1
00:00:06,869 --> 00:00:04,789
hi i'm kelly humphries here at the nasa

2
00:00:09,430 --> 00:00:06,879
johnson space center in the immunology

3
00:00:10,790 --> 00:00:09,440
lab with brian crushin brian's a nasa

4
00:00:12,470 --> 00:00:10,800
immunologist and he's looking at

5
00:00:14,390 --> 00:00:12,480
astronauts in space

6
00:00:16,710 --> 00:00:14,400
can you tell us what the issues are with

7
00:00:18,230 --> 00:00:16,720
space flight and the immune system

8
00:00:20,150 --> 00:00:18,240
it's a good question

9
00:00:21,670 --> 00:00:20,160
the human immune system is altered

10
00:00:23,269 --> 00:00:21,680
during space flight

11
00:00:25,029 --> 00:00:23,279
we're unsure of exactly what the nature

12
00:00:26,550 --> 00:00:25,039
of that change is though

13
00:00:28,230 --> 00:00:26,560

people have been looking at the immune

14
00:00:30,150 --> 00:00:28,240
system regarding space flight for

15
00:00:31,910 --> 00:00:30,160
decades but the vast majority of those

16
00:00:33,350 --> 00:00:31,920
have been post flight studies and

17
00:00:35,430 --> 00:00:33,360
collecting samples and looking at this

18
00:00:37,350 --> 00:00:35,440
in astronauts after flight doesn't

19
00:00:39,750 --> 00:00:37,360
necessarily tell you the status of the

20
00:00:41,670 --> 00:00:39,760
immune system during flight

21
00:00:43,270 --> 00:00:41,680
re-entry is a tremendous physio

22
00:00:45,670 --> 00:00:43,280
physiological stress on the body

23
00:00:47,430 --> 00:00:45,680
re-adaptation to gravity so we've been

24
00:00:49,190 --> 00:00:47,440
the community has been waiting for a

25
00:00:51,029 --> 00:00:49,200
research platform such as the space

26
00:00:53,029 --> 00:00:51,039
station that affords us the opportunity

27
00:00:55,270 --> 00:00:53,039
to examine this type of physiological

28
00:00:56,470 --> 00:00:55,280
question during space flight

29
00:00:58,150 --> 00:00:56,480
so

30
00:01:00,310 --> 00:00:58,160
do you know what causes this change in

31
00:01:02,150 --> 00:01:00,320
the immune system yet

32
00:01:03,910 --> 00:01:02,160
that's another good question

33
00:01:05,750 --> 00:01:03,920
uh there are multiple factors that can

34
00:01:07,990 --> 00:01:05,760
influence the immune system during space

35
00:01:09,830 --> 00:01:08,000
flight uh radiation the most sensitive

36
00:01:12,310 --> 00:01:09,840
cells to radiation in the body are the

37
00:01:15,190 --> 00:01:12,320
immune precursors in the bone marrow

38
00:01:16,789 --> 00:01:15,200

also microgravity itself may affect how

39
00:01:17,990 --> 00:01:16,799
immune cells activate and perform their

40
00:01:20,070 --> 00:01:18,000
functions

41
00:01:22,550 --> 00:01:20,080
but also physiological stress

42
00:01:24,149 --> 00:01:22,560
confinement isolation disrupted

43
00:01:26,230 --> 00:01:24,159
circadian rhythms all have the potential

44
00:01:27,830 --> 00:01:26,240
to influence the immune system so we we

45
00:01:29,510 --> 00:01:27,840
generally consider

46
00:01:31,350 --> 00:01:29,520
it being a problem of how is the immune

47
00:01:32,469 --> 00:01:31,360
system during space flight and and not

48
00:01:34,069 --> 00:01:32,479
necessarily

49
00:01:35,990 --> 00:01:34,079
in response to any of those specific

50
00:01:37,429 --> 00:01:36,000
variables okay well what kind of

51
00:01:39,510 --> 00:01:37,439
equipment do we have on board the space

52
00:01:41,510 --> 00:01:39,520
station the astronauts use to

53
00:01:43,749 --> 00:01:41,520
get the samples you need well for our

54
00:01:45,429 --> 00:01:43,759
study we collect blood

55
00:01:47,030 --> 00:01:45,439
samples from the astronauts during space

56
00:01:49,350 --> 00:01:47,040
flight and we return them to the ground

57
00:01:51,190 --> 00:01:49,360
for analysis

58
00:01:52,950 --> 00:01:51,200
much as you might go to your doctor's

59
00:01:54,230 --> 00:01:52,960
office and and give a sample that's

60
00:01:55,830 --> 00:01:54,240
collected in your doctor's office and

61
00:01:57,429 --> 00:01:55,840
it's sent to the reference lab or the

62
00:01:58,870 --> 00:01:57,439
reference lab for the space station for

63
00:02:00,069 --> 00:01:58,880

this study

64
00:02:01,429 --> 00:02:00,079
what's unique about our blood

65
00:02:03,670 --> 00:02:01,439
collections is

66
00:02:05,749 --> 00:02:03,680
most blood collections on orbit are

67
00:02:07,990 --> 00:02:05,759
frozen for

68
00:02:09,910 --> 00:02:08,000
frozen return to earth and analysis

69
00:02:11,990 --> 00:02:09,920
because we need live immune cells to

70
00:02:13,510 --> 00:02:12,000
gauge their functional capacity we need

71
00:02:15,990 --> 00:02:13,520
to collect our samples

72
00:02:17,750 --> 00:02:16,000
during docked operations of some vehicle

73
00:02:19,110 --> 00:02:17,760
and then right before hatch closure and

74
00:02:22,630 --> 00:02:19,120
undocking of that vehicle so they can

75
00:02:24,790 --> 00:02:22,640
return our samples so if it's soyuz or

76
00:02:26,229 --> 00:02:24,800
the shuttle when we had the shuttle

77
00:02:27,589 --> 00:02:26,239
we would collect our samples just before

78
00:02:28,869 --> 00:02:27,599
hatch closure they would bring the

79
00:02:30,550 --> 00:02:28,879
samples to us

80
00:02:32,390 --> 00:02:30,560
we collect them in special types of

81
00:02:34,949 --> 00:02:32,400
tubes that maintain their viability for

82
00:02:36,390 --> 00:02:34,959
48 to 72 hours and that gets us a nice

83
00:02:39,430 --> 00:02:36,400
live sample that we can analyze in the

84
00:02:41,509 --> 00:02:39,440
laboratory here at jsc can you tell us

85
00:02:42,390 --> 00:02:41,519
what you use to collect blood samples on

86
00:02:43,990 --> 00:02:42,400
orbit

87
00:02:45,430 --> 00:02:44,000
sure we we have a blood sample

88
00:02:46,470 --> 00:02:45,440

collection kit that was designed for

89
00:02:47,990 --> 00:02:46,480
this study

90
00:02:49,830 --> 00:02:48,000
i have a training unit here i can show

91
00:02:52,869 --> 00:02:49,840
you

92
00:02:55,430 --> 00:02:52,879
lot of velcro velcro is a very handy

93
00:02:57,830 --> 00:02:55,440
thing to have on orbit for first

94
00:03:00,070 --> 00:02:57,840
deploying your your kit and keeping all

95
00:03:01,990 --> 00:03:00,080
the items uh readily available in front

96
00:03:04,070 --> 00:03:02,000
of you it has most of the components you

97
00:03:07,430 --> 00:03:04,080
might expect

98
00:03:10,070 --> 00:03:07,440
needles gloves tourniquet band-aids

99
00:03:11,910 --> 00:03:10,080
also we especially collect our blood

100
00:03:14,390 --> 00:03:11,920
samples in these padded tubes to protect

101
00:03:16,309 --> 00:03:14,400
them for for landing re-entry

102
00:03:18,229 --> 00:03:16,319
we collect our samples

103
00:03:19,910 --> 00:03:18,239
in two types of tubes both

104
00:03:22,869 --> 00:03:19,920
anticoagulated to prevent the blood from

105
00:03:25,190 --> 00:03:22,879
clotting a purple top tube and a yellow

106
00:03:27,750 --> 00:03:25,200
tube which actually contains nutrients

107
00:03:29,990 --> 00:03:27,760
to keep the cells alive for 48 to 72

108
00:03:32,710 --> 00:03:30,000
hours so we can get those live cells

109
00:03:34,149 --> 00:03:32,720
back to the laboratory for analysis

110
00:03:35,830 --> 00:03:34,159
those look a lot like the tubes that

111
00:03:38,229 --> 00:03:35,840
they put my blood into when i go to the

112
00:03:40,949 --> 00:03:38,239
doctor is it harder to take blood in

113
00:03:42,630 --> 00:03:40,959

microgravity than it is on the earth

114
00:03:45,350 --> 00:03:42,640
actually we didn't know that starting

115
00:03:47,270 --> 00:03:45,360
the study but it turns out that it is

116
00:03:48,949 --> 00:03:47,280
when you collect samples blood samples

117
00:03:50,630 --> 00:03:48,959
on the ground if you picture how this

118
00:03:53,589 --> 00:03:50,640
might work in your doctor's office they

119
00:03:55,509 --> 00:03:53,599
fill the tube and the tube fills

120
00:03:57,750 --> 00:03:55,519
from the bottom to the top we cheat when

121
00:03:59,190 --> 00:03:57,760
we have gravity available to us in space

122
00:04:01,110 --> 00:03:59,200
you lose that

123
00:04:03,830 --> 00:04:01,120
ability to gauge when the tube is full

124
00:04:06,070 --> 00:04:03,840
and kind of fills the tube all at once

125
00:04:07,830 --> 00:04:06,080
and foams into the tube so what was

126
00:04:09,509 --> 00:04:07,840
happening in the early part of the study

127
00:04:11,190 --> 00:04:09,519
is we were getting samples that were not

128
00:04:12,470 --> 00:04:11,200
quite filled all the way until we

129
00:04:14,789 --> 00:04:12,480
learned what was happening we had some

130
00:04:16,710 --> 00:04:14,799
nice on orbit video collected by the

131
00:04:18,710 --> 00:04:16,720
crew members sent to us that helped us

132
00:04:20,789 --> 00:04:18,720
determine what was going on and now we

133
00:04:21,749 --> 00:04:20,799
simply time the collections to make sure

134
00:04:23,830 --> 00:04:21,759
we have a

135
00:04:24,950 --> 00:04:23,840
completely full sample so you mentioned

136
00:04:27,110 --> 00:04:24,960
that

137
00:04:28,790 --> 00:04:27,120
there are changes in the immune system

138
00:04:30,790 --> 00:04:28,800

that might not be a big problem on the

139
00:04:32,790 --> 00:04:30,800
space station close to home but would be

140
00:04:34,390 --> 00:04:32,800
a big problem if you're on your way to

141
00:04:36,070 --> 00:04:34,400
mars or something on a long duration

142
00:04:37,590 --> 00:04:36,080
flight why is that

143
00:04:40,310 --> 00:04:37,600
you've characterized it perfectly

144
00:04:41,749 --> 00:04:40,320
basically we see immune changes during

145
00:04:44,230 --> 00:04:41,759
space flight

146
00:04:45,670 --> 00:04:44,240
we see it maintaining itself for six

147
00:04:46,950 --> 00:04:45,680
months during low earth orbital flight

148
00:04:49,270 --> 00:04:46,960
but that doesn't necessarily mean crew

149
00:04:51,189 --> 00:04:49,280
members are sick it means we're seeing

150
00:04:52,790 --> 00:04:51,199
transient immune changes and we all

151
00:04:54,469 --> 00:04:52,800
experience those

152
00:04:56,550 --> 00:04:54,479
periodically on the ground

153
00:04:58,230 --> 00:04:56,560
but we during uh

154
00:05:00,390 --> 00:04:58,240
flight on the space station

155
00:05:02,469 --> 00:05:00,400
we don't really see that progress uh to

156
00:05:04,710 --> 00:05:02,479
to a very high level to clinical disease

157
00:05:06,629 --> 00:05:04,720
uh so it's an interesting phenomenon

158
00:05:07,990 --> 00:05:06,639
what we're concerned about is how the

159
00:05:10,230 --> 00:05:08,000
environment will change during an

160
00:05:12,150 --> 00:05:10,240
exploration class mission if you're in a

161
00:05:14,950 --> 00:05:12,160
smaller vehicle for three years at a

162
00:05:16,870 --> 00:05:14,960
time on your way to mars or an asteroid

163
00:05:19,110 --> 00:05:16,880

the situation is dramatically changed

164
00:05:21,430 --> 00:05:19,120
the radiation environment is elevated

165
00:05:23,430 --> 00:05:21,440
you have more limited clinical care you

166
00:05:25,590 --> 00:05:23,440
don't have a return option anymore so

167
00:05:27,110 --> 00:05:25,600
these things that were minor problems

168
00:05:28,870 --> 00:05:27,120
potentially minor medical problems on

169
00:05:31,430 --> 00:05:28,880
the space station could become much more

170
00:05:34,310 --> 00:05:31,440
serious in that environment

171
00:05:35,270 --> 00:05:34,320
specific adverse clinical events

172
00:05:36,870 --> 00:05:35,280
could include things like

173
00:05:40,710 --> 00:05:36,880
hypersensitivities

174
00:05:42,310 --> 00:05:40,720
allergic responses infectious disease

175
00:05:44,310 --> 00:05:42,320
and that type of thing

176
00:05:46,150 --> 00:05:44,320
so brian you do a lot of analysis in the

177
00:05:47,990 --> 00:05:46,160
lab of that blood that you bring down

178
00:05:49,189 --> 00:05:48,000
from the space station can you show us a

179
00:05:51,110 --> 00:05:49,199
little bit about that here on your

180
00:05:51,990 --> 00:05:51,120
computer and what you're looking at here

181
00:05:54,550 --> 00:05:52,000
on these

182
00:05:56,230 --> 00:05:54,560
in these uh readings sure basically this

183
00:05:58,309 --> 00:05:56,240
is a flow cytometer

184
00:05:59,670 --> 00:05:58,319
it has a laser we shine that on the

185
00:06:01,830 --> 00:05:59,680
cells as we pass them in front of the

186
00:06:03,830 --> 00:06:01,840
laser beam it scatters light we can also

187
00:06:05,110 --> 00:06:03,840
stain the cells with various dyes that

188
00:06:07,110 --> 00:06:05,120

allows us to separate them out into

189
00:06:09,350 --> 00:06:07,120
populations and identify them

190
00:06:10,790 --> 00:06:09,360
we do two types of assays assays that

191
00:06:12,070 --> 00:06:10,800
look at the distribution of the immune

192
00:06:13,590 --> 00:06:12,080
cells in the blood

193
00:06:15,670 --> 00:06:13,600
that's very similar to if you went to

194
00:06:18,309 --> 00:06:15,680
the physician and he drew a tube and

195
00:06:20,870 --> 00:06:18,319
ordered a complete blood count or a cbc

196
00:06:23,110 --> 00:06:20,880
that looks at at a very high level

197
00:06:25,189 --> 00:06:23,120
certain bulk populations by staining

198
00:06:26,469 --> 00:06:25,199
them with various dyes we're able to

199
00:06:29,029 --> 00:06:26,479
resolve

200
00:06:30,550 --> 00:06:29,039
many more different subsets of subsets

201
00:06:31,990 --> 00:06:30,560
of immune cells

202
00:06:33,909 --> 00:06:32,000
so when we look at the distribution of

203
00:06:35,909 --> 00:06:33,919
those in your body right now it tells us

204
00:06:38,309 --> 00:06:35,919
a little bit about any pathology you may

205
00:06:40,550 --> 00:06:38,319
be experiencing today

206
00:06:42,550 --> 00:06:40,560
second aspect of the analysis is to take

207
00:06:43,749 --> 00:06:42,560
those cells and culture them in the

208
00:06:45,430 --> 00:06:43,759
laboratory

209
00:06:47,189 --> 00:06:45,440
pulse them with various chemicals to

210
00:06:49,110 --> 00:06:47,199
stimulate them and simulate an immune

211
00:06:51,189 --> 00:06:49,120
response in the test tube then we can

212
00:06:52,550 --> 00:06:51,199
look at their functional capacity so

213
00:06:54,469 --> 00:06:52,560

once one hand we're looking at the

214
00:06:55,510 --> 00:06:54,479
distribution and their numbers on the

215
00:06:57,189 --> 00:06:55,520
other hand we're looking at their

216
00:06:59,189 --> 00:06:57,199
functional capacity or whether they're

217
00:07:00,629 --> 00:06:59,199
working well or not

218
00:07:02,629 --> 00:07:00,639
where all these little dots and boxes

219
00:07:04,790 --> 00:07:02,639
here well these are typical flow

220
00:07:06,550 --> 00:07:04,800
cytometry scatter plots basically we'll

221
00:07:08,150 --> 00:07:06,560
we'll stain the cells in a test tube

222
00:07:09,749 --> 00:07:08,160
load it onto the machine

223
00:07:11,430 --> 00:07:09,759
pass it through the machine and we can

224
00:07:13,909 --> 00:07:11,440
plot any of these parameters against

225
00:07:16,790 --> 00:07:13,919
each other each dot is a cell so we'll

226
00:07:18,710 --> 00:07:16,800
collect 10 000 cells or or so and will

227
00:07:20,550 --> 00:07:18,720
resolve various populations and then

228
00:07:22,710 --> 00:07:20,560
that's how we're able to count them so

229
00:07:24,710 --> 00:07:22,720
here we've resolved t cells and then we

230
00:07:27,430 --> 00:07:24,720
can take the t cells and separate them

231
00:07:29,749 --> 00:07:27,440
into cd4 cd positive subsets then we can

232
00:07:32,309 --> 00:07:29,759
take the cd8 positive subsets further

233
00:07:35,430 --> 00:07:32,319
separate that out into naive cells

234
00:07:37,510 --> 00:07:35,440
active cytotoxic cells or or aged immune

235
00:07:39,670 --> 00:07:37,520
cells and that's how we

236
00:07:41,189 --> 00:07:39,680
use this uh instrument to look at the

237
00:07:42,950 --> 00:07:41,199
distribution of the cells in the blood

238
00:07:44,869 --> 00:07:42,960

so brian krusian thank you very much for

239
00:07:46,869 --> 00:07:44,879
having us here in the nasa immunology

240
00:07:48,550 --> 00:07:46,879
lab uh we really appreciate you showing

241
00:07:50,550 --> 00:07:48,560
us around it's a pleasure having you

242
00:07:51,749 --> 00:07:50,560
stop by anytime great thanks a whole lot