> 00:11:07,120
either have to work with hardware that's

299
00:11:12,069 --> 00:11:09,519
fully automated or you have to design

300
00:11:14,790 --> 00:11:12,079
your experiment so that the crew has

301
00:11:16,550 --> 00:11:14,800
minimal amount of time that they have to

302
00:11:18,949 --> 00:11:16,560
invest in doing your experiment although

303
00:11:20,630 --> 00:11:18,959
i will say the crew is awesome the

304
00:11:22,710 --> 00:11:20,640
astronauts always want to give extra

305
00:11:24,630 --> 00:11:22,720
time to do science your experiment has

306
00:11:27,910 --> 00:11:24,640
to be designed to minimize hardware

307
00:11:30,069 --> 00:11:27,920
volume minimize mass and power needs you

308
00:11:31,750 --> 00:11:30,079
need to really minimize the amount of

309
00:11:33,910 --> 00:11:31,760
volume that you're sending up in flight

310
00:11:35,910 --> 00:11:33,920
and that can pose a challenge for your

311
00:11:37,990 --> 00:11:35,920
downstream analysis of your samples

312
00:11:40,389 --> 00:11:38,000
because you have to have enough volume

313
00:11:42,470 --> 00:11:40,399

to get enough sample to be analyzed for

314
00:11:44,310 --> 00:11:42,480
both gene expression and virulence

315
00:11:46,150 --> 00:11:44,320
you obviously have to minimize mass

316
00:11:47,190 --> 00:11:46,160
because size constraints matter you want

317
00:11:49,509 --> 00:11:47,200
to fly

318
00:11:51,670 --> 00:11:49,519
as small of volumes as possible and

319
00:11:53,509 --> 00:11:51,680
power needs because most of the power

320
00:11:55,430 --> 00:11:53,519
has to go to run the shuttle

321
00:11:57,590 --> 00:11:55,440
so we were very fortunate that our

322
00:11:59,509 --> 00:11:57,600
experiments could fly just at ambient or

323
00:12:01,590 --> 00:11:59,519
room temperature and the bacterial cells

324
00:12:03,910 --> 00:12:01,600
would be fine and we actually had the

325
00:12:06,150 --> 00:12:03,920
astronauts performing manually our

326
00:12:07,750 --> 00:12:06,160
experiments for us so we didn't need the

327
00:12:11,030 --> 00:12:07,760
hardware to be

328
00:12:13,190 --> 00:12:11,040
as much of a power drain to the shuttle

329
00:12:15,030 --> 00:12:13,200
so what did we find from our spaceflight

330
00:12:16,710 --> 00:12:15,040
experiment with salmonella well we found

331
00:12:19,110 --> 00:12:16,720
that spaceflight uniquely increased the

332
00:12:21,190 --> 00:12:19,120
virulence of this pathogen and it also

333
00:12:23,509 --> 00:12:21,200
globally changed its gene expression

334
00:12:25,350 --> 00:12:23,519
profile and the unique part of the

335
00:12:27,430 --> 00:12:25,360
change in gene expression profile is

336
00:12:29,509 --> 00:12:27,440
that the genes that were being turned on

337
00:12:31,110 --> 00:12:29,519
and off weren't being turned on and off

338
00:12:32,949 --> 00:12:31,120

in a manner that would be consistent

339
00:12:34,710 --> 00:12:32,959
with salmonella actually being more

340
00:12:37,590 --> 00:12:34,720
virulent actually being able to cause

341
00:12:40,710 --> 00:12:37,600
disease better so what this taught us is

342
00:12:42,949 --> 00:12:40,720
that salmonella is causing disease in a

343
00:12:45,190 --> 00:12:42,959
different manner than we can detect when

344
00:12:47,509 --> 00:12:45,200
we grow it conventionally on ground when

345
00:12:49,509 --> 00:12:47,519
we fly at microgravity so greatly

346
00:12:51,110 --> 00:12:49,519
removing the force of gravity unveiled

347
00:12:59,030 --> 00:12:51,120
new ways that salmonella is causing

348
00:13:03,350 --> 00:13:00,949
so i'm one of those people who knew from

349
00:13:05,269 --> 00:13:03,360
day one i was going to be in biology and

350
00:13:06,790 --> 00:13:05,279
life sciences i knew it would be in

351
00:13:09,110 --> 00:13:06,800
biomedical research i just didn't know

352
00:13:10,949 --> 00:13:09,120
what end of it so my entire career

353
00:13:12,870 --> 00:13:10,959
training kind of guided me toward that

354
00:13:15,910 --> 00:13:12,880
trajectory so my undergraduate degree

355
00:13:18,629 --> 00:13:15,920
was in biology my master's genetics phd

356
00:13:20,629 --> 00:13:18,639
in microbiology postdoc in bacterial

357
00:13:22,710 --> 00:13:20,639
pathogenesis and that's where it really

358
00:13:25,030 --> 00:13:22,720
hit me the infectious disease world is

359
00:13:26,470 --> 00:13:25,040
where i was going to go i had no idea in

360
00:13:27,990 --> 00:13:26,480
a million years that i would get the

361
00:13:30,230 --> 00:13:28,000
privilege and opportunity to work with

362
00:13:32,710 --> 00:13:30,240
nasa and do space flight research as a

363
00:13:34,629 --> 00:13:32,720

way to help provide new solutions to

364
00:13:36,389 --> 00:13:34,639
outpace infectious diseases but i was

365
00:13:39,030 --> 00:13:36,399
very fortunate to have gone to graduate

366
00:13:41,030 --> 00:13:39,040
school with mark ott he went to nasa i

367
00:13:42,790 --> 00:13:41,040
took my first lab position in infectious

368
00:13:44,949 --> 00:13:42,800
diseases and vaccinology in my first

369
00:13:47,430 --> 00:13:44,959
faculty position and it's just taken off

370
00:13:49,590 --> 00:13:47,440
from there the most important thing you

371
00:13:51,590 --> 00:13:49,600
have to have is passion you find what

372
00:13:53,990 --> 00:13:51,600
you're passionate about you love it and

373
00:13:56,230 --> 00:13:54,000
you live it and you contribute in that

374
00:13:58,550 --> 00:13:56,240
manner to society

375
00:14:01,430 --> 00:13:58,560
in taking a look at a career path to

376
00:14:02,790 --> 00:14:01,440
make it to nasa there are a wide variety

377
00:14:04,710 --> 00:14:02,800
of options

378
00:14:07,189 --> 00:14:04,720
to get into something like microbiology

379
00:14:09,670 --> 00:14:07,199
and microbiology research a background

380
00:14:11,829 --> 00:14:09,680
in microbiology is important there are a

381
00:14:13,750 --> 00:14:11,839
lot of other majors that can do great

382
00:14:15,430 --> 00:14:13,760
contributions here degrees in

383
00:14:17,110 --> 00:14:15,440
biochemistry

384
00:14:19,750 --> 00:14:17,120
immunology

385
00:14:21,269 --> 00:14:19,760
looking at general biology

386
00:14:23,590 --> 00:14:21,279
engineering

387
00:14:25,670 --> 00:14:23,600
all have a way of joining in when we

388
00:14:28,470 --> 00:14:25,680

look at the space flight industry

389
00:14:29,509 --> 00:14:28,480
but remember first and foremost do what

390
00:14:31,670 --> 00:14:29,519
i did