
PAO

1
00:00:05,829 --> 00:00:03,669
hey everybody this is dan hewitt here in

2
00:00:07,190 --> 00:00:05,839
mission control houston i'm joined by dr

3
00:00:09,750 --> 00:00:07,200
tara rutley

4
00:00:11,430 --> 00:00:09,760
and uh this this is mission control

5
00:00:13,110 --> 00:00:11,440
you're joining us here now

6
00:00:14,390 --> 00:00:13,120
this is where we fly the international

7
00:00:16,150 --> 00:00:14,400
space station this is where all the

8
00:00:17,830 --> 00:00:16,160
flight controllers are monitoring

9
00:00:19,510 --> 00:00:17,840
everything that's going on on board as

10
00:00:21,510 --> 00:00:19,520
our astronauts are hard at work on

11
00:00:24,230 --> 00:00:21,520
maintenance and experiments and all

12
00:00:26,870 --> 00:00:24,240
kinds of things while they're flying 17

13
00:00:28,070 --> 00:00:26,880

500 miles an hour so welcome inside of

14
00:00:29,990 --> 00:00:28,080
mission control it's really great to

15
00:00:31,830 --> 00:00:30,000
have everybody here

16
00:00:33,430 --> 00:00:31,840
tara and i are really excited to take

17
00:00:38,310 --> 00:00:33,440
some of your questions so why don't we

18
00:00:41,990 --> 00:00:39,670
thank you

19
00:00:43,910 --> 00:00:42,000
did you want to take our questions now

20
00:00:46,069 --> 00:00:43,920
yeah we would love to take any questions

21
00:00:48,869 --> 00:00:46,079
you guys have right now

22
00:00:51,510 --> 00:00:48,879
okay so you did not want to brief us on

23
00:00:53,510 --> 00:00:51,520
anything right now we have time we have

24
00:00:55,510 --> 00:00:53,520
lots of questions so

25
00:00:57,110 --> 00:00:55,520
that's what you're telling us to do yep

26
00:00:58,709 --> 00:00:57,120
you got lots of questions we want to get

27
00:01:02,310 --> 00:00:58,719
them all

28
00:01:06,630 --> 00:01:04,549
hello my name is sebastian

29
00:01:08,230 --> 00:01:06,640
thank you for taking my question what

30
00:01:10,630 --> 00:01:08,240
types of science experiments are the

31
00:01:12,469 --> 00:01:10,640
astronauts working on in space

32
00:01:14,149 --> 00:01:12,479
ah very good question that's the best

33
00:01:16,630 --> 00:01:14,159
question because that's what i really

34
00:01:18,630 --> 00:01:16,640
love to talk about the most um

35
00:01:20,630 --> 00:01:18,640
right now they're on space station right

36
00:01:23,030 --> 00:01:20,640
and they do all kinds of science

37
00:01:24,710 --> 00:01:23,040
experiments if you can think about if

38
00:01:26,469 --> 00:01:24,720

you've ever participated in a science

39
00:01:27,350 --> 00:01:26,479
fair and you've done your science

40
00:01:29,510 --> 00:01:27,360
project

41
00:01:31,429 --> 00:01:29,520
imagine what might happen if you take

42
00:01:35,190 --> 00:01:31,439
gravity out of everything that you've

43
00:01:37,190 --> 00:01:35,200
done so imagine creating any kind of

44
00:01:38,870 --> 00:01:37,200
experiment that you could do here on

45
00:01:41,190 --> 00:01:38,880
earth but what would happen when you

46
00:01:43,350 --> 00:01:41,200
take gravity away and so more fun

47
00:01:45,030 --> 00:01:43,360
problems would be a lot more fun

48
00:01:46,710 --> 00:01:45,040
would be much more fun than what i did

49
00:01:49,510 --> 00:01:46,720
as a as a student in my science fair

50
00:01:51,109 --> 00:01:49,520
days but um so what they do and and the

51
00:01:53,109 --> 00:01:51,119
number one coolest thing i think that

52
00:01:55,830 --> 00:01:53,119
they work on is the human research they

53
00:01:58,149 --> 00:01:55,840
they test their own bodies

54
00:02:00,469 --> 00:01:58,159
for changes that occur in microgravity

55
00:02:01,990 --> 00:02:00,479
or as a result of staying in space

56
00:02:03,910 --> 00:02:02,000
where things are just different there's

57
00:02:06,550 --> 00:02:03,920
no gravity if you think about how our

58
00:02:09,029 --> 00:02:06,560
body is designed we have bones and

59
00:02:10,949 --> 00:02:09,039
muscles for a reason that's to keep us

60
00:02:13,030 --> 00:02:10,959
upright against that gravity vector on

61
00:02:14,309 --> 00:02:13,040
earth but when you get out into space

62
00:02:16,790 --> 00:02:14,319
you don't have that gravity vector

63
00:02:19,190 --> 00:02:16,800

anymore so what they're finding is that

64
00:02:21,350 --> 00:02:19,200
our bones start to shrink i mean i'm

65
00:02:23,110 --> 00:02:21,360
sorry our bones start to get weaker our

66
00:02:25,350 --> 00:02:23,120
muscles start to shrink

67
00:02:26,470 --> 00:02:25,360
and so that's just that's just one

68
00:02:29,350 --> 00:02:26,480
example of some of the changes that

69
00:02:31,030 --> 00:02:29,360
happen in the body but our heart changes

70
00:02:32,070 --> 00:02:31,040
size because it's pumping fluids

71
00:02:34,229 --> 00:02:32,080
differently

72
00:02:36,070 --> 00:02:34,239
so any system in the human body you can

73
00:02:37,430 --> 00:02:36,080
think of they're doing experiments to

74
00:02:40,150 --> 00:02:37,440
figure out what's going on with the

75
00:02:42,150 --> 00:02:40,160
changes in space not just human

76
00:02:44,869 --> 00:02:42,160
physiology though they're also doing

77
00:02:47,190 --> 00:02:44,879
some basic physics work looking at how

78
00:02:49,030 --> 00:02:47,200
fluid behaves differently without

79
00:02:51,030 --> 00:02:49,040
without the gravity vector you know the

80
00:02:53,509 --> 00:02:51,040
way that fluid behaves here on earth

81
00:02:55,350 --> 00:02:53,519
again that gravity vector drives a lot

82
00:02:57,110 --> 00:02:55,360
of how we drink out of a cup how we

83
00:02:58,869 --> 00:02:57,120
water our plants and how the plants will

84
00:03:01,110 --> 00:02:58,879
take up that water

85
00:03:03,430 --> 00:03:01,120
so it's different in space where we need

86
00:03:06,550 --> 00:03:03,440
water systems we need to understand how

87
00:03:09,589 --> 00:03:06,560
water behaves in space water tends to

88
00:03:10,869 --> 00:03:09,599

climb the walls of the of the containers

89
00:03:12,710 --> 00:03:10,879
that they're in and that's called

90
00:03:14,470 --> 00:03:12,720
capillary action and that happens on

91
00:03:15,350 --> 00:03:14,480
earth but in space it's much more

92
00:03:17,270 --> 00:03:15,360
pronounced because you don't have

93
00:03:18,949 --> 00:03:17,280
gravity pulling the liquid back down so

94
00:03:20,710 --> 00:03:18,959
we're trying to figure out um what

95
00:03:22,229 --> 00:03:20,720
happens to the fluids and and it's

96
00:03:24,149 --> 00:03:22,239
important for when you're creating

97
00:03:26,869 --> 00:03:24,159
things like propellant

98
00:03:28,390 --> 00:03:26,879
and water recycling systems

99
00:03:30,070 --> 00:03:28,400
and anything that has to do with any

100
00:03:31,430 --> 00:03:30,080
kind of fluid in space and we learned

101
00:03:33,190 --> 00:03:31,440
much about how

102
00:03:34,710 --> 00:03:33,200
what happens in space we can apply it to

103
00:03:36,550 --> 00:03:34,720
earth and better ways to water our

104
00:03:38,789 --> 00:03:36,560
plants and things like that

105
00:03:40,550 --> 00:03:38,799
they also there's investigations that

106
00:03:43,030 --> 00:03:40,560
are looking and taking images of the

107
00:03:45,670 --> 00:03:43,040
earth and of the space sky to look at

108
00:03:46,390 --> 00:03:45,680
changes in cosmic rays

109
00:03:49,990 --> 00:03:46,400
there

110
00:03:52,710 --> 00:03:50,000
are looking at how

111
00:03:54,470 --> 00:03:52,720
bacteria and viruses behave because they

112
00:03:56,630 --> 00:03:54,480
behave very differently which has an

113
00:03:58,789 --> 00:03:56,640

impact on our crew but it also tells us

114
00:04:01,910 --> 00:03:58,799
something about how they how the the

115
00:04:05,509 --> 00:04:01,920
bugs treat us here on earth as well so i

116
00:04:07,030 --> 00:04:05,519
think just about every kind of uh

117
00:04:08,470 --> 00:04:07,040
every kind of discipline you can think

118
00:04:10,630 --> 00:04:08,480
of if you have an interest in any kind

119
00:04:12,309 --> 00:04:10,640
of science or engineering you could

120
00:04:13,670 --> 00:04:12,319
probably come up with any kind of

121
00:04:15,350 --> 00:04:13,680
thoughtful experiment that they are

122
00:04:16,069 --> 00:04:15,360
probably covering on space station right

123
00:04:18,870 --> 00:04:16,079
now

124
00:04:21,430 --> 00:04:18,880
okay definitely tara's favorite question

125
00:04:23,590 --> 00:04:21,440
all right let's move on to the next one

126
00:04:25,909 --> 00:04:23,600
thank you so much could i get both of

127
00:04:27,749 --> 00:04:25,919
your names we have some media in here

128
00:04:29,990 --> 00:04:27,759
with us and we'd like to share your

129
00:04:32,870 --> 00:04:30,000
names with our media so could i get both

130
00:04:35,189 --> 00:04:32,880
of your names yeah sure i'm dan hewitt

131
00:04:40,150 --> 00:04:35,199
h-u-o-t

132
00:04:45,110 --> 00:04:42,950
oh and your name tara uh-huh there it is

133
00:04:46,310 --> 00:04:45,120
yeah on the screen are you ttt ellie

134
00:05:03,670 --> 00:04:46,320
okay

135
00:05:07,029 --> 00:05:05,430
hi my name is amariah mitchell thank you

136
00:05:08,550 --> 00:05:07,039
for taking my question

137
00:05:10,790 --> 00:05:08,560
are there plans to take other

138
00:05:13,350 --> 00:05:10,800

vertebrates with the astronauts and

139
00:05:15,110 --> 00:05:13,360
colonizing another planet

140
00:05:16,870 --> 00:05:15,120
i didn't quite catch that question did

141
00:05:19,909 --> 00:05:16,880
you are they going to take what with

142
00:05:23,029 --> 00:05:20,870
a little bit

143
00:05:26,469 --> 00:05:23,039
gotta be loud you did it great you just

144
00:05:29,749 --> 00:05:28,310
are there plans to take other

145
00:05:32,310 --> 00:05:29,759
vertebrates

146
00:05:34,230 --> 00:05:32,320
when the astronauts

147
00:05:35,909 --> 00:05:34,240
with the astronauts when colonizing

148
00:05:37,590 --> 00:05:35,919
another planet

149
00:05:39,270 --> 00:05:37,600
oh are there plans to take other

150
00:05:41,350 --> 00:05:39,280
vertebrates when the astronauts go to

151
00:05:43,270 --> 00:05:41,360
colonize other planets uh you know what

152
00:05:44,870 --> 00:05:43,280
that's a really good question i think

153
00:05:47,270 --> 00:05:44,880
the only way to find out if that's

154
00:05:49,350 --> 00:05:47,280
really necessary or what we might learn

155
00:05:51,350 --> 00:05:49,360
from doing that is to try it out on the

156
00:05:52,629 --> 00:05:51,360
space station first we don't know a

157
00:05:54,150 --> 00:05:52,639
whole lot about

158
00:05:56,870 --> 00:05:54,160
how vertebrates

159
00:05:58,629 --> 00:05:56,880
function in space and so before we would

160
00:06:00,950 --> 00:05:58,639
take them or figure out how we would use

161
00:06:03,189 --> 00:06:00,960
them on a planet we'd want to figure out

162
00:06:04,469 --> 00:06:03,199
how they even behave and react in space

163
00:06:06,550 --> 00:06:04,479

first but that's a really good and

164
00:06:08,550 --> 00:06:06,560
thought thought provoking question and

165
00:06:10,309 --> 00:06:08,560
we have had a couple of different types

166
00:06:12,790 --> 00:06:10,319
of animals already onboard the station

167
00:06:14,710 --> 00:06:12,800
we just had a couple of spiders return

168
00:06:16,710 --> 00:06:14,720
fairly recently from a trip on board the

169
00:06:19,110 --> 00:06:16,720
station and they were able to adapt to

170
00:06:21,430 --> 00:06:19,120
microgravity and spin webs and actually

171
00:06:22,870 --> 00:06:21,440
adapted really quite well once they were

172
00:06:24,710 --> 00:06:22,880
up there and actually we also have

173
00:06:27,270 --> 00:06:24,720
another experiment going on right now

174
00:06:30,070 --> 00:06:27,280
where we have a bunch of tiny fish in a

175
00:06:32,710 --> 00:06:30,080
very specialized aquatic habitat they're

176
00:06:35,430 --> 00:06:32,720
called madoka fish and they're up there

177
00:06:36,629 --> 00:06:35,440
to try and see any type of bone loss

178
00:06:39,430 --> 00:06:36,639
that they go through because you know

179
00:06:41,670 --> 00:06:39,440
fish aren't is constrained by gravity

180
00:06:44,390 --> 00:06:41,680
quite as much as you or i you and i are

181
00:06:45,909 --> 00:06:44,400
down here on earth so we have experience

182
00:06:47,110 --> 00:06:45,919
experimented with a couple of different

183
00:06:49,749 --> 00:06:47,120
types of

184
00:06:52,469 --> 00:06:49,759
specimens from the animal kingdom but

185
00:06:54,070 --> 00:06:52,479
as far as anything like taking

186
00:06:56,070 --> 00:06:54,080
you know a dog with us to mars or

187
00:06:57,909 --> 00:06:56,080
something that might that might be

188
00:07:00,150 --> 00:06:57,919

something we do in the very distant

189
00:07:02,550 --> 00:07:00,160
future but right now we're really not

190
00:07:04,629 --> 00:07:02,560
sure all right all right great question

191
00:07:05,749 --> 00:07:04,639
though really cool

192
00:07:08,150 --> 00:07:05,759
thank you

193
00:07:10,870 --> 00:07:08,160
um i we were doing research the other

194
00:07:13,749 --> 00:07:10,880
day and um in one of the first space

195
00:07:16,550 --> 00:07:13,759
flights um you took a dog but i guess

196
00:07:18,790 --> 00:07:16,560
the dog did not survive and so that

197
00:07:20,629 --> 00:07:18,800
stimulated their curiosity about other

198
00:07:21,589 --> 00:07:20,639
vertebrates that's right they went

199
00:07:23,350 --> 00:07:21,599
before

200
00:07:25,270 --> 00:07:23,360
we did i think one of the first the

201
00:07:26,870 --> 00:07:25,280
first animal in space was a russian dog

202
00:07:28,790 --> 00:07:26,880
known as leica

203
00:07:30,870 --> 00:07:28,800
and i mean that was back when we were

204
00:07:33,270 --> 00:07:30,880
launching things and it was very very

205
00:07:36,150 --> 00:07:33,280
rudimentary and we weren't even sure

206
00:07:37,670 --> 00:07:36,160
if any bean could survive in space so

207
00:07:41,430 --> 00:07:37,680
that was one of the first experiments

208
00:07:43,909 --> 00:07:41,440
that they did and they sent up a dog yep

209
00:07:46,629 --> 00:07:43,919
i had madeline hello my name is madeline

210
00:07:49,029 --> 00:07:46,639
bernard thank you for taking my question

211
00:07:52,230 --> 00:07:49,039
what type of what types of experiments

212
00:07:54,390 --> 00:07:52,240
do astronauts like to do the most

213
00:07:56,150 --> 00:07:54,400

i think the answer to that is whichever

214
00:07:57,830 --> 00:07:56,160
ones they get to put their hands on

215
00:07:59,749 --> 00:07:57,840
which experiments do the astronauts like

216
00:08:01,830 --> 00:07:59,759
to do the most i think it

217
00:08:03,510 --> 00:08:01,840
most from when i talk to them it's just

218
00:08:06,790 --> 00:08:03,520
whichever ones they can participate in

219
00:08:09,270 --> 00:08:06,800
because um you know

220
00:08:11,830 --> 00:08:09,280
everybody has a drive for for for

221
00:08:13,749 --> 00:08:11,840
figuring things out that may not even be

222
00:08:15,990 --> 00:08:13,759
in their own area of interest so we may

223
00:08:18,309 --> 00:08:16,000
have a scientist who's up there who has

224
00:08:19,990 --> 00:08:18,319
a background in human physiology or the

225
00:08:21,510 --> 00:08:20,000
human body but

226
00:08:23,029 --> 00:08:21,520
how cool is it to be able to do flame

227
00:08:24,790 --> 00:08:23,039
experiments when flames behave

228
00:08:26,710 --> 00:08:24,800
differently in in the microgravity

229
00:08:29,029 --> 00:08:26,720
environment so it's my understanding i

230
00:08:30,309 --> 00:08:29,039
think anyone that they can they can do

231
00:08:32,310 --> 00:08:30,319
themselves

232
00:08:34,469 --> 00:08:32,320
because some of the experiments are um

233
00:08:36,310 --> 00:08:34,479
automated and not all have to be done by

234
00:08:38,389 --> 00:08:36,320
the astronauts but so they just like

235
00:08:40,469 --> 00:08:38,399
getting up there and doing doing any

236
00:08:42,709 --> 00:08:40,479
number of them

237
00:08:44,870 --> 00:08:42,719
very good question oh we just

238
00:08:47,990 --> 00:08:44,880

thank you we just uh completed our

239
00:08:49,750 --> 00:08:48,000
biology unit so we were studying genetic

240
00:08:55,670 --> 00:08:49,760
modification i have a student with a

241
00:09:00,550 --> 00:08:57,829
hello my name is christian smith thank

242
00:09:02,790 --> 00:09:00,560
you for taking my question uh are you

243
00:09:05,590 --> 00:09:02,800
doing any research on genetically

244
00:09:07,430 --> 00:09:05,600
modified organisms in outer space

245
00:09:10,630 --> 00:09:07,440
yeah i think the coolest one that i can

246
00:09:13,030 --> 00:09:10,640
think of offhand is uh how bacteria

247
00:09:14,949 --> 00:09:13,040
behave differently in space that's a

248
00:09:16,630 --> 00:09:14,959
really good question

249
00:09:17,990 --> 00:09:16,640
and and there are so many experiments on

250
00:09:20,150 --> 00:09:18,000
that but the one i like the most is

251
00:09:21,030 --> 00:09:20,160
bacteria and there's one that they have

252
00:09:23,190 --> 00:09:21,040
found

253
00:09:25,030 --> 00:09:23,200
that behaves much differently and it's

254
00:09:26,710 --> 00:09:25,040
one that you and i can relate to that

255
00:09:28,949 --> 00:09:26,720
makes you sick to your stomach if you've

256
00:09:31,269 --> 00:09:28,959
ever eaten some food that

257
00:09:33,190 --> 00:09:31,279
has made you sick the bacteria in that

258
00:09:35,110 --> 00:09:33,200
is called salmonella one of those could

259
00:09:37,509 --> 00:09:35,120
potentially be called salmonella and we

260
00:09:39,829 --> 00:09:37,519
found out that salmonella become more

261
00:09:42,150 --> 00:09:39,839
aggressive in space they just become

262
00:09:44,470 --> 00:09:42,160
nastier and and scientists wanted to

263
00:09:46,070 --> 00:09:44,480

find out why and so they they took the

264
00:09:47,990 --> 00:09:46,080
some samples back that had flown on

265
00:09:49,509 --> 00:09:48,000
space and and they looked at them here

266
00:09:52,790 --> 00:09:49,519
on the ground in their laboratories and

267
00:09:55,590 --> 00:09:52,800
they did find genetic modifications

268
00:09:58,150 --> 00:09:55,600
one particular gene that became much

269
00:10:01,190 --> 00:09:58,160
more what's called upregulated or much

270
00:10:04,389 --> 00:10:01,200
more active in affecting the behavior of

271
00:10:06,230 --> 00:10:04,399
those salmonella bacteria why that is

272
00:10:08,550 --> 00:10:06,240
it's still hard to say

273
00:10:10,790 --> 00:10:08,560
some of the scientists think that

274
00:10:13,670 --> 00:10:10,800
because salmonella like to live inside

275
00:10:15,990 --> 00:10:13,680
your intestines and your intestines are

276
00:10:17,910 --> 00:10:16,000
a low fluid shear environment or an

277
00:10:19,110 --> 00:10:17,920
environment that doesn't cause a lot of

278
00:10:21,030 --> 00:10:19,120
turbulence

279
00:10:23,350 --> 00:10:21,040
it's just like what they grew in

280
00:10:25,110 --> 00:10:23,360
microgravity where fluid doesn't that's

281
00:10:26,790 --> 00:10:25,120
not turbulent it's also something called

282
00:10:29,030 --> 00:10:26,800
low shear so they think that the

283
00:10:30,870 --> 00:10:29,040
microgravity environment is similar to

284
00:10:34,470 --> 00:10:30,880
what is inside of your intestine and

285
00:10:35,269 --> 00:10:34,480
that's what makes these bacteria

286
00:10:37,350 --> 00:10:35,279
just

287
00:10:40,949 --> 00:10:37,360
upregulate that that one gene that makes

288
00:10:47,910 --> 00:10:44,829

okay that is fascinating thank you uh

289
00:10:50,150 --> 00:10:47,920
isha has a question um

290
00:10:52,949 --> 00:10:50,160
lately our research has been focused on

291
00:10:55,110 --> 00:10:52,959
the planet so we were wondering if isha

292
00:10:57,110 --> 00:10:55,120
came up with this question

293
00:10:59,509 --> 00:10:57,120
um hi my name is isha thank you for

294
00:11:01,350 --> 00:10:59,519
taking my question what are we learning

295
00:11:03,910 --> 00:11:01,360
on the space station that will help us

296
00:11:05,509 --> 00:11:03,920
understand the solar solar system

297
00:11:08,710 --> 00:11:05,519
awesome question

298
00:11:10,470 --> 00:11:08,720
we have a couple of external um what we

299
00:11:12,150 --> 00:11:10,480
call payloads a couple of external

300
00:11:14,550 --> 00:11:12,160
pieces of hardware that are outside on

301
00:11:17,910 --> 00:11:14,560
the space station truss and they're

302
00:11:19,110 --> 00:11:17,920
scanning the skies for changes in cosmic

303
00:11:21,750 --> 00:11:19,120
patterns

304
00:11:24,470 --> 00:11:21,760
things like changes in x-ray sources

305
00:11:26,150 --> 00:11:24,480
that could potentially identify

306
00:11:29,190 --> 00:11:26,160
some events that we've not seen before

307
00:11:32,870 --> 00:11:29,200
for example there's one payload called

308
00:11:34,949 --> 00:11:32,880
maxi and it has it registered a

309
00:11:37,590 --> 00:11:34,959
signature change in the sky that said

310
00:11:40,150 --> 00:11:37,600
that showed for the first time ever

311
00:11:42,230 --> 00:11:40,160
that it was an indicator that a star had

312
00:11:44,230 --> 00:11:42,240
gotten too close to a black hole and the

313
00:11:46,870 --> 00:11:44,240

black hole started shredding the star

314
00:11:48,389 --> 00:11:46,880
and so the events the x-ray events that

315
00:11:50,870 --> 00:11:48,399
came from that

316
00:11:53,350 --> 00:11:50,880
were picked up and measured by this maxi

317
00:11:55,750 --> 00:11:53,360
payload and it was the first time ever

318
00:11:57,110 --> 00:11:55,760
that astrophysicists were able to see

319
00:11:58,790 --> 00:11:57,120
something like that actually happening

320
00:12:00,310 --> 00:11:58,800
because it always been thought about and

321
00:12:03,110 --> 00:12:00,320
they always thought it happened but we'd

322
00:12:04,710 --> 00:12:03,120
never seen it before so understanding

323
00:12:06,230 --> 00:12:04,720
what happens in our solar system

324
00:12:07,590 --> 00:12:06,240
especially when you're talking about a

325
00:12:10,470 --> 00:12:07,600
star that might orbit too close to a

326
00:12:12,150 --> 00:12:10,480
black hole says a lot about how we might

327
00:12:13,590 --> 00:12:12,160
venture out further

328
00:12:20,470 --> 00:12:13,600
there's also

329
00:12:22,550 --> 00:12:20,480
that is doing an investigation

330
00:12:23,750 --> 00:12:22,560
called geo flow and they take the

331
00:12:26,150 --> 00:12:23,760
components of what they thought the

332
00:12:28,150 --> 00:12:26,160
earth might have uh been made of in the

333
00:12:30,470 --> 00:12:28,160
very beginning and they put it inside of

334
00:12:33,430 --> 00:12:30,480
this chamber uh that's a fluid uh a

335
00:12:34,949 --> 00:12:33,440
fluid chamber and uh basically recreate

336
00:12:36,629 --> 00:12:34,959
the events of how we thought the earth

337
00:12:38,470 --> 00:12:36,639
might have been formed and the way the

338
00:12:41,030 --> 00:12:38,480

reason it's done on the space station is

339
00:12:42,550 --> 00:12:41,040
because it's microgravity it's it's

340
00:12:44,069 --> 00:12:42,560
missing that earth's gravity and that's

341
00:12:46,069 --> 00:12:44,079
a critical part of how the earth would

342
00:12:48,710 --> 00:12:46,079
have been formed and so this is called

343
00:12:50,790 --> 00:12:48,720
geoflow and it's uh being done by our

344
00:12:52,470 --> 00:12:50,800
european partners and so when the

345
00:12:53,910 --> 00:12:52,480
information comes back from that that'll

346
00:12:55,670 --> 00:12:53,920
advance our knowledge of how our own

347
00:12:58,069 --> 00:12:55,680
planet was formed and give us even

348
00:13:01,430 --> 00:12:58,079
further insights as to how other planets

349
00:13:06,629 --> 00:13:04,550
you mentioned uh radiation and one of

350
00:13:16,150 --> 00:13:06,639
our questions uh students have a

351
00:13:20,550 --> 00:13:18,629
hello my name is thomas thank you for

352
00:13:23,430 --> 00:13:20,560
taking my question

353
00:13:26,150 --> 00:13:23,440
are the astronauts exposed to any types

354
00:13:28,150 --> 00:13:26,160
of harmful radiation

355
00:13:31,430 --> 00:13:28,160
fall in outer space

356
00:13:33,110 --> 00:13:31,440
another good question so the uh vehicle

357
00:13:34,629 --> 00:13:33,120
itself the space yes there's lots of

358
00:13:36,949 --> 00:13:34,639
radiation out in space when you leave

359
00:13:39,509 --> 00:13:36,959
the earth's atmosphere quite certainly

360
00:13:41,750 --> 00:13:39,519
uh and so any vehicle or spacesuit that

361
00:13:44,150 --> 00:13:41,760
you create has to take that into account

362
00:13:45,110 --> 00:13:44,160
for crew health and so the space station

363
00:13:47,269 --> 00:13:45,120

itself

364
00:13:50,069 --> 00:13:47,279
is consis consists of material that

365
00:13:51,990 --> 00:13:50,079
works to shield the crew against the

366
00:13:54,230 --> 00:13:52,000
harmful radiation effects

367
00:13:56,629 --> 00:13:54,240
and and then also in addition to the

368
00:13:58,470 --> 00:13:56,639
materials that are used we have a number

369
00:14:00,389 --> 00:13:58,480
of radiation detectors and a lot of

370
00:14:01,670 --> 00:14:00,399
different types of radiation detectors

371
00:14:04,069 --> 00:14:01,680
that are positioned all around the

372
00:14:06,470 --> 00:14:04,079
inside of the space station that can

373
00:14:07,750 --> 00:14:06,480
constantly tell us sends the signal down

374
00:14:09,750 --> 00:14:07,760
to the earth so the scientists are

375
00:14:11,430 --> 00:14:09,760
constantly evaluating the radiation

376
00:14:13,910 --> 00:14:11,440
amounts that the crew are being exposed

377
00:14:17,110 --> 00:14:13,920
to and so it's definitely

378
00:14:18,069 --> 00:14:17,120
a big health issue and it's very real

379
00:14:20,949 --> 00:14:18,079
and

380
00:14:22,870 --> 00:14:20,959
measures in place to try to protect the

381
00:14:25,110 --> 00:14:22,880
crew from that kind of exposure

382
00:14:26,870 --> 00:14:25,120
but the space station being where it is

383
00:14:29,269 --> 00:14:26,880
it's only a few hundred miles off the

384
00:14:30,949 --> 00:14:29,279
surface so it's still kind of protected

385
00:14:33,670 --> 00:14:30,959
the thing that really protects us from

386
00:14:36,230 --> 00:14:33,680
radiation from the sun and intergalactic

387
00:14:37,670 --> 00:14:36,240
things is our magnetosphere so the

388
00:14:39,509 --> 00:14:37,680

station's still close enough that it's

389
00:14:41,269 --> 00:14:39,519
really protected by that but it's as

390
00:14:43,350 --> 00:14:41,279
soon as we decide to start going really

391
00:14:44,870 --> 00:14:43,360
far out like when we want to go to mars

392
00:14:47,670 --> 00:14:44,880
that are astronauts will be a lot more

393
00:14:49,110 --> 00:14:47,680
susceptible so we're developing new

394
00:14:51,189 --> 00:14:49,120
methods onboard the station for

395
00:14:53,110 --> 00:14:51,199
detecting and protecting

396
00:14:54,949 --> 00:14:53,120
and those will be really important as we

397
00:14:56,710 --> 00:14:54,959
start to move you know millions and

398
00:14:58,870 --> 00:14:56,720
millions of miles away from the earth

399
00:15:01,590 --> 00:14:58,880
yep

400
00:15:03,509 --> 00:15:01,600
thank you so much um just uh you're

401
00:15:05,430 --> 00:15:03,519
speaking about radiation do they wear

402
00:15:09,670 --> 00:15:05,440
sunscreen do they have to worry about

403
00:15:12,629 --> 00:15:11,269
i think that they actually have to i

404
00:15:14,230 --> 00:15:12,639
don't think they get that but they

405
00:15:15,910 --> 00:15:14,240
actually have to take vitamin d increase

406
00:15:17,910 --> 00:15:15,920
vitamin d doses

407
00:15:19,829 --> 00:15:17,920
but i think their spacesuits and all

408
00:15:20,949 --> 00:15:19,839
that protect them enough

409
00:15:21,829 --> 00:15:20,959
yep

410
00:15:22,550 --> 00:15:21,839
okay

411
00:15:25,189 --> 00:15:22,560
hey

412
00:15:27,430 --> 00:15:25,199
anna anna we have another student with a

413
00:15:30,470 --> 00:15:27,440

question about the experiences of

414
00:15:33,749 --> 00:15:30,480
gravity and or the lack of gravity in

415
00:15:37,030 --> 00:15:35,590
hi my name is anna thank you for taking

416
00:15:38,710 --> 00:15:37,040
my question

417
00:15:40,949 --> 00:15:38,720
since the astronauts are experienced

418
00:15:43,829 --> 00:15:40,959
less gravity how does this affect their

419
00:15:45,350 --> 00:15:43,839
skeleton or bone mass oh yeah a really

420
00:15:47,749 --> 00:15:45,360
good question and that's that's the

421
00:15:49,590 --> 00:15:47,759
number one um thing that we need to work

422
00:15:52,710 --> 00:15:49,600
on if we're going to go beyond low earth

423
00:15:55,670 --> 00:15:52,720
orbit and stay for longer out in periods

424
00:15:57,509 --> 00:15:55,680
in space because you're not constantly

425
00:15:59,670 --> 00:15:57,519
working against the gravity environment

426
00:16:02,069 --> 00:15:59,680
think about all day you stand you sit

427
00:16:04,790 --> 00:16:02,079
you walk you climb upstairs you use your

428
00:16:06,870 --> 00:16:04,800
muscles to get you around and then in

429
00:16:08,230 --> 00:16:06,880
the microgravity environment really

430
00:16:09,990 --> 00:16:08,240
they're just kind of floating around and

431
00:16:11,910 --> 00:16:10,000
they can use their muscles to push off

432
00:16:15,189 --> 00:16:11,920
and get them where they need to go um

433
00:16:17,110 --> 00:16:15,199
and so definitely um there starts to be

434
00:16:18,550 --> 00:16:17,120
it's use it or lose it so you're you

435
00:16:20,470 --> 00:16:18,560
know if you've ever exercised and then

436
00:16:22,470 --> 00:16:20,480
you stopped you you probably can tell

437
00:16:24,069 --> 00:16:22,480
your muscles will start to to get

438
00:16:25,749 --> 00:16:24,079

smaller and it's the same with them

439
00:16:26,949 --> 00:16:25,759
they'll lose some muscle mass and

440
00:16:29,670 --> 00:16:26,959
they'll lose some

441
00:16:31,910 --> 00:16:29,680
bone mass but what they do

442
00:16:34,069 --> 00:16:31,920
on orbit what they're finding is as they

443
00:16:36,230 --> 00:16:34,079
keep up with their exercise well they

444
00:16:38,150 --> 00:16:36,240
have very high resistive exercise that

445
00:16:40,310 --> 00:16:38,160
they do it's similar to weight lifting

446
00:16:41,749 --> 00:16:40,320
they have cardiovascular exercise on the

447
00:16:43,590 --> 00:16:41,759
treadmill that they do and they also

448
00:16:45,829 --> 00:16:43,600
have a cycle ergometer up there which is

449
00:16:48,230 --> 00:16:45,839
a stationary bike and with the

450
00:16:50,230 --> 00:16:48,240
combination of those three and also

451
00:16:51,990 --> 00:16:50,240
eating the right kind of diets and fish

452
00:16:53,910 --> 00:16:52,000
is a big one because it's got omega-3

453
00:16:55,670 --> 00:16:53,920
fatty acid which helps

454
00:16:57,350 --> 00:16:55,680
preserve bone

455
00:16:59,189 --> 00:16:57,360
and if they eat all their calories which

456
00:17:01,670 --> 00:16:59,199
is important for energy and they take

457
00:17:02,629 --> 00:17:01,680
their vitamin d doses because they lack

458
00:17:06,309 --> 00:17:02,639
sun

459
00:17:08,390 --> 00:17:06,319
important for bone if they do all those

460
00:17:10,230 --> 00:17:08,400
things then they're shut what we're

461
00:17:13,350 --> 00:17:10,240
seeing is we're able to maintain the

462
00:17:16,390 --> 00:17:13,360
bone mass so we're the the crew seems to

463
00:17:18,230 --> 00:17:16,400

not be losing as much of bone mass and

464
00:17:19,829 --> 00:17:18,240
now one second thing we want to worry

465
00:17:22,230 --> 00:17:19,839
about with the bones is although we may

466
00:17:23,669 --> 00:17:22,240
be tainting bone mass in terms of

467
00:17:25,189 --> 00:17:23,679
minerals

468
00:17:26,870 --> 00:17:25,199
what about the strength we don't know

469
00:17:28,230 --> 00:17:26,880
much about the quality that's being

470
00:17:30,150 --> 00:17:28,240
maintained on the bone so there's

471
00:17:31,590 --> 00:17:30,160
actually a lot more research that needs

472
00:17:33,830 --> 00:17:31,600
to be done on what's going on on the

473
00:17:35,909 --> 00:17:33,840
inside of the bone so it's we're keeping

474
00:17:37,350 --> 00:17:35,919
the bone mass there but what you know

475
00:17:39,510 --> 00:17:37,360
what's the structure like on the inside

476
00:17:41,029 --> 00:17:39,520
of the bone is it fragile is it brittle

477
00:17:42,950 --> 00:17:41,039
because if it is then we could have

478
00:17:44,950 --> 00:17:42,960
issues with fracture and we don't want

479
00:17:46,630 --> 00:17:44,960
to see hip fractures or bone fractures

480
00:17:48,950 --> 00:17:46,640
if we get all the way out to

481
00:17:50,549 --> 00:17:48,960
mars or wherever we're headed um you

482
00:17:52,150 --> 00:17:50,559
know we and we get back on something

483
00:17:54,310 --> 00:17:52,160
that's a terrestrial environment that

484
00:17:56,630 --> 00:17:54,320
has some gravity vector we want to make

485
00:17:57,590 --> 00:17:56,640
sure our bones are strong enough that we

486
00:18:00,150 --> 00:17:57,600
don't

487
00:18:01,750 --> 00:18:00,160
encounter breaks and fractures and we

488
00:18:03,909 --> 00:18:01,760

want to make sure our muscles are strong

489
00:18:05,510 --> 00:18:03,919
enough to get us to to be able to move

490
00:18:08,070 --> 00:18:05,520
around and carry the weight of our

491
00:18:10,789 --> 00:18:08,080
spacesuit and and get us from point a to

492
00:18:12,950 --> 00:18:10,799
point b so bone and muscle in addition

493
00:18:14,470 --> 00:18:12,960
to radiation are the bigger biggest

494
00:18:17,430 --> 00:18:14,480
things that we need to overcome as

495
00:18:19,190 --> 00:18:17,440
humans and and learn and understand to

496
00:18:22,870 --> 00:18:19,200
be able to get us out past low earth

497
00:18:27,110 --> 00:18:25,029
wow thank you

498
00:18:29,430 --> 00:18:27,120
speaking of breaking things i have a

499
00:18:31,350 --> 00:18:29,440
question with a student with a question

500
00:18:37,590 --> 00:18:31,360
related to

501
00:18:40,789 --> 00:18:39,350
hi my name is will thank you for taking

502
00:18:42,950 --> 00:18:40,799
my question

503
00:18:45,750 --> 00:18:42,960
what happens if the space station is hit

504
00:18:48,070 --> 00:18:45,760
by space debris ah well the right the

505
00:18:51,430 --> 00:18:48,080
first answer is always prevention right

506
00:18:53,190 --> 00:18:51,440
so so we here uh at nasa are big on

507
00:18:54,789 --> 00:18:53,200
redundancy and prevention so the first

508
00:18:57,669 --> 00:18:54,799
things that we are always doing is

509
00:18:59,990 --> 00:18:57,679
looking out ahead at the at the patterns

510
00:19:02,390 --> 00:19:00,000
of of space debris that are approaching

511
00:19:04,710 --> 00:19:02,400
or near anywhere near the space station

512
00:19:07,669 --> 00:19:04,720
and so um there's a whole group of

513
00:19:09,750 --> 00:19:07,679

people that that that's their only job

514
00:19:11,750 --> 00:19:09,760
and so if we see something that might be

515
00:19:13,750 --> 00:19:11,760
getting a little too close

516
00:19:14,950 --> 00:19:13,760
or something of something we want to

517
00:19:17,350 --> 00:19:14,960
watch

518
00:19:18,230 --> 00:19:17,360
then the teams on the ground here get

519
00:19:20,549 --> 00:19:18,240
together

520
00:19:22,870 --> 00:19:20,559
decide on whether the crew should be

521
00:19:24,870 --> 00:19:22,880
alerted and sometimes i believe we can

522
00:19:26,710 --> 00:19:24,880
do things to move the vehicle even right

523
00:19:28,630 --> 00:19:26,720
if we had to in extreme cases we have

524
00:19:30,310 --> 00:19:28,640
the ability to do things known as debris

525
00:19:32,630 --> 00:19:30,320
avoidance maneuvers where we'll have

526
00:19:34,950 --> 00:19:32,640
thrusters either on a spacecraft

527
00:19:36,870 --> 00:19:34,960
visiting the station that'll then be

528
00:19:38,710 --> 00:19:36,880
fired and they can actually raise the

529
00:19:39,750 --> 00:19:38,720
altitude and kind of get it up out of

530
00:19:41,510 --> 00:19:39,760
the way

531
00:19:43,430 --> 00:19:41,520
and i mean that's done for

532
00:19:45,590 --> 00:19:43,440
any object that we're able to track and

533
00:19:47,430 --> 00:19:45,600
we can track very small objects while

534
00:19:49,750 --> 00:19:47,440
they're in space but the other problem

535
00:19:51,750 --> 00:19:49,760
is there are a lot of very even smaller

536
00:19:54,230 --> 00:19:51,760
objects that we can always track the

537
00:19:56,870 --> 00:19:54,240
station will actually be you know hit by

538
00:19:58,950 --> 00:19:56,880

dust sized particles which may not seem

539
00:20:00,789 --> 00:19:58,960
like much but when you're traveling at

540
00:20:02,710 --> 00:20:00,799
the speeds you're traveling at they can

541
00:20:05,029 --> 00:20:02,720
leave marks they can leave dents they

542
00:20:06,870 --> 00:20:05,039
can actually damage the station if it

543
00:20:08,470 --> 00:20:06,880
were to actually be hit by something

544
00:20:10,470 --> 00:20:08,480
there are a number of procedures in

545
00:20:12,390 --> 00:20:10,480
place so the astronauts would always be

546
00:20:14,149 --> 00:20:12,400
safe they have spacecraft they could

547
00:20:16,710 --> 00:20:14,159
shelter in and come back down to earth

548
00:20:18,789 --> 00:20:16,720
immediately they can seal off different

549
00:20:21,270 --> 00:20:18,799
sections of the station with hatches so

550
00:20:22,630 --> 00:20:21,280
they are there are things in place that

551
00:20:24,310 --> 00:20:22,640
should that ever happen and we don't

552
00:20:28,310 --> 00:20:24,320
catch it and maneuver out of the way in

553
00:20:31,190 --> 00:20:28,320
time the astronauts would still be okay

554
00:20:33,029 --> 00:20:31,200
oh wow great so there's no chance of

555
00:20:35,510 --> 00:20:33,039
being hit by a

556
00:20:37,270 --> 00:20:35,520
orbiting planet

557
00:20:39,350 --> 00:20:37,280
it's too big

558
00:20:41,909 --> 00:20:39,360
we see that one coming

559
00:20:44,230 --> 00:20:41,919
okay okay go ahead we have a question

560
00:20:47,110 --> 00:20:44,240
related to uh planets

561
00:20:49,029 --> 00:20:47,120
hi my name is caitlin and thank you for

562
00:20:51,029 --> 00:20:49,039
taking my question

563
00:20:53,669 --> 00:20:51,039

are the astronauts able to see the

564
00:20:55,990 --> 00:20:53,679
planets from the space station

565
00:20:58,630 --> 00:20:56,000
oh that is a good question

566
00:21:00,950 --> 00:20:58,640
you know i i don't think so

567
00:21:02,549 --> 00:21:00,960
they are every once in a while um we

568
00:21:04,149 --> 00:21:02,559
actually i don't know if you guys

569
00:21:05,110 --> 00:21:04,159
followed when we did the big transit of

570
00:21:06,549 --> 00:21:05,120
venus

571
00:21:08,710 --> 00:21:06,559
a couple of months back but one of our

572
00:21:10,630 --> 00:21:08,720
astronauts was actually able to you know

573
00:21:12,630 --> 00:21:10,640
take photographs and that was his venus

574
00:21:14,630 --> 00:21:12,640
was crossing right in front of the sun

575
00:21:16,870 --> 00:21:14,640
and we were able to see venus very well

576
00:21:19,110 --> 00:21:16,880
through telescopes all over the planet

577
00:21:21,190 --> 00:21:19,120
but our astronauts are able to see and

578
00:21:23,110 --> 00:21:21,200
they can see them generally like you and

579
00:21:24,870 --> 00:21:23,120
i can see them because again

580
00:21:26,710 --> 00:21:24,880
they are in space but they're only a few

581
00:21:28,950 --> 00:21:26,720
hundred miles away and when you talk

582
00:21:31,190 --> 00:21:28,960
about planets they're tens and hundreds

583
00:21:33,029 --> 00:21:31,200
and millions of miles away so anything

584
00:21:35,110 --> 00:21:33,039
that they could see is really what you

585
00:21:37,029 --> 00:21:35,120
can see down here maybe just a little

586
00:21:39,350 --> 00:21:37,039
bit clearer

587
00:21:44,310 --> 00:21:39,360
that's a good question okay interesting

588
00:21:47,909 --> 00:21:46,470

hi my name is sequoia and thank you for

589
00:21:49,750 --> 00:21:47,919
taking my question

590
00:21:51,590 --> 00:21:49,760
what are some of the new planets

591
00:21:53,430 --> 00:21:51,600
recently discovered

592
00:21:54,230 --> 00:21:53,440
oh yeah that's a good question now i

593
00:21:55,909 --> 00:21:54,240
read

594
00:21:59,029 --> 00:21:55,919
something that came out just yesterday

595
00:22:01,029 --> 00:21:59,039
from nasa's kepler telescope mission and

596
00:22:02,549 --> 00:22:01,039
um so if you're interested in in how

597
00:22:04,230 --> 00:22:02,559
we're discovering new planets i would

598
00:22:07,110 --> 00:22:04,240
check out the kepler

599
00:22:09,830 --> 00:22:07,120
mission site uh it seems like um

600
00:22:11,590 --> 00:22:09,840
kepler's been running since i think 2009

601
00:22:13,590 --> 00:22:11,600
and so its sole job is to look for

602
00:22:15,110 --> 00:22:13,600
potential new planets or candidate

603
00:22:18,230 --> 00:22:15,120
planets and

604
00:22:20,789 --> 00:22:18,240
and i believe um yesterday came out uh

605
00:22:24,070 --> 00:22:20,799
saying that there had been about 461

606
00:22:26,470 --> 00:22:24,080
potential new planet planet candidates

607
00:22:29,110 --> 00:22:26,480
discovered and i think of of all of

608
00:22:30,950 --> 00:22:29,120
those lately um four of those are in

609
00:22:31,669 --> 00:22:30,960
what are called the habitable zone or

610
00:22:33,830 --> 00:22:31,679
they're

611
00:22:35,750 --> 00:22:33,840
all near the roughly this a little bit

612
00:22:37,590 --> 00:22:35,760
bigger than earth but also um have the

613
00:22:40,710 --> 00:22:37,600

potential to have water on the on the

614
00:22:42,710 --> 00:22:40,720
surface so um so that was really neat

615
00:22:43,990 --> 00:22:42,720
when i read that and um and so you

616
00:22:46,710 --> 00:22:44,000
should definitely check out the kepler

617
00:22:49,430 --> 00:22:46,720
telescope mission site

618
00:22:51,830 --> 00:22:49,440
and we have time for questions

619
00:22:53,190 --> 00:22:51,840
okay go ahead we have one related to

620
00:22:56,070 --> 00:22:53,200
that um

621
00:22:58,230 --> 00:22:56,080
about new planet discovery

622
00:22:59,510 --> 00:22:58,240
hi my name is ghana thank you for taking

623
00:23:01,270 --> 00:22:59,520
my question

624
00:23:04,149 --> 00:23:01,280
which planet looks to be the most

625
00:23:05,909 --> 00:23:04,159
promising for human habitation

626
00:23:08,549 --> 00:23:05,919
as of right now i'd have to say mars

627
00:23:09,990 --> 00:23:08,559
would you i would agree i mean

628
00:23:12,870 --> 00:23:10,000
when you're talking about the planets in

629
00:23:14,870 --> 00:23:12,880
our solar system the closest ones

630
00:23:16,470 --> 00:23:14,880
if you're going to inhabit a planet with

631
00:23:18,710 --> 00:23:16,480
humans it's got to be a solid planet

632
00:23:21,270 --> 00:23:18,720
like ours the only ones that fit that

633
00:23:22,630 --> 00:23:21,280
are the ones in our immediate area the

634
00:23:24,630 --> 00:23:22,640
issues with the other ones you know

635
00:23:27,190 --> 00:23:24,640
mercury you're much too close to the sun

636
00:23:29,110 --> 00:23:27,200
it's very far away it's a lot smaller it

637
00:23:30,470 --> 00:23:29,120
doesn't really offer everything and

638
00:23:31,430 --> 00:23:30,480

atmosphere things like that that we

639
00:23:33,830 --> 00:23:31,440
would need

640
00:23:35,830 --> 00:23:33,840
venus is the exact opposite it has such

641
00:23:37,830 --> 00:23:35,840
a huge atmosphere and so much pressure

642
00:23:39,990 --> 00:23:37,840
that if you were to stand on the surface

643
00:23:41,830 --> 00:23:40,000
of venus you would literally be crushed

644
00:23:44,390 --> 00:23:41,840
and so we couldn't really inhabit that

645
00:23:46,789 --> 00:23:44,400
one but mars is basically kind of a

646
00:23:48,710 --> 00:23:46,799
miniature earth it doesn't have nearly

647
00:23:50,710 --> 00:23:48,720
the atmosphere it's very small

648
00:23:51,990 --> 00:23:50,720
atmosphere compared to us and it doesn't

649
00:23:54,070 --> 00:23:52,000
quite offer the same radiation

650
00:23:56,149 --> 00:23:54,080
protection but it's close enough and

651
00:23:58,149 --> 00:23:56,159
like us enough that we could that would

652
00:24:00,470 --> 00:23:58,159
be our best candidate to

653
00:24:01,909 --> 00:24:00,480
go and inhabit

654
00:24:03,990 --> 00:24:01,919
but really good question i think that's

655
00:24:05,830 --> 00:24:04,000
all the time that we have for today but

656
00:24:08,390 --> 00:24:05,840
i really want to thank you guys for some

657
00:24:09,590 --> 00:24:08,400
pretty awesome questions today i hope

658
00:24:11,269 --> 00:24:09,600
you enjoyed your time here in mission

659
00:24:12,630 --> 00:24:11,279
control with us and

660
00:24:14,390 --> 00:24:12,640
maybe we'll hear from you guys again

661
00:24:16,870 --> 00:24:14,400
soon

662
00:24:22,149 --> 00:24:16,880
thank you so much we appreciate your