1
00:00:09,190 --> 00:00:07,590
one of the new investigations delivered

2
00:00:12,070 --> 00:00:09,200
to the international space station by

3
00:00:14,709 --> 00:00:12,080
the recent dragon cargo ship is designed

4
00:00:17,189 --> 00:00:14,719
to improve our understanding of the risk

5
00:00:19,750 --> 00:00:17,199
of infections that long-duration space

6
00:00:20,870 --> 00:00:19,760
travelers face and it uses roundworms to

7
00:00:23,029 --> 00:00:20,880
do the work

8
00:00:25,269 --> 00:00:23,039
recently my colleague brandy dean spoke

9
00:00:27,509 --> 00:00:25,279
with dr cheryl nickerson a professor of

10
00:00:29,750 --> 00:00:27,519
life sciences with the biodesign

11
00:00:32,069 --> 00:00:29,760
institute at the arizona state

12
00:00:34,389 --> 00:00:32,079
university who is the principal

13
00:00:38,630 --> 00:00:34,399

investigator of the experiment known as

14
00:00:42,310 --> 00:00:39,990
cheryl why don't we start with what we

15
00:00:43,990 --> 00:00:42,320
know about how being in space affects an

16
00:00:46,549 --> 00:00:44,000
astronaut's immune system does it make

17
00:00:49,830 --> 00:00:46,559
it easier for them to get sick

18
00:00:52,229 --> 00:00:49,840
uh it might what we do know is that

19
00:00:54,150 --> 00:00:52,239
without question being in space and in

20
00:00:57,350 --> 00:00:54,160
microgravity definitely impacts the

21
00:00:59,110 --> 00:00:57,360
crew's immune system it blunts

22
00:01:00,869 --> 00:00:59,120
several aspects of their immune function

23
00:01:03,110 --> 00:01:00,879
so their immune systems don't work as

24
00:01:05,189 --> 00:01:03,120
well as they normally do on the ground

25
00:01:07,190 --> 00:01:05,199
we're still trying to learn more of the

26
00:01:08,950 --> 00:01:07,200
clinical details as to exactly why it

27
00:01:11,109 --> 00:01:08,960
happens but it's a fact that it does

28
00:01:12,550 --> 00:01:11,119
happen and you know that's a concern

29
00:01:14,469 --> 00:01:12,560
because even here on earth when our

30
00:01:16,230 --> 00:01:14,479
immune system doesn't work so well we're

31
00:01:17,990 --> 00:01:16,240
susceptible to a lot of different kinds

32
00:01:19,910 --> 00:01:18,000
of diseases most certainly including

33
00:01:22,230 --> 00:01:19,920
infectious diseases so

34
00:01:25,510 --> 00:01:22,240
we are we are interested in in

35
00:01:28,630 --> 00:01:25,520
understanding how space flight impacts

36
00:01:30,789 --> 00:01:28,640
the crew's ability to uh to acquire

37
00:01:33,109 --> 00:01:30,799
infectious diseases in flight

38
00:01:35,429 --> 00:01:33,119

and i understand that meanwhile um being

39
00:01:37,590 --> 00:01:35,439
in space can sometimes make the the

40
00:01:40,310 --> 00:01:37,600
diseases the microbes i guess um more

41
00:01:42,710 --> 00:01:40,320
virulent is that right as well

42
00:01:44,789 --> 00:01:42,720
well we have shown that for one pathogen

43
00:01:46,950 --> 00:01:44,799
and we have shown that for the major

44
00:01:49,350 --> 00:01:46,960
bacterial foodborne pathogen

45
00:01:51,910 --> 00:01:49,360
in the united states salmonella

46
00:01:53,270 --> 00:01:51,920
and uh that is the only pathogen for

47
00:01:55,749 --> 00:01:53,280
which an increased what we call

48
00:01:58,310 --> 00:01:55,759
virulence or disease-causing ability has

49
00:02:00,469 --> 00:01:58,320
actually been demonstrated in flight

50
00:02:02,950 --> 00:02:00,479
however we've profiled a number of other

51
00:02:05,429 --> 00:02:02,960
pathogens in flight and i can tell you

52
00:02:07,270 --> 00:02:05,439
that some of their properties change in

53
00:02:09,350 --> 00:02:07,280
a manner which suggests that they might

54
00:02:10,949 --> 00:02:09,360
be more problematic to the crew

55
00:02:14,070 --> 00:02:10,959
interesting and i guess that's what your

56
00:02:16,949 --> 00:02:14,080
study micro five looks at right

57
00:02:18,869 --> 00:02:16,959
yes so microfiber actually uh leveraged

58
00:02:21,030 --> 00:02:18,879
off of my lab's previous space flight

59
00:02:23,510 --> 00:02:21,040
research which was done on the shuttle

60
00:02:25,350 --> 00:02:23,520
uh wherein we studied the effect of

61
00:02:27,589 --> 00:02:25,360
space flight or microgravity on

62
00:02:29,910 --> 00:02:27,599
microbial pathogens and the infectious

63
00:02:32,390 --> 00:02:29,920

disease process and what's been very

64
00:02:34,830 --> 00:02:32,400
exciting to us is we've been able to use

65
00:02:37,670 --> 00:02:34,840
the microgravity platform to

66
00:02:40,150 --> 00:02:37,680
unveil or reveal new ways that pathogens

67
00:02:42,949 --> 00:02:40,160
like salmonella are actually causing

68
00:02:45,430 --> 00:02:42,959
disease in our own bodies and and we are

69
00:02:47,190 --> 00:02:45,440
able to uh use the microgravity platform

70
00:02:49,030 --> 00:02:47,200
to get this information because

71
00:02:50,550 --> 00:02:49,040
sometimes when we study these processes

72
00:02:52,710 --> 00:02:50,560
on earth

73
00:02:54,710 --> 00:02:52,720
the force of gravity can mask what the

74
00:02:56,470 --> 00:02:54,720
pathogen is doing when it infects us and

75
00:02:58,790 --> 00:02:56,480
what our body is doing and it responds

76
00:03:00,710 --> 00:02:58,800
to it so one of the really cool things

77
00:03:02,790 --> 00:03:00,720
to us in addition to having the

78
00:03:05,430 --> 00:03:02,800
opportunity to keep the crew healthy in

79
00:03:08,630 --> 00:03:05,440
flight our work is actually translating

80
00:03:10,790 --> 00:03:08,640
back down here on earth uh with our goal

81
00:03:12,710 --> 00:03:10,800
of developing new strategies to help

82
00:03:14,550 --> 00:03:12,720
keep us healthy and outpace infectious

83
00:03:16,470 --> 00:03:14,560
disease well tell us a little bit about

84
00:03:17,670 --> 00:03:16,480
how this experiment actually works in

85
00:03:20,630 --> 00:03:17,680
space

86
00:03:23,430 --> 00:03:20,640
sure i'd be happy to um so first of all

87
00:03:25,350 --> 00:03:23,440
the crew in space will set up the

88
00:03:26,789 --> 00:03:25,360

cameras so they can do imaging of our

89
00:03:27,910 --> 00:03:26,799
experiment but what they're going to do

90
00:03:30,789 --> 00:03:27,920
is they're going to activate the

91
00:03:33,190 --> 00:03:30,799
bacteria to grow salmonella to grow once

92
00:03:35,270 --> 00:03:33,200
it's grown uh for a certain period of

93
00:03:38,789 --> 00:03:35,280
time they will then infect the nematodes

94
00:03:40,309 --> 00:03:38,799
the host with that bacterium and then a

95
00:03:42,309 --> 00:03:40,319
portion of that experiment will be put

96
00:03:44,229 --> 00:03:42,319
under the video cameras for imaging

97
00:03:45,910 --> 00:03:44,239
we'll get that data in real time and

98
00:03:48,229 --> 00:03:45,920
then other portions of the experiment

99
00:03:51,030 --> 00:03:48,239
for gene expression and microscopy will

100
00:03:53,990 --> 00:03:51,040
be fixed uh in chemicals or frozen at

101
00:03:55,670 --> 00:03:54,000
different points at later points in time

102
00:03:57,670 --> 00:03:55,680
uh and then those samples will be

103
00:03:59,429 --> 00:03:57,680
analyzed when they get back and so i

104
00:04:01,030 --> 00:03:59,439
would really like to just quickly

105
00:04:03,190 --> 00:04:01,040
mention that it really does take a

106
00:04:04,550 --> 00:04:03,200
village to do this experiment it's been

107
00:04:06,789 --> 00:04:04,560
five years in the making we have

108
00:04:09,429 --> 00:04:06,799
phenomenal collaborators at every level

109
00:04:11,190 --> 00:04:09,439
at nasa nasa ames most certainly the

110
00:04:13,350 --> 00:04:11,200
johnson space center kennedy space

111
00:04:14,869 --> 00:04:13,360
center the university of chicago and oh

112
00:04:17,670 --> 00:04:14,879
my goodness

113
00:04:19,030 --> 00:04:17,680

uh orion's quest who who we have high

114
00:04:20,870 --> 00:04:19,040
school students they're helping us with

115
00:04:23,990 --> 00:04:20,880
some of our data and analyze it but

116
00:04:27,110 --> 00:04:24,000
especially to terry verts who has done

117
00:04:28,550 --> 00:04:27,120
such a phenomenal job as our amazing

118
00:04:30,310 --> 00:04:28,560
crew member who's done this work for us

119
00:04:32,870 --> 00:04:30,320
on orbit we've followed him we've been

120
00:04:34,950 --> 00:04:32,880
so excited i there's no one who could

121
00:04:37,510 --> 00:04:34,960
have done it better and without him we

122
00:04:39,350 --> 00:04:37,520
wouldn't have the work to analyze so

123
00:04:40,710 --> 00:04:39,360
my shout out and thank you to terry i'm

124
00:04:43,110 --> 00:04:40,720
going to tweet him when i get out of

125
00:04:45,909 --> 00:04:43,120
this but he's done a spectacular job so

126
00:04:47,270 --> 00:04:45,919
it's been a lot of work but a lot of fun

127
00:04:48,390 --> 00:04:47,280
you mentioned i think that you were

128
00:04:49,909 --> 00:04:48,400
going to be looking at countermeasures

129
00:04:51,749 --> 00:04:49,919
as well for sick astronauts can you tell

130
00:04:54,710 --> 00:04:51,759
us a little bit more about that

131
00:04:57,110 --> 00:04:54,720
uh sure i can it i want to

132
00:04:58,070 --> 00:04:57,120
kind of uh preface my comments with

133
00:05:01,110 --> 00:04:58,080
saying

134
00:05:03,029 --> 00:05:01,120
this is not necessarily um

135
00:05:04,629 --> 00:05:03,039
a direct countermeasure that would be

136
00:05:06,070 --> 00:05:04,639
used immediately

137
00:05:08,629 --> 00:05:06,080
but it could certainly lead us towards

138
00:05:10,550 --> 00:05:08,639

one so our previous work had had shown

139
00:05:12,710 --> 00:05:10,560
two things number one salmonella became

140
00:05:15,430 --> 00:05:12,720
a better pathogen in flight and on a

141
00:05:16,950 --> 00:05:15,440
follow-up experiment we reasoned we

142
00:05:18,790 --> 00:05:16,960
could come up with a way to turn off

143
00:05:20,629 --> 00:05:18,800
that increased disease-causing potential

144
00:05:21,990 --> 00:05:20,639
in flight which we were able to do and

145
00:05:23,430 --> 00:05:22,000
we were able to do that with the

146
00:05:24,550 --> 00:05:23,440
nutritional counter measure which

147
00:05:26,390 --> 00:05:24,560
contained

148
00:05:28,230 --> 00:05:26,400
several

149
00:05:30,469 --> 00:05:28,240
ions or metals like you'd see on the

150
00:05:32,629 --> 00:05:30,479
back of your vitamin bottle one of them

151
00:05:34,230 --> 00:05:32,639
was phosphate and we thought that

152
00:05:35,990 --> 00:05:34,240
phosphate actually might be one of the

153
00:05:37,590 --> 00:05:36,000
key reasons that we could turn off that

154
00:05:38,550 --> 00:05:37,600
increased disease-causing potential and

155
00:05:42,790 --> 00:05:38,560
flight

156
00:05:45,189 --> 00:05:42,800
so in this experiment we're actually uh

157
00:05:47,670 --> 00:05:45,199
in one of our samples when we infect the

158
00:05:51,189 --> 00:05:47,680
nematodes with salmonella we will have a

159
00:05:52,870 --> 00:05:51,199
phosphate ions in there

160
00:05:55,189 --> 00:05:52,880
and we will look to see if those

161
00:05:57,110 --> 00:05:55,199
phosphate ions can prevent the nematode

162
00:05:59,350 --> 00:05:57,120
from getting sick in the first place if

163
00:06:01,510 --> 00:05:59,360

it can then we've understood something

164
00:06:04,469 --> 00:06:01,520
very important about how

165
00:06:06,150 --> 00:06:04,479
uh salmonella causes disease in flight

166
00:06:08,390 --> 00:06:06,160
for the crew and that could potentially

167
00:06:10,550 --> 00:06:08,400
be something that could be added to

168
00:06:12,230 --> 00:06:10,560
their food as a way if salmonella

169
00:06:14,710 --> 00:06:12,240
actually actually accidentally got in

170
00:06:17,590 --> 00:06:14,720
their food it missed being detected

171
00:06:20,230 --> 00:06:17,600
to keep them safe and it could be

172
00:06:22,150 --> 00:06:20,240
of direct interest for how to keep food

173
00:06:24,309 --> 00:06:22,160
safe down here because we hear about

174
00:06:26,870 --> 00:06:24,319
salmonella recalls all the time you know

175
00:06:28,629 --> 00:06:26,880
in foods so maybe if salmonella got into

176
00:06:30,790 --> 00:06:28,639
the food but you had the right level of

177
00:06:32,469 --> 00:06:30,800
ions or phosphates in that processed

178
00:06:34,309 --> 00:06:32,479
food you might not have to worry about

179
00:06:37,909 --> 00:06:34,319
it so these are just examples of how we

180
00:06:40,070 --> 00:06:37,919
can hopefully help the crew and us be

181
00:06:41,909 --> 00:06:40,080
healthier on the ground this came up on

182
00:06:43,110 --> 00:06:41,919
the latest spacex i think so when when

183
00:06:45,830 --> 00:06:43,120
do you think you'll start getting some

184
00:06:46,870 --> 00:06:45,840
of the results back to the ground we are

185
00:06:48,790 --> 00:06:46,880
so there are three parts of the

186
00:06:50,309 --> 00:06:48,800
experiment some of the first part of the

187
00:06:51,990 --> 00:06:50,319
experiment we're already starting to get

188
00:06:54,790 --> 00:06:52,000

back so the first part of the experiment

189
00:06:57,430 --> 00:06:54,800
is is real-time profiling of the actual

190
00:07:00,710 --> 00:06:57,440
infection process from beginning to end

191
00:07:03,110 --> 00:07:00,720
and the first video started coming down

192
00:07:05,430 --> 00:07:03,120
uh the minute the very second almost the

193
00:07:06,870 --> 00:07:05,440
infection started okay and we're

194
00:07:09,029 --> 00:07:06,880
profiling that throughout the course of

195
00:07:11,029 --> 00:07:09,039
14 days we're getting a lot of real-time

196
00:07:12,629 --> 00:07:11,039
data coming down and we of course have

197
00:07:14,309 --> 00:07:12,639
to pair that compare that to our

198
00:07:15,589 --> 00:07:14,319
identical ground controls so we're

199
00:07:19,029 --> 00:07:15,599
already getting that part of the

200
00:07:21,510 --> 00:07:19,039
experiment down uh the other two parts

201
00:07:23,189 --> 00:07:21,520
of the experiment uh have to do with the

202
00:07:25,189 --> 00:07:23,199
fact that the astronauts have to process

203
00:07:27,110 --> 00:07:25,199
they have to freeze or fix the samples

204
00:07:29,670 --> 00:07:27,120
for us and those analyses can only be

205
00:07:30,469 --> 00:07:29,680
done back here in our labs at asu

206
00:07:32,469 --> 00:07:30,479
so

207
00:07:33,430 --> 00:07:32,479
one of those is to look at

208
00:07:35,350 --> 00:07:33,440
um

209
00:07:37,350 --> 00:07:35,360
the language that the pathogen and the

210
00:07:39,110 --> 00:07:37,360
host are using when they're infecting

211
00:07:41,430 --> 00:07:39,120
each other uh but well when the pathogen

212
00:07:43,189 --> 00:07:41,440
is infecting the host because um

213
00:07:44,950 --> 00:07:43,199

they talk to each other and i kind of

214
00:07:47,909 --> 00:07:44,960
view the infection process as a high

215
00:07:49,510 --> 00:07:47,919
risk poker game right you get infected

216
00:07:51,510 --> 00:07:49,520
and your body has a response the

217
00:07:53,110 --> 00:07:51,520
pathogen comes back and counters that

218
00:07:55,029 --> 00:07:53,120
and you keep countering one another and

219
00:07:57,589 --> 00:07:55,039
if you have a functional and you know

220
00:07:59,830 --> 00:07:57,599
healthy immune system you usually win

221
00:08:02,230 --> 00:07:59,840
but you don't always win all the time

222
00:08:04,070 --> 00:08:02,240
and so we want to understand that that

223
00:08:05,990 --> 00:08:04,080
language between the two of them at a

224
00:08:08,070 --> 00:08:06,000
molecular level and an immune response

225
00:08:09,909 --> 00:08:08,080
level so those kinds of studies will be

226
00:08:12,390 --> 00:08:09,919
done on the ground back in my lab and

227
00:08:14,390 --> 00:08:12,400
then we're also going to look inside the

228
00:08:16,629 --> 00:08:14,400
worm with microscopes

229
00:08:18,469 --> 00:08:16,639
to find out where those pathogens are

230
00:08:20,230 --> 00:08:18,479
getting inside the worm in flight and

231
00:08:21,749 --> 00:08:20,240
how they differ with where they get when

232
00:08:23,990 --> 00:08:21,759
we do the experiment identically on the

233
00:08:27,270 --> 00:08:24,000
ground so we want to put together all of

234
00:08:30,150 --> 00:08:27,280
this information to better understand at

235
00:08:31,990 --> 00:08:30,160
a mechanistic level why we would see the

236
00:08:33,430 --> 00:08:32,000
difference that we hope we'll see in

237
00:08:36,070 --> 00:08:33,440
flight with the infection profile

238
00:08:38,709 --> 00:08:36,080

because that would allow us to then take

239
00:08:41,509 --> 00:08:38,719
that information and and and go towards

240
00:08:42,949 --> 00:08:41,519
uh some translational approaches

241
00:08:44,470 --> 00:08:42,959
well it all sounds very interesting we

242
00:08:46,070 --> 00:08:44,480
can't wait to hear how it goes in space

243
00:08:47,670 --> 00:08:46,080
and eventually see the results here on

244
00:08:49,509 --> 00:08:47,680
the ground thanks so much again for

245
00:08:51,590 --> 00:08:49,519
joining us cheryl nickerson is the

246
00:08:53,910 --> 00:08:51,600
professor of life sciences at the