
STENNIS • AMES • DRYDEN • GLENN • GODDARD • HEADQUART
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JOHNSON • LANGLEY • MARSHALL
GLENN • HEADQUARTERS • JPL

1
00:00:10,709 --> 00:00:09,190
hello and welcome to the nasa open house

2
00:00:13,430 --> 00:00:10,719
held today in conjunction with the

3
00:00:14,310 --> 00:00:13,440
presidential inauguration 2013 i'm john

4
00:00:16,070 --> 00:00:14,320
yemerick with nasa office of

5
00:00:18,390 --> 00:00:16,080
communications the social media director

6
00:00:19,750 --> 00:00:18,400
at nasa and your host for today

7
00:00:21,109 --> 00:00:19,760
this open house means folks will be

8
00:00:23,429 --> 00:00:21,119
coming in and out of the room and we are

9
00:00:25,189 --> 00:00:23,439
welcome to uh to take part in today's

10
00:00:26,870 --> 00:00:25,199
conversation but we're doing something

11
00:00:28,870 --> 00:00:26,880
also special here today we have a nasa

12
00:00:30,630 --> 00:00:28,880
social which is where we invite folks in

13
00:00:33,030 --> 00:00:30,640

the public to come in get behind the

14
00:00:34,310 --> 00:00:33,040
scenes access to nasa and communicate

15
00:00:35,750 --> 00:00:34,320
that out to their friends and followers

16
00:00:36,709 --> 00:00:35,760
and i believe we have some nasa social

17
00:00:38,549 --> 00:00:36,719
guests here in the audience with us

18
00:00:39,670 --> 00:00:38,559
today if you don't mind just uh maybe

19
00:00:48,310 --> 00:00:39,680
clapping your hands so we know who you

20
00:00:52,310 --> 00:00:49,830
great the nasa social programs are

21
00:00:54,150 --> 00:00:52,320
really successful for us and actually

22
00:00:55,910 --> 00:00:54,160
connecting and directly with you the

23
00:00:58,549 --> 00:00:55,920
public and if you want to get more

24
00:01:00,310 --> 00:00:58,559
involved in social media nasa visit us

25
00:01:01,430 --> 00:01:00,320
on the web at nasa.gov

26
00:01:02,869 --> 00:01:01,440
social

27
00:01:05,390 --> 00:01:02,879
for today's event you can follow along

28
00:01:08,149 --> 00:01:05,400
with the hashtag

29
00:01:09,590 --> 00:01:08,159
poundinog202013 that's pound i-n-a-u-g

30
00:01:11,429 --> 00:01:09,600
2013

31
00:01:13,830 --> 00:01:11,439
pound nasa and for our nasa social

32
00:01:15,350 --> 00:01:13,840
guests pound nasa social you can also

33
00:01:18,710 --> 00:01:15,360
ask us questions using the hashtag

34
00:01:20,070 --> 00:01:18,720
poundmasknasa that's asknasa that is uh

35
00:01:22,230 --> 00:01:20,080
you can do that on twitter or google

36
00:01:24,870 --> 00:01:22,240
plus you can also follow our stream on

37
00:01:25,670 --> 00:01:24,880
youtube and ask questions on facebook as

38
00:01:27,190 --> 00:01:25,680

well

39
00:01:28,550 --> 00:01:27,200
uh we're pleased to discuss some amazing

40
00:01:30,390 --> 00:01:28,560
things we're doing here at nasa with you

41
00:01:31,749 --> 00:01:30,400
today but to be honest with you we're

42
00:01:33,830 --> 00:01:31,759
only going to be touching the surface of

43
00:01:35,990 --> 00:01:33,840
what nasa does i mean right now we have

44
00:01:37,510 --> 00:01:36,000
spacecraft that are

45
00:01:38,950 --> 00:01:37,520
leaving our solar system right now we

46
00:01:40,630 --> 00:01:38,960
have a spacecraft that's making

47
00:01:42,630 --> 00:01:40,640
discoveries on mercury we have one

48
00:01:44,550 --> 00:01:42,640
that's going out to pluto we have

49
00:01:47,109 --> 00:01:44,560
spacecraft that are discovering distant

50
00:01:48,550 --> 00:01:47,119
planets around distant stars

51
00:01:50,550 --> 00:01:48,560
we have we're still discovering new

52
00:01:52,149 --> 00:01:50,560
galaxies we have earth observation

53
00:01:53,590 --> 00:01:52,159
satellites that are helping us better

54
00:01:55,830 --> 00:01:53,600
understand climate change here on earth

55
00:01:57,670 --> 00:01:55,840
we have a rover that is crawling the

56
00:01:59,270 --> 00:01:57,680
surface of mars right now that is paving

57
00:02:01,109 --> 00:01:59,280
the way for future mars exploration to

58
00:02:02,709 --> 00:02:01,119
the red planet we have an engineering

59
00:02:04,950 --> 00:02:02,719
marvel the international space station

60
00:02:06,789 --> 00:02:04,960
orbiting above where humans have lived

61
00:02:09,350 --> 00:02:06,799
and worked for over 12 years and if you

62
00:02:11,350 --> 00:02:09,360
think about that seventh graders have

63
00:02:13,030 --> 00:02:11,360

never known a world without humans

64
00:02:14,710 --> 00:02:13,040
living permanently in space

65
00:02:15,830 --> 00:02:14,720
and with all the stuff we have going on

66
00:02:17,030 --> 00:02:15,840
we're also here on the ground we're

67
00:02:19,110 --> 00:02:17,040
developing the next generation

68
00:02:20,710 --> 00:02:19,120
spacecraft that are going to take us out

69
00:02:22,390 --> 00:02:20,720
of low earth orbit and into the solar

70
00:02:24,229 --> 00:02:22,400
system while also investing in

71
00:02:25,910 --> 00:02:24,239
commercial space flight which will help

72
00:02:26,790 --> 00:02:25,920
us bring down the cost of space flight

73
00:02:28,790 --> 00:02:26,800
and make it more accessible and

74
00:02:29,910 --> 00:02:28,800
affordable for everybody and through all

75
00:02:31,670 --> 00:02:29,920
of this stuff

76
00:02:33,270 --> 00:02:31,680
there's technologies emerge and these

77
00:02:35,509 --> 00:02:33,280
technologies help benefit us here on

78
00:02:37,030 --> 00:02:35,519
earth to earth today

79
00:02:38,710 --> 00:02:37,040
so today you're going to hear from some

80
00:02:40,229 --> 00:02:38,720
of the some of the leaders here at nasa

81
00:02:41,430 --> 00:02:40,239
headquarters they're going to tell you

82
00:02:42,390 --> 00:02:41,440
about some of the exciting things we're

83
00:02:43,670 --> 00:02:42,400
doing

84
00:02:44,630 --> 00:02:43,680
and our first guest i'd like to

85
00:02:49,990 --> 00:02:44,640
introduce

86
00:02:52,869 --> 00:02:51,509
excuse me

87
00:02:54,309 --> 00:02:52,879
he is the decorated naval aviator who

88
00:02:55,910 --> 00:02:54,319

flew over 100 combat missions during the

89
00:02:57,589 --> 00:02:55,920
vietnam war

90
00:02:59,430 --> 00:02:57,599
he's a retired three-star marine corps

91
00:03:00,949 --> 00:02:59,440
general he piloted commanders space

92
00:03:02,229 --> 00:03:00,959
shuttle four times during his career as

93
00:03:04,390 --> 00:03:02,239
an astronaut

94
00:03:06,390 --> 00:03:04,400
and despite all this all the time he's

95
00:03:08,149 --> 00:03:06,400
spending the clouds he is really down to

96
00:03:09,270 --> 00:03:08,159
earth

97
00:03:11,110 --> 00:03:09,280
ladies and gentlemen please help me

98
00:03:17,110 --> 00:03:11,120
welcome to the stage nasa administrator

99
00:03:21,430 --> 00:03:19,350
hey

100
00:03:23,270 --> 00:03:21,440
thanks very much john and um i want to

101
00:03:24,949 --> 00:03:23,280
thank all of you first of all for coming

102
00:03:25,830 --> 00:03:24,959
and i welcome you to nasa headquarters

103
00:03:27,750 --> 00:03:25,840
you're going to have a lot of people

104
00:03:30,149 --> 00:03:27,760
welcome you to nasa headquarters today

105
00:03:33,030 --> 00:03:30,159
it's a big day for us because it's a big

106
00:03:35,589 --> 00:03:33,040
weekend for the nation uh it's a time

107
00:03:37,750 --> 00:03:35,599
when we celebrate the memory of

108
00:03:39,830 --> 00:03:37,760
a great civil rights leader the reverend

109
00:03:42,309 --> 00:03:39,840
dr martin luther king jr

110
00:03:44,710 --> 00:03:42,319
the official celebration of his birthday

111
00:03:45,830 --> 00:03:44,720
is next monday but it's also a very

112
00:03:48,789 --> 00:03:45,840
important day because it's the

113
00:03:50,630 --> 00:03:48,799

inauguration day for uh for president

114
00:03:52,550 --> 00:03:50,640
barack obama and

115
00:03:54,789 --> 00:03:52,560
i'm very excited to be here and be a

116
00:03:57,190 --> 00:03:54,799
part of the team i also want to thank

117
00:03:58,630 --> 00:03:57,200
nasa's director of outreach

118
00:04:00,710 --> 00:03:58,640
alan ladwig

119
00:04:02,550 --> 00:04:00,720
alan doesn't i don't think he gets

120
00:04:04,949 --> 00:04:02,560
enough love

121
00:04:08,070 --> 00:04:04,959
uh from many of us and it's because

122
00:04:09,990 --> 00:04:08,080
alan's kind of uh a freewheeling guy but

123
00:04:11,670 --> 00:04:10,000
he i tell you when when you want

124
00:04:14,149 --> 00:04:11,680
something done give it to him and it

125
00:04:15,750 --> 00:04:14,159
gets delivered and alan again as i said

126
00:04:17,590 --> 00:04:15,760
last night i want to thank you and the

127
00:04:19,670 --> 00:04:17,600
entire team for what i think is going to

128
00:04:21,189 --> 00:04:19,680
be a an incredible weekend not just for

129
00:04:23,189 --> 00:04:21,199
nasa but for the nation people who have

130
00:04:26,150 --> 00:04:23,199
an opportunity to to see the stuff that

131
00:04:28,469 --> 00:04:26,160
we do i want to thank my my press

132
00:04:31,350 --> 00:04:28,479
secretary i say my press secretary it's

133
00:04:33,749 --> 00:04:31,360
the nasa press secretary lauren worley

134
00:04:36,550 --> 00:04:33,759
and i saw lauren roaming around there

135
00:04:39,430 --> 00:04:36,560
she was roaming around some there she is

136
00:04:40,790 --> 00:04:39,440
um good to have you here rudy and

137
00:04:42,629 --> 00:04:40,800
thanks very much for all the stuff you

138
00:04:44,230 --> 00:04:42,639

do i also want to thank thank all the

139
00:04:45,990 --> 00:04:44,240
people on the teams

140
00:04:48,310 --> 00:04:46,000
who have been working to help us open

141
00:04:49,990 --> 00:04:48,320
the doors of nasa uh to many of our

142
00:04:52,629 --> 00:04:50,000
friends from around the country who are

143
00:04:55,189 --> 00:04:52,639
here uh in the washington area for the

144
00:04:57,749 --> 00:04:55,199
for the inauguration this weekend

145
00:05:00,550 --> 00:04:57,759
john our emcee for today john yemrick is

146
00:05:03,510 --> 00:05:00,560
also nasa's social media manager and

147
00:05:06,150 --> 00:05:03,520
we're very proud here at nasa to

148
00:05:08,469 --> 00:05:06,160
to be considered by many to be a leader

149
00:05:10,150 --> 00:05:08,479
in the use of social media and i

150
00:05:11,510 --> 00:05:10,160
understand over the course of the day

151
00:05:14,230 --> 00:05:11,520
we're probably going to have about 100

152
00:05:16,950 --> 00:05:14,240
or so members of our nasa social media

153
00:05:18,469 --> 00:05:16,960
network that will be going and coming

154
00:05:20,390 --> 00:05:18,479
john's already asked you all to

155
00:05:21,670 --> 00:05:20,400
recognize yourselves but i want to take

156
00:05:23,510 --> 00:05:21,680
a moment just to

157
00:05:26,150 --> 00:05:23,520
to talk to others about how important

158
00:05:27,749 --> 00:05:26,160
these folk are uh i'm gonna ask you not

159
00:05:29,510 --> 00:05:27,759
only clap but how about standing up for

160
00:05:32,550 --> 00:05:29,520
a moment people who have been part of

161
00:05:35,110 --> 00:05:32,560
the nasa social media uh group for quite

162
00:05:39,270 --> 00:05:35,120
some time and i i get to see them a lot

163
00:05:40,790 --> 00:05:39,280

i i want to applaud you uh personally

164
00:05:42,550 --> 00:05:40,800
thank you very much

165
00:05:43,430 --> 00:05:42,560
and and i want to tell you why i do that

166
00:05:46,629 --> 00:05:43,440
you know

167
00:05:48,870 --> 00:05:46,639
uh i came to nasa the first time in 1980

168
00:05:50,870 --> 00:05:48,880
when i entered the astronaut corps and i

169
00:05:52,790 --> 00:05:50,880
spent 14 years in the agency and i

170
00:05:55,029 --> 00:05:52,800
complained all the time about our

171
00:05:57,909 --> 00:05:55,039
inability to get our story out to the

172
00:06:00,070 --> 00:05:57,919
public uh i was somewhat notorious as a

173
00:06:01,590 --> 00:06:00,080
young as a young astronaut candidate i

174
00:06:02,309 --> 00:06:01,600
got in trouble the first time i traveled

175
00:06:04,070 --> 00:06:02,319
to

176
00:06:06,710 --> 00:06:04,080
the langley research center and i made a

177
00:06:08,950 --> 00:06:06,720
statement in a in a uh david weaver our

178
00:06:10,469 --> 00:06:08,960
director of of uh the office of

179
00:06:13,110 --> 00:06:10,479
communications is always worried about

180
00:06:15,110 --> 00:06:13,120
what i'm going to say but i i was at uh

181
00:06:17,110 --> 00:06:15,120
at langley for one of my first forays

182
00:06:19,110 --> 00:06:17,120
away from the johnson space center and i

183
00:06:21,350 --> 00:06:19,120
think i did something with the uh

184
00:06:23,350 --> 00:06:21,360
oh it was the pilot or some newspaper in

185
00:06:24,950 --> 00:06:23,360
that area and they said

186
00:06:27,110 --> 00:06:24,960
you know what do you think about nasa's

187
00:06:28,710 --> 00:06:27,120
public relations efforts and i said i

188
00:06:31,350 --> 00:06:28,720

think it sucks

189
00:06:32,870 --> 00:06:31,360
and uh he said what do you mean i said

190
00:06:34,710 --> 00:06:32,880
we just don't we don't we don't

191
00:06:36,070 --> 00:06:34,720
effectively tell our story

192
00:06:37,749 --> 00:06:36,080
and um

193
00:06:39,510 --> 00:06:37,759
david won't remember this but some of

194
00:06:42,790 --> 00:06:39,520
the folk in the in the office of

195
00:06:43,670 --> 00:06:42,800
communications will uh i came in and and

196
00:06:45,430 --> 00:06:43,680
uh

197
00:06:47,990 --> 00:06:45,440
into one of their meetings shortly after

198
00:06:51,189 --> 00:06:48,000
i had become the nasa administrator and

199
00:06:52,870 --> 00:06:51,199
i apologize because i said you know i

200
00:06:54,710 --> 00:06:52,880
i've been blaming the office of

201
00:06:56,550 --> 00:06:54,720
communications and the public relations

202
00:06:59,270 --> 00:06:56,560
department for our failure to tell our

203
00:07:01,830 --> 00:06:59,280
story when in fact it's my fault as the

204
00:07:03,830 --> 00:07:01,840
nasa administrator you know my job is to

205
00:07:05,110 --> 00:07:03,840
be the face and voice of nasa and get

206
00:07:07,830 --> 00:07:05,120
our story out

207
00:07:09,589 --> 00:07:07,840
um i have been frustrated for some time

208
00:07:11,350 --> 00:07:09,599
in not being able to do that effectively

209
00:07:13,990 --> 00:07:11,360
and then all of a sudden

210
00:07:16,870 --> 00:07:14,000
uh we had people like john yembrick

211
00:07:19,110 --> 00:07:16,880
and and alan and others who came up with

212
00:07:20,629 --> 00:07:19,120
this thing about uh you know

213
00:07:22,870 --> 00:07:20,639

nasa socials

214
00:07:23,830 --> 00:07:22,880
um we first started calling them tweet

215
00:07:26,230 --> 00:07:23,840
ups

216
00:07:28,230 --> 00:07:26,240
and what we found with the nasa social

217
00:07:29,510 --> 00:07:28,240
was we brought people in who could

218
00:07:31,589 --> 00:07:29,520
passionately

219
00:07:33,430 --> 00:07:31,599
talk about the experience of a nasa

220
00:07:35,430 --> 00:07:33,440
event

221
00:07:36,469 --> 00:07:35,440
whether it was a launch or something

222
00:07:38,629 --> 00:07:36,479
like this

223
00:07:41,430 --> 00:07:38,639
and so the reason we want to thank you

224
00:07:43,589 --> 00:07:41,440
is because you have been more effective

225
00:07:46,150 --> 00:07:43,599
in helping us tell our story than we

226
00:07:48,390 --> 00:07:46,160
ever were for about 50 years

227
00:07:50,950 --> 00:07:48,400
and that is critical you have been a you

228
00:07:53,110 --> 00:07:50,960
have been a revolutionary change in

229
00:07:54,550 --> 00:07:53,120
nasa's ability to get its story out to

230
00:07:56,710 --> 00:07:54,560
the rest of the world

231
00:07:58,390 --> 00:07:56,720
and what i ask you

232
00:08:01,189 --> 00:07:58,400
some of you who have been with with me

233
00:08:03,029 --> 00:08:01,199
before you know i i ask you uh be

234
00:08:05,430 --> 00:08:03,039
passionate in your writing and your

235
00:08:07,670 --> 00:08:05,440
tweeting and everything else there are

236
00:08:09,749 --> 00:08:07,680
literally millions of people around the

237
00:08:13,350 --> 00:08:09,759
world who will read what you say who

238
00:08:15,670 --> 00:08:13,360

will see what you what you tweet and uh

239
00:08:17,990 --> 00:08:15,680
they are not fortunate to be here but

240
00:08:20,710 --> 00:08:18,000
they can feel things through you

241
00:08:22,150 --> 00:08:20,720
if you write and speak with passion so

242
00:08:24,230 --> 00:08:22,160
that's what we ask you to do tell them

243
00:08:25,670 --> 00:08:24,240
what it's like to be here

244
00:08:27,830 --> 00:08:25,680
and tell them what what you're

245
00:08:29,589 --> 00:08:27,840
experiencing and and you will do far

246
00:08:31,670 --> 00:08:29,599
more than you could ever imagine so i do

247
00:08:34,070 --> 00:08:31,680
want to thank you as i said this is a

248
00:08:35,350 --> 00:08:34,080
particularly historic weekend uh not

249
00:08:37,350 --> 00:08:35,360
only for the president and the first

250
00:08:38,870 --> 00:08:37,360
family but for all of us in government

251
00:08:40,630 --> 00:08:38,880
and in communities throughout this

252
00:08:42,790 --> 00:08:40,640
nation who are ready to build on the

253
00:08:44,710 --> 00:08:42,800
progress we've made to make the next

254
00:08:45,670 --> 00:08:44,720
four years the best this nation has ever

255
00:08:47,670 --> 00:08:45,680
known

256
00:08:51,110 --> 00:08:47,680
as you may know

257
00:08:53,030 --> 00:08:51,120
and i've mentioned earlier this year's

258
00:08:54,949 --> 00:08:53,040
this year president obama's inauguration

259
00:08:57,190 --> 00:08:54,959
coincides with the reverend dr martin

260
00:08:59,590 --> 00:08:57,200
luther king day and the national day of

261
00:09:02,389 --> 00:08:59,600
service both observances that nasa

262
00:09:04,310 --> 00:09:02,399
strongly supports in fact tomorrow as

263
00:09:05,110 --> 00:09:04,320

john already mentioned on the national

264
00:09:07,030 --> 00:09:05,120
mall

265
00:09:08,710 --> 00:09:07,040
we'll honor the legacy of the of the

266
00:09:11,590 --> 00:09:08,720
20th century's greatest civil rights

267
00:09:14,389 --> 00:09:11,600
leader by joining 92 national service

268
00:09:16,230 --> 00:09:14,399
organizations and 14 federal agencies in

269
00:09:19,430 --> 00:09:16,240
an event on the national mall from 10

270
00:09:21,590 --> 00:09:19,440
a.m to 5 p.m designed to connect

271
00:09:23,190 --> 00:09:21,600
citizens with volunteer opportunities

272
00:09:25,269 --> 00:09:23,200
across the nation

273
00:09:27,269 --> 00:09:25,279
nasa's tent will be on the mall between

274
00:09:29,509 --> 00:09:27,279
14th street and 12th street in the

275
00:09:31,030 --> 00:09:29,519
education section did i get that right

276
00:09:32,790 --> 00:09:31,040
all right

277
00:09:34,870 --> 00:09:32,800
there you'll be able to meet and mingle

278
00:09:37,350 --> 00:09:34,880
with several of our astronauts learn

279
00:09:39,430 --> 00:09:37,360
more about ways that you can engage

280
00:09:42,150 --> 00:09:39,440
directly with nasa programs

281
00:09:44,949 --> 00:09:42,160
i also understand that you may have an

282
00:09:47,350 --> 00:09:44,959
opportunity to meet mohawk guy

283
00:09:49,750 --> 00:09:47,360
of curiosity fame he is scheduled to be

284
00:09:51,829 --> 00:09:49,760
here he became somewhat of a celebrity

285
00:09:53,509 --> 00:09:51,839
as a part of the mission team uh that

286
00:09:56,070 --> 00:09:53,519
completed the unprecedented landing of

287
00:09:57,269 --> 00:09:56,080
the curiosity rover on mars back in

288
00:09:59,990 --> 00:09:57,279

august

289
00:10:02,310 --> 00:10:00,000
later saturday evening from 5 30 to 9 30

290
00:10:05,110 --> 00:10:02,320
p.m at the david m brown planetarium in

291
00:10:06,150 --> 00:10:05,120
arlington virginia we're hosting a star

292
00:10:08,230 --> 00:10:06,160
party

293
00:10:10,230 --> 00:10:08,240
a chance to stargaze through telescopes

294
00:10:12,389 --> 00:10:10,240
that will be set up at the planetarium

295
00:10:15,110 --> 00:10:12,399
and astronomers from nasa and local

296
00:10:16,949 --> 00:10:15,120
astronomy organizations will be on hand

297
00:10:18,470 --> 00:10:16,959
to discuss and answer any questions that

298
00:10:19,910 --> 00:10:18,480
you all may have

299
00:10:22,470 --> 00:10:19,920
both events are free and open to the

300
00:10:24,150 --> 00:10:22,480
public and i urge all of you who can to

301
00:10:25,590 --> 00:10:24,160
take advantage of these unique

302
00:10:27,190 --> 00:10:25,600
opportunities

303
00:10:29,509 --> 00:10:27,200
finally

304
00:10:32,230 --> 00:10:29,519
more nasa astronauts and full-size

305
00:10:35,030 --> 00:10:32,240
models of two nasa spacecraft will be

306
00:10:36,949 --> 00:10:35,040
featured on monday's inaugural parade uh

307
00:10:39,509 --> 00:10:36,959
the curiosity rover and our orion

308
00:10:41,110 --> 00:10:39,519
multi-purpose capsule that's under final

309
00:10:43,030 --> 00:10:41,120
construction will take our and we'll

310
00:10:45,350 --> 00:10:43,040
take our astronauts farther into space

311
00:10:46,870 --> 00:10:45,360
than ever before uh will be represented

312
00:10:49,910 --> 00:10:46,880
on these floats

313
00:10:52,630 --> 00:10:49,920

to set the stage for all of that we've

314
00:10:54,710 --> 00:10:52,640
put together an exciting program today

315
00:10:56,710 --> 00:10:54,720
featuring panel discussions

316
00:10:58,790 --> 00:10:56,720
video presentations

317
00:11:00,790 --> 00:10:58,800
and exhibits to give you a bird's eye

318
00:11:03,110 --> 00:11:00,800
view of some of the exciting things that

319
00:11:05,269 --> 00:11:03,120
are happening here at nasa

320
00:11:07,509 --> 00:11:05,279
this morning from now until about 11

321
00:11:09,910 --> 00:11:07,519
o'clock you'll hear from nasa's top

322
00:11:11,829 --> 00:11:09,920
human exploration experts about the

323
00:11:14,949 --> 00:11:11,839
progress we're making to send humans

324
00:11:16,550 --> 00:11:14,959
farther into space than ever before

325
00:11:18,150 --> 00:11:16,560
that will be followed by a panel

326
00:11:20,069 --> 00:11:18,160
discussion that will address the

327
00:11:22,630 --> 00:11:20,079
important role that technology and

328
00:11:24,870 --> 00:11:22,640
innovation play in advancing the goals

329
00:11:26,630 --> 00:11:24,880
of nasa and our economy

330
00:11:28,470 --> 00:11:26,640
we'll conclude the morning session with

331
00:11:31,910 --> 00:11:28,480
an 11 30 demonstration of our

332
00:11:33,910 --> 00:11:31,920
exoskeleton a 57 pound robotic which is

333
00:11:36,470 --> 00:11:33,920
undergoing tests at the johnson space

334
00:11:38,630 --> 00:11:36,480
center in houston has anybody ever seen

335
00:11:41,590 --> 00:11:38,640
not here at nasa headquarters has

336
00:11:43,750 --> 00:11:41,600
anybody ever seen the exoskeleton before

337
00:11:45,430 --> 00:11:43,760
anybody got a guess what it is what's

338
00:11:47,269 --> 00:11:45,440

your name the young lady right there

339
00:11:49,269 --> 00:11:47,279
beautiful young lady

340
00:11:50,310 --> 00:11:49,279
what's your name

341
00:11:51,590 --> 00:11:50,320
sophie

342
00:11:53,430 --> 00:11:51,600
is that right is that your brother

343
00:11:54,470 --> 00:11:53,440
sophie the one that's squirming and

344
00:11:57,110 --> 00:11:54,480
stuff

345
00:11:58,710 --> 00:11:57,120
that's not your brother that's your son

346
00:12:01,030 --> 00:11:58,720
or your brother

347
00:12:02,310 --> 00:12:01,040
your son what's your name

348
00:12:04,790 --> 00:12:02,320
aiden

349
00:12:06,470 --> 00:12:04,800
so aidan and sophie uh are you all gonna

350
00:12:07,509 --> 00:12:06,480
be around for the exoskeleton about 11

351
00:12:10,310 --> 00:12:07,519
30.

352
00:12:11,590 --> 00:12:10,320
okay it stand by it's thrilling and i'm

353
00:12:14,550 --> 00:12:11,600
not going to give you any more stuff but

354
00:12:16,870 --> 00:12:14,560
it's it's pretty exciting and we love it

355
00:12:18,870 --> 00:12:16,880
because not only do we think it has

356
00:12:20,710 --> 00:12:18,880
applica applications for

357
00:12:22,470 --> 00:12:20,720
astronauts operating in space on the

358
00:12:25,750 --> 00:12:22,480
international space station or other

359
00:12:27,509 --> 00:12:25,760
places in our universe but it may also

360
00:12:29,509 --> 00:12:27,519
have applicability to people here on

361
00:12:31,910 --> 00:12:29,519
earth who who are not as fortunate as

362
00:12:34,069 --> 00:12:31,920
many of us and can't just mobilize

363
00:12:38,069 --> 00:12:34,079

around the way that that many of us do

364
00:12:39,910 --> 00:12:38,079
so stand by for for the exoskeleton

365
00:12:42,550 --> 00:12:39,920
an astronaut in space could wear this

366
00:12:45,509 --> 00:12:42,560
device over his or her body either to

367
00:12:47,590 --> 00:12:45,519
assist or inhibit movement in leg joints

368
00:12:50,069 --> 00:12:47,600
the exoskeleton also holds promise for

369
00:12:50,870 --> 00:12:50,079
assisting paraplegics in walking here on

370
00:12:53,829 --> 00:12:50,880
earth

371
00:12:56,389 --> 00:12:53,839
there will be a break around noon and uh

372
00:12:58,550 --> 00:12:56,399
we have a plethora

373
00:12:59,750 --> 00:12:58,560
that means an abundance

374
00:13:03,350 --> 00:12:59,760
knot

375
00:13:05,670 --> 00:13:03,360
of restaurants and uh fine eateries

376
00:13:06,790 --> 00:13:05,680
right here near nasa you notice i said

377
00:13:08,870 --> 00:13:06,800
not

378
00:13:11,190 --> 00:13:08,880
but but there are places where you can

379
00:13:13,030 --> 00:13:11,200
find food that's that's very close

380
00:13:15,190 --> 00:13:13,040
within walking distance and we even have

381
00:13:16,310 --> 00:13:15,200
a cafeteria down on the other end of the

382
00:13:17,990 --> 00:13:16,320
building so

383
00:13:20,230 --> 00:13:18,000
get a bite to eat and then come back for

384
00:13:22,629 --> 00:13:20,240
the afternoon session because we're

385
00:13:24,550 --> 00:13:22,639
going to reconvene at 2 for a second set

386
00:13:25,750 --> 00:13:24,560
of panel discussions focusing on our

387
00:13:27,990 --> 00:13:25,760
science

388
00:13:29,110 --> 00:13:28,000

that the astronauts and students here on

389
00:13:30,870 --> 00:13:29,120
earth are conducting on the

390
00:13:32,470 --> 00:13:30,880
international space station

391
00:13:34,470 --> 00:13:32,480
that will be followed by an update on

392
00:13:36,470 --> 00:13:34,480
the mars curiosity mission

393
00:13:38,870 --> 00:13:36,480
and a panel discussion on our future

394
00:13:40,150 --> 00:13:38,880
plans for exploring the red planet

395
00:13:41,509 --> 00:13:40,160
finally

396
00:13:43,910 --> 00:13:41,519
i have to tell you that space

397
00:13:46,550 --> 00:13:43,920
exploration is one of the few things

398
00:13:48,550 --> 00:13:46,560
that enjoys bipartisan support here in

399
00:13:50,150 --> 00:13:48,560
in washington d.c

400
00:13:52,389 --> 00:13:50,160
none of the exciting things we're doing

401
00:13:54,629 --> 00:13:52,399
at nasa would be possible without the

402
00:13:56,790 --> 00:13:54,639
support of president obama the members

403
00:13:58,629 --> 00:13:56,800
of congress of both parties and most

404
00:14:00,870 --> 00:13:58,639
particularly you

405
00:14:02,389 --> 00:14:00,880
so as we prepare for president obama's

406
00:14:04,949 --> 00:14:02,399
second inauguration

407
00:14:07,509 --> 00:14:04,959
i want to thank him and all of you for

408
00:14:09,430 --> 00:14:07,519
your support of america's space program

409
00:14:11,829 --> 00:14:09,440
i especially hope that all the young

410
00:14:13,750 --> 00:14:11,839
people who are here go back home with a

411
00:14:15,269 --> 00:14:13,760
heightened passion and a greater

412
00:14:18,949 --> 00:14:15,279
understanding of the importance of

413
00:14:20,629 --> 00:14:18,959

science technology engineering and math

414
00:14:23,430 --> 00:14:20,639
the stem disciplines are not only

415
00:14:25,910 --> 00:14:23,440
essential to the growth of nasa they are

416
00:14:28,389 --> 00:14:25,920
your gateway to the jobs of the future

417
00:14:31,829 --> 00:14:28,399
and the keys to american competitiveness

418
00:14:33,189 --> 00:14:31,839
in the 21st century so sophie

419
00:14:35,189 --> 00:14:33,199
stand by

420
00:14:37,430 --> 00:14:35,199
hopefully you all will have a phenomenal

421
00:14:39,590 --> 00:14:37,440
day i want to thank all of you again for

422
00:14:57,430 --> 00:14:39,600
coming enjoy this day and this weekend

423
00:15:03,269 --> 00:14:59,990
we are the explorers

424
00:15:05,910 --> 00:15:03,279
we have a need to find what is out there

425
00:15:08,949 --> 00:15:05,920
it is a drive inside each and every one

426
00:15:12,949 --> 00:15:08,959
of us the drive to wonder to push the

427
00:15:15,670 --> 00:15:12,959
boundaries and to explore

428
00:15:17,430 --> 00:15:15,680
we expanded across our lands settling

429
00:15:19,829 --> 00:15:17,440
new frontiers

430
00:15:22,389 --> 00:15:19,839
we took to the oceans and learned that

431
00:15:24,550 --> 00:15:22,399
we could cross treacherous expanses in

432
00:15:29,110 --> 00:15:24,560
the pursuit of discovery

433
00:15:31,590 --> 00:15:29,120
and then we took to the skies and flew

434
00:15:37,030 --> 00:15:31,600
but that wasn't enough we left the

435
00:15:44,790 --> 00:15:42,069
we flew in space we walked in space

436
00:15:49,030 --> 00:15:44,800
what once was a melodramatic flight of

437
00:15:52,069 --> 00:15:49,040
fantasy became reality

438
00:15:54,230 --> 00:15:52,079

then a new generation of spaceships

439
00:15:57,189 --> 00:15:54,240
captured hearts and minds for three

440
00:16:03,430 --> 00:15:57,199
decades and helped build a castle in the

441
00:16:08,310 --> 00:16:05,590
we have always looked up

442
00:16:10,870 --> 00:16:08,320
for centuries we wondered what was on

443
00:16:13,590 --> 00:16:10,880
the other side of the sky and we have

444
00:16:16,150 --> 00:16:13,600
begun to answer that question

445
00:16:18,710 --> 00:16:16,160
we have learned that all the exploration

446
00:16:20,870 --> 00:16:18,720
humankind has achieved is only a

447
00:16:22,949 --> 00:16:20,880
beginning

448
00:16:25,110 --> 00:16:22,959
right now men and women are working on

449
00:16:27,030 --> 00:16:25,120
the next steps to go farther than we

450
00:16:29,829 --> 00:16:27,040
have ever gone before

451
00:16:33,030 --> 00:16:29,839
new vessels will carry us and new

452
00:16:35,350 --> 00:16:33,040
destinations await us

453
00:16:38,310 --> 00:16:35,360
everything we have ever accomplished

454
00:16:40,790 --> 00:16:38,320
leads to this moment in time where

455
00:16:44,230 --> 00:16:40,800
exploration will now take us to the

456
00:16:46,710 --> 00:16:44,240
planets and the stars

457
00:16:50,230 --> 00:16:46,720
our nearest neighbors in the night sky

458
00:16:53,350 --> 00:16:50,240
have beckoned us invited us dared us to

459
00:16:57,910 --> 00:16:54,230
we

460
00:17:00,790 --> 00:16:57,920
are the explorers throughout our history

461
00:17:02,829 --> 00:17:00,800
we have taken both small steps and giant

462
00:17:07,029 --> 00:17:02,839
leaps in that

463
00:17:09,590 --> 00:17:07,039

pursuit our next destination awaits

464
00:17:10,549 --> 00:17:09,600
we don't know what new discoveries lie

465
00:17:26,470 --> 00:17:10,559
ahead

466
00:17:29,350 --> 00:17:27,829
before we start next panel i want to

467
00:17:30,950 --> 00:17:29,360
remind those watching home you can ask

468
00:17:33,669 --> 00:17:30,960
questions on social media using the

469
00:17:35,750 --> 00:17:33,679
hashtag pound ask nasa and hopefully

470
00:17:37,909 --> 00:17:35,760
we'll be able to answer them here

471
00:17:39,990 --> 00:17:37,919
at nasa headquarters in washington

472
00:17:41,830 --> 00:17:40,000
human space exploration helped address

473
00:17:43,350 --> 00:17:41,840
fundamental questions about our place in

474
00:17:44,710 --> 00:17:43,360
the universe and the history of our

475
00:17:46,230 --> 00:17:44,720
solar system

476
00:17:47,590 --> 00:17:46,240
we are human and we identify with the

477
00:17:48,710 --> 00:17:47,600
human experience

478
00:17:50,710 --> 00:17:48,720
through addressing the challenges

479
00:17:52,310 --> 00:17:50,720
related to human space exploration we

480
00:17:54,950 --> 00:17:52,320
expand technologies

481
00:17:57,190 --> 00:17:54,960
create new industries and help to foster

482
00:17:59,590 --> 00:17:57,200
a peaceful connection with other nations

483
00:18:00,950 --> 00:17:59,600
please welcome momta

484
00:18:03,190 --> 00:18:00,960
our moderator for this morning's first

485
00:18:08,549 --> 00:18:03,200
panel on nasa's plans for human space

486
00:18:11,990 --> 00:18:10,470
good morning good morning and thank you

487
00:18:13,669 --> 00:18:12,000
so much for being with us i hope you're

488
00:18:16,070 --> 00:18:13,679

ready for an educational day as you

489
00:18:18,470 --> 00:18:16,080
learn about what nasa has in store for

490
00:18:20,789 --> 00:18:18,480
our nation as we push new frontiers

491
00:18:23,350 --> 00:18:20,799
today we have mr bill gerstenmaier and

492
00:18:25,190 --> 00:18:23,360
dr mike gazarick here to tell you just

493
00:18:27,669 --> 00:18:25,200
about that what we have planned for the

494
00:18:29,029 --> 00:18:27,679
future of space mr bill gerstenmaier is

495
00:18:30,870 --> 00:18:29,039
the is currently the associate

496
00:18:33,350 --> 00:18:30,880
administrator for our human exploration

497
00:18:36,950 --> 00:18:33,360
and operations directorate

498
00:18:38,070 --> 00:18:36,960
in that position he leads our nation our

499
00:18:40,230 --> 00:18:38,080
agency

500
00:18:41,990 --> 00:18:40,240
in strategy and direction for

501
00:18:44,710 --> 00:18:42,000
all of our human-based exploration

502
00:18:46,310 --> 00:18:44,720
programs so it sounds like a big job huh

503
00:18:47,990 --> 00:18:46,320
well it is but luckily he brings a

504
00:18:49,909 --> 00:18:48,000
storied career from the early days of

505
00:18:52,230 --> 00:18:49,919
the space shuttle at what was then

506
00:18:53,990 --> 00:18:52,240
called the lewis research center to most

507
00:18:55,909 --> 00:18:54,000
recently managing the international

508
00:18:57,350 --> 00:18:55,919
space station program at johnson space

509
00:18:58,950 --> 00:18:57,360
center before coming here at

510
00:19:01,190 --> 00:18:58,960
headquarters in leading our human-based

511
00:19:02,870 --> 00:19:01,200
exploration program he's an alumnus of

512
00:19:04,789 --> 00:19:02,880
purdue university in aeronautical

513
00:19:06,789 --> 00:19:04,799

engineering and he is certainly somebody

514
00:19:09,270 --> 00:19:06,799
who can answer most if not all of your

515
00:19:11,110 --> 00:19:09,280
questions on human-based exploration

516
00:19:13,110 --> 00:19:11,120
along with mr gerstenmaier we have dr

517
00:19:15,270 --> 00:19:13,120
mike gazarick who is the director of our

518
00:19:17,590 --> 00:19:15,280
space technology program

519
00:19:19,990 --> 00:19:17,600
dr gazarick has over 25 years in the

520
00:19:21,990 --> 00:19:20,000
engineering industry in our space flight

521
00:19:24,710 --> 00:19:22,000
program he's worked on numerous projects

522
00:19:26,230 --> 00:19:24,720
from the mars science laboratory to and

523
00:19:28,549 --> 00:19:26,240
let me make sure i get this right

524
00:19:30,470 --> 00:19:28,559
advanced laser-based

525
00:19:31,990 --> 00:19:30,480
rendezvous and docking sensor systems i

526
00:19:33,430 --> 00:19:32,000
had to memorize that it sounds very

527
00:19:35,990 --> 00:19:33,440
intelligent so besides bringing

528
00:19:37,830 --> 00:19:36,000
intelligence to the table he also has

529
00:19:39,190 --> 00:19:37,840
just the knowledge we need to to learn

530
00:19:41,110 --> 00:19:39,200
about the technology it will take to

531
00:19:43,430 --> 00:19:41,120
achieve our future future space flight

532
00:19:45,350 --> 00:19:43,440
goals so what i'd like to do is begin by

533
00:19:47,430 --> 00:19:45,360
allowing each of our panelists to give

534
00:19:49,590 --> 00:19:47,440
you an introduction and insight into the

535
00:19:51,029 --> 00:19:49,600
future of human space flight and then

536
00:19:52,950 --> 00:19:51,039
answer any of those questions that you

537
00:19:55,190 --> 00:19:52,960
may have so mr gerstenmaier if you can

538
00:19:57,669 --> 00:19:55,200

begin by letting us know what the next

539
00:20:00,230 --> 00:19:57,679
five to ten years hold for nasa

540
00:20:01,909 --> 00:20:00,240
okay i'll kind of just give you a kind

541
00:20:03,750 --> 00:20:01,919
of a quick thumbnail sketch of what

542
00:20:05,669 --> 00:20:03,760
we're doing and what's moving forward

543
00:20:08,630 --> 00:20:05,679
it's a pretty exciting time in human

544
00:20:10,710 --> 00:20:08,640
space flight you know again we have as

545
00:20:12,470 --> 00:20:10,720
john said earlier we have six crew

546
00:20:14,390 --> 00:20:12,480
onboard the space station today as we

547
00:20:16,630 --> 00:20:14,400
sit here and it's it's pretty amazing to

548
00:20:18,710 --> 00:20:16,640
me to think that every day we've got six

549
00:20:21,110 --> 00:20:18,720
folks living working doing research

550
00:20:22,549 --> 00:20:21,120
onboard space station every single day a

551
00:20:23,990 --> 00:20:22,559
lot of their activities are in the

552
00:20:25,669 --> 00:20:24,000
science realm and there'll be a panel

553
00:20:28,070 --> 00:20:25,679
later this afternoon it'll talk about

554
00:20:30,230 --> 00:20:28,080
those activities but we also use the

555
00:20:32,470 --> 00:20:30,240
space station as kind of a technology

556
00:20:34,870 --> 00:20:32,480
and research platform you know this week

557
00:20:36,470 --> 00:20:34,880
we had a media event where we talked

558
00:20:38,070 --> 00:20:36,480
about a module we're going to add

559
00:20:39,430 --> 00:20:38,080
essentially an expandable structure

560
00:20:41,110 --> 00:20:39,440
that's going to sit on the outside of

561
00:20:43,590 --> 00:20:41,120
space station

562
00:20:45,750 --> 00:20:43,600
that's a very unique structure typically

563
00:20:48,549 --> 00:20:45,760

our modules we live in are large

564
00:20:50,789 --> 00:20:48,559
aluminum cans where the

565
00:20:53,190 --> 00:20:50,799
the the center piece or down the middle

566
00:20:55,430 --> 00:20:53,200
of the activity is open and then all the

567
00:20:57,350 --> 00:20:55,440
research equipment is on the outside we

568
00:20:58,950 --> 00:20:57,360
go to expandables there's going to be a

569
00:21:00,870 --> 00:20:58,960
keel down the middle and now there's

570
00:21:02,870 --> 00:21:00,880
just all this open space and volume on

571
00:21:04,710 --> 00:21:02,880
the outside we think those new modules

572
00:21:06,950 --> 00:21:04,720
will be very important to us as we go do

573
00:21:08,630 --> 00:21:06,960
exploration they'll be needed for for

574
00:21:10,789 --> 00:21:08,640
the long distances we're going to travel

575
00:21:12,950 --> 00:21:10,799
where we'll be in space for up to years

576
00:21:14,470 --> 00:21:12,960
maybe two three years and you really

577
00:21:15,990 --> 00:21:14,480
need some large habitable volume so

578
00:21:17,430 --> 00:21:16,000
we'll gain some experience on space

579
00:21:19,350 --> 00:21:17,440
station with that with that type of

580
00:21:20,789 --> 00:21:19,360
module they also work well on surface

581
00:21:22,230 --> 00:21:20,799
systems

582
00:21:23,990 --> 00:21:22,240
so that's kind of the first piece of

583
00:21:25,750 --> 00:21:24,000
space station the next piece is we're

584
00:21:27,270 --> 00:21:25,760
working on the orion capsule down in

585
00:21:29,029 --> 00:21:27,280
florida today

586
00:21:31,350 --> 00:21:29,039
you saw some of the pictures of it in

587
00:21:32,149 --> 00:21:31,360
the videos here we're getting ready for

588
00:22:15,909 --> 00:21:32,159

a

589
00:22:18,149 --> 00:22:15,919
vicinity of the moon in 2021 so pretty

590
00:22:20,230 --> 00:22:18,159
exciting near-term period with with that

591
00:22:21,669 --> 00:22:20,240
vehicle that vehicle needs to ride on a

592
00:22:23,270 --> 00:22:21,679
new launch system that's called the

593
00:22:25,510 --> 00:22:23,280
space launch system that'll be

594
00:22:27,430 --> 00:22:25,520
manufactured in new orleans we're in the

595
00:22:29,510 --> 00:22:27,440
process of doing a lot of design work

596
00:22:30,630 --> 00:22:29,520
and getting that ready to move forward

597
00:22:31,909 --> 00:22:30,640
the other thing that you're starting to

598
00:22:33,590 --> 00:22:31,919
see now is you're starting to see a lot

599
00:22:35,510 --> 00:22:33,600
of commercial activities occur both on

600
00:22:37,990 --> 00:22:35,520
the cargo delivery to space station and

601
00:22:39,669 --> 00:22:38,000
also new vehicles that will take crews

602
00:22:40,789 --> 00:22:39,679
to the space station and we call those

603
00:22:42,630 --> 00:22:40,799
commercial or they're coming

604
00:22:44,630 --> 00:22:42,640
predominantly from the private sector so

605
00:22:46,470 --> 00:22:44,640
we're acquiring those new capabilities

606
00:22:48,310 --> 00:22:46,480
in a different way so instead of nasa

607
00:22:50,470 --> 00:22:48,320
being there kind of hand in hand and

608
00:22:52,390 --> 00:22:50,480
guiding and leading the design the

609
00:22:54,310 --> 00:22:52,400
technology is mature enough in low earth

610
00:22:55,430 --> 00:22:54,320
orbit that we can let someone go do that

611
00:22:57,430 --> 00:22:55,440
for us and all we're doing is

612
00:23:00,310 --> 00:22:57,440
essentially buying a service so it's

613
00:23:02,470 --> 00:23:00,320

exciting to see a whole group new group

614
00:23:05,029 --> 00:23:02,480
of engineers new companies come on board

615
00:23:06,950 --> 00:23:05,039
to actually deliver services for us so

616
00:23:08,789 --> 00:23:06,960
again those are the major highlights i

617
00:23:10,710 --> 00:23:08,799
look forward to your questions i think

618
00:23:12,549 --> 00:23:10,720
the thing that really drives us at this

619
00:23:14,630 --> 00:23:12,559
agency more than anything is we really

620
00:23:16,710 --> 00:23:14,640
love a challenge i think all the folks

621
00:23:18,230 --> 00:23:16,720
and engineers that work with us they

622
00:23:20,310 --> 00:23:18,240
like those problems in the back of the

623
00:23:22,630 --> 00:23:20,320
book that it said this is for extra

624
00:23:24,230 --> 00:23:22,640
credit there's no answer to this problem

625
00:23:26,070 --> 00:23:24,240
these are the things that we thrive on

626
00:23:27,990 --> 00:23:26,080
every day so whether it's a budget

627
00:23:29,750 --> 00:23:28,000
challenge it's a political challenge

628
00:23:31,510 --> 00:23:29,760
it's a technology challenge whatever

629
00:23:33,110 --> 00:23:31,520
that challenge is i have a team that

630
00:23:34,710 --> 00:23:33,120
works behind me that i'm willing to give

631
00:23:36,789 --> 00:23:34,720
that challenge to and it's amazing what

632
00:23:38,310 --> 00:23:36,799
this agency can accomplish if we just

633
00:23:40,310 --> 00:23:38,320
articulate the challenge in a way they

634
00:23:41,990 --> 00:23:40,320
can understand so i'll turn it over to

635
00:23:43,510 --> 00:23:42,000
mike to talk about some technology

636
00:23:45,350 --> 00:23:43,520
absolutely if you could give us an idea

637
00:23:46,870 --> 00:23:45,360
into the technologies that will be

638
00:23:49,110 --> 00:23:46,880

required to achieve these goals mr

639
00:23:51,269 --> 00:23:49,120
gerstenmaier spoke about absolutely it's

640
00:23:52,789 --> 00:23:51,279
great to be here and and thanks and

641
00:23:53,830 --> 00:23:52,799
welcome again everybody here thanks for

642
00:23:57,830 --> 00:23:53,840
coming out

643
00:23:59,909 --> 00:23:57,840
um so space technology uh is uh a a very

644
00:24:02,470 --> 00:23:59,919
exciting program this year uh we have

645
00:24:04,549 --> 00:24:02,480
over 800 projects that we've uh are

646
00:24:06,149 --> 00:24:04,559
engaged in making progress in and what

647
00:24:07,909 --> 00:24:06,159
we're working on are the technologies

648
00:24:09,590 --> 00:24:07,919
that are needed for future exploration

649
00:24:11,510 --> 00:24:09,600
for some of the things that that bill

650
00:24:13,269 --> 00:24:11,520
talked about those technologies that are

651
00:24:14,789 --> 00:24:13,279
needed we're working on those today

652
00:24:16,870 --> 00:24:14,799
we're building those we're testing them

653
00:24:18,950 --> 00:24:16,880
we're in the laboratories uh trying to

654
00:24:20,630 --> 00:24:18,960
figure out and develop and get ready for

655
00:24:23,430 --> 00:24:20,640
future mission exploration that can be

656
00:24:25,110 --> 00:24:23,440
used in our exploration plans

657
00:24:27,510 --> 00:24:25,120
so we can go further than we ever have

658
00:24:29,269 --> 00:24:27,520
before in space so we're looking at

659
00:24:31,269 --> 00:24:29,279
technologies that will allow us to go

660
00:24:32,950 --> 00:24:31,279
above and beyond you know the the

661
00:24:35,029 --> 00:24:32,960
international space station in low earth

662
00:24:36,710 --> 00:24:35,039
orbit and so we know

663
00:24:38,470 --> 00:24:36,720

there are things that we need to do to

664
00:24:40,549 --> 00:24:38,480
go explore that we have to get ready to

665
00:24:41,750 --> 00:24:40,559
make sure we understand how they work

666
00:24:44,630 --> 00:24:41,760
and solve some of the really tough

667
00:24:46,070 --> 00:24:44,640
problems that bill just described

668
00:24:47,830 --> 00:24:46,080
the list of challenges you need to

669
00:24:49,510 --> 00:24:47,840
explore is pretty interesting it's it's

670
00:24:51,269 --> 00:24:49,520
pretty much been the same list that's

671
00:24:52,789 --> 00:24:51,279
been there since let's say early viking

672
00:24:54,630 --> 00:24:52,799
explorers you know you need a way to be

673
00:24:56,789 --> 00:24:54,640
able to move we need propulsion you need

674
00:24:59,029 --> 00:24:56,799
to be able to way to stay alive food or

675
00:25:01,909 --> 00:24:59,039
eat you know life environmental systems

676
00:25:03,590 --> 00:25:01,919
you need an ability to communicate um

677
00:25:05,510 --> 00:25:03,600
and send signals back and forth and be

678
00:25:07,269 --> 00:25:05,520
able to to communicate of course back to

679
00:25:09,029 --> 00:25:07,279
the home base for the crew and so those

680
00:25:10,710 --> 00:25:09,039
kind of are the same basic problems and

681
00:25:11,830 --> 00:25:10,720
challenges we've had really you know for

682
00:25:13,750 --> 00:25:11,840
years and so those are some of the

683
00:25:15,510 --> 00:25:13,760
things we're working on so for example

684
00:25:17,269 --> 00:25:15,520
one of the projects we have uh very

685
00:25:19,190 --> 00:25:17,279
excited it's based up here at the

686
00:25:21,510 --> 00:25:19,200
goddard space flight center is to use

687
00:25:24,390 --> 00:25:21,520
optical communication lasers sending

688
00:25:26,549 --> 00:25:24,400

data back and forth um from space to be

689
00:25:27,909 --> 00:25:26,559
able to transmit the data as we go uh

690
00:25:29,590 --> 00:25:27,919
and we'll need that as we go and explore

691
00:25:31,909 --> 00:25:29,600
space you may have seen some of the

692
00:25:34,149 --> 00:25:31,919
great images from mars from some of the

693
00:25:35,669 --> 00:25:34,159
orbiters we have on mars you know the

694
00:25:37,830 --> 00:25:35,679
majority of the data the pictures on

695
00:25:39,350 --> 00:25:37,840
mars actually remain on mars we can't

696
00:25:41,430 --> 00:25:39,360
get them off the planet and through the

697
00:25:42,950 --> 00:25:41,440
bandwidth and back here to earth and so

698
00:25:45,190 --> 00:25:42,960
and so uh you know we don't want to

699
00:25:46,710 --> 00:25:45,200
continue we want to con you know explore

700
00:25:48,149 --> 00:25:46,720
if you will the universe with uh

701
00:25:49,669 --> 00:25:48,159
something let's say like a cable modem

702
00:25:51,110 --> 00:25:49,679
you know versus the old dial up modems

703
00:25:52,630 --> 00:25:51,120
you know that we had you know years ago

704
00:25:53,510 --> 00:25:52,640
for those of you who are old enough to

705
00:25:54,549 --> 00:25:53,520
remember

706
00:25:55,830 --> 00:25:54,559
those things

707
00:25:58,390 --> 00:25:55,840
um the other thing we're working on is

708
00:26:00,149 --> 00:25:58,400
propulsion right the ability to uh of

709
00:26:02,070 --> 00:26:00,159
course travel the vast distances in

710
00:26:03,590 --> 00:26:02,080
space and uh one of the ways we're

711
00:26:05,750 --> 00:26:03,600
looking at that is actually an exhibit

712
00:26:07,590 --> 00:26:05,760
here uh in the lobby i hope you get to

713
00:26:09,590 --> 00:26:07,600

see it it's a big what we call a solar

714
00:26:11,590 --> 00:26:09,600
sail and it's using the sun's energy the

715
00:26:13,909 --> 00:26:11,600
photons and the sun's energy to capture

716
00:26:15,669 --> 00:26:13,919
it in a big sail uh to be able to move

717
00:26:18,149 --> 00:26:15,679
without the need of propellant uh we can

718
00:26:20,149 --> 00:26:18,159
use the sun's energy then to to move

719
00:26:22,149 --> 00:26:20,159
around in space now you can't move very

720
00:26:24,149 --> 00:26:22,159
far and you can't move very fast but for

721
00:26:25,909 --> 00:26:24,159
a lot of applications especially those

722
00:26:28,310 --> 00:26:25,919
that are looking at the solar weather

723
00:26:30,390 --> 00:26:28,320
when we look at the sun and the type of

724
00:26:32,789 --> 00:26:30,400
energy and whether it it

725
00:26:34,549 --> 00:26:32,799
it spews that out us

726
00:26:36,149 --> 00:26:34,559
a mission like that that needs to stay

727
00:26:37,909 --> 00:26:36,159
in one place and for a long period of

728
00:26:40,630 --> 00:26:37,919
time great great application for

729
00:26:41,990 --> 00:26:40,640
something like a solar sail

730
00:26:43,830 --> 00:26:42,000
we cover a lot of things in space

731
00:26:44,710 --> 00:26:43,840
technology one of the ones that charlie

732
00:26:46,870 --> 00:26:44,720
mentioned is going to be that

733
00:26:48,789 --> 00:26:46,880
demonstration of exoskeleton

734
00:26:50,310 --> 00:26:48,799
this uh you know it's real iron man like

735
00:26:51,830 --> 00:26:50,320
stuff i i had the

736
00:26:53,590 --> 00:26:51,840
luxury to put on some of the hardware

737
00:26:55,990 --> 00:26:53,600
when i was at johnson space center just

738
00:26:57,909 --> 00:26:56,000

just a few weeks ago uh and and you know

739
00:26:59,190 --> 00:26:57,919
you can strap it on and i just kind of

740
00:27:01,269 --> 00:26:59,200
kind of like the movie but it's it's

741
00:27:03,590 --> 00:27:01,279
fantastic work allowing robotics and

742
00:27:05,430 --> 00:27:03,600
humans to interact um and as charlie

743
00:27:07,430 --> 00:27:05,440
mentioned great applications both for

744
00:27:09,190 --> 00:27:07,440
astronauts and of course for here here

745
00:27:10,870 --> 00:27:09,200
on earth

746
00:27:12,870 --> 00:27:10,880
in addition to that you may have seen on

747
00:27:15,269 --> 00:27:12,880
the international space station r2 he's

748
00:27:17,029 --> 00:27:15,279
a robot humanoid robot you may have seen

749
00:27:19,029 --> 00:27:17,039
him work in the presence of the crew

750
00:27:20,389 --> 00:27:19,039
that's another great example of robotics

751
00:27:22,149 --> 00:27:20,399
in the presence of humans

752
00:27:23,830 --> 00:27:22,159
and that started also at the johnson

753
00:27:25,269 --> 00:27:23,840
space center in a partnership with

754
00:27:27,269 --> 00:27:25,279
general motors

755
00:27:29,830 --> 00:27:27,279
both you may have seen robotics in

756
00:27:30,950 --> 00:27:29,840
automotive manufacturing plants you

757
00:27:32,549 --> 00:27:30,960
notice there's not a lot of humans

758
00:27:33,669 --> 00:27:32,559
around those typically because they can

759
00:27:35,029 --> 00:27:33,679
kill you

760
00:27:36,630 --> 00:27:35,039
they're big they're powerful right they

761
00:27:38,470 --> 00:27:36,640
move fast well the idea the astronauts

762
00:27:40,230 --> 00:27:38,480
get a little nervous about that uh on

763
00:27:42,230 --> 00:27:40,240

the international space station and so

764
00:27:44,230 --> 00:27:42,240
obviously we prefer a robotic that can

765
00:27:46,149 --> 00:27:44,240
detect your presence they can understand

766
00:27:47,590 --> 00:27:46,159
you're there and work and save proximity

767
00:27:49,669 --> 00:27:47,600
to astronauts

768
00:27:51,350 --> 00:27:49,679
so and so we have tough problems to

769
00:27:52,870 --> 00:27:51,360
solve as we we go to space we know it's

770
00:27:54,549 --> 00:27:52,880
a really really hard and challenging

771
00:27:56,149 --> 00:27:54,559
environment we have some of the toughest

772
00:27:57,430 --> 00:27:56,159
problems there are in the nation and so

773
00:27:58,950 --> 00:27:57,440
that's what the space tech program is

774
00:28:01,430 --> 00:27:58,960
about is going and tackling those

775
00:28:03,350 --> 00:28:01,440
problems and one of the ways we do that

776
00:28:05,110 --> 00:28:03,360
is not only the nasa workforce and

777
00:28:07,029 --> 00:28:05,120
talented as it is but we're also

778
00:28:09,029 --> 00:28:07,039
reaching out to universities to the

779
00:28:11,269 --> 00:28:09,039
nation's brightest and best and we now

780
00:28:14,149 --> 00:28:11,279
have engaged over 100 universities and

781
00:28:15,909 --> 00:28:14,159
350 activities in space technology as we

782
00:28:18,230 --> 00:28:15,919
engage them you know on the problems we

783
00:28:20,149 --> 00:28:18,240
need to solve for nasa and really some

784
00:28:21,350 --> 00:28:20,159
of the problems we have for the nation

785
00:28:23,029 --> 00:28:21,360
so that's a great year in space

786
00:28:25,350 --> 00:28:23,039
technology and again too i'll be glad to

787
00:28:27,110 --> 00:28:25,360
talk more about it uh as we go forward

788
00:28:28,950 --> 00:28:27,120

this morning absolutely if i could take

789
00:28:30,549 --> 00:28:28,960
all of the time with you i would but

790
00:28:32,950 --> 00:28:30,559
instead we'll open up the questions to

791
00:28:34,710 --> 00:28:32,960
the audience i'm sure you have many

792
00:28:37,350 --> 00:28:34,720
thoughts you'd like to ask our panel

793
00:28:38,870 --> 00:28:37,360
members today

794
00:28:40,549 --> 00:28:38,880
so if anybody has a question just raise

795
00:28:46,870 --> 00:28:40,559
your hand real high so our mic handlers

796
00:28:49,990 --> 00:28:48,149
and we'll wait for the microphones to

797
00:28:57,669 --> 00:28:50,000
come to you so our audience at home can

798
00:29:03,190 --> 00:29:01,269
so i've read a fair amount about uh

799
00:29:04,389 --> 00:29:03,200
electric propulsion as opposed to

800
00:29:06,630 --> 00:29:04,399
chemical

801
00:29:08,470 --> 00:29:06,640
and it sounds really exciting

802
00:29:10,230 --> 00:29:08,480
what do you think for deep space deep

803
00:29:13,909 --> 00:29:10,240
space exploration is it going to be

804
00:29:17,510 --> 00:29:15,590
we can we'll both kind of answer that i

805
00:29:19,110 --> 00:29:17,520
would tell you from a from a human

806
00:29:21,029 --> 00:29:19,120
standpoint and when we're going these

807
00:29:22,710 --> 00:29:21,039
long distances electric repulsion is

808
00:29:24,470 --> 00:29:22,720
really the way to go

809
00:29:26,470 --> 00:29:24,480
to carry the amount of propellant and

810
00:29:28,549 --> 00:29:26,480
stored in chemical fashion versus

811
00:29:29,909 --> 00:29:28,559
electrical is just weight prohibitive so

812
00:29:32,070 --> 00:29:29,919
i think we're definitely heading towards

813
00:29:33,830 --> 00:29:32,080

electric propulsion and and mike can

814
00:29:35,750 --> 00:29:33,840
give you some details of the activities

815
00:29:37,190 --> 00:29:35,760
that they've got planned in that area

816
00:29:39,110 --> 00:29:37,200
yeah great quick great question and just

817
00:29:40,549 --> 00:29:39,120
like bill said so that's one of the the

818
00:29:42,310 --> 00:29:40,559
needs that the mission has and so in

819
00:29:44,389 --> 00:29:42,320
space technology we're working on that

820
00:29:47,190 --> 00:29:44,399
today we think solar electric propulsion

821
00:29:49,269 --> 00:29:47,200
has great benefits not only for space

822
00:29:51,269 --> 00:29:49,279
but there's a whole variety of interest

823
00:29:53,029 --> 00:29:51,279
by the commercial industry

824
00:29:54,950 --> 00:29:53,039
satellite communication providers other

825
00:29:56,470 --> 00:29:54,960
government agencies all interested in

826
00:29:58,389 --> 00:29:56,480
solar electric propulsion so this is the

827
00:30:00,389 --> 00:29:58,399
idea that instead of chemical as you say

828
00:30:02,630 --> 00:30:00,399
right you can use sun's energy solar

829
00:30:04,789 --> 00:30:02,640
arrays collect that energy and then use

830
00:30:05,750 --> 00:30:04,799
uh high charged particles ions if you

831
00:30:07,669 --> 00:30:05,760
will

832
00:30:09,750 --> 00:30:07,679
out the back of the thruster to be able

833
00:30:11,909 --> 00:30:09,760
to move now it's not a lot of thrust

834
00:30:13,350 --> 00:30:11,919
it's really slow but it's continuous you

835
00:30:14,950 --> 00:30:13,360
know when we go to mars for example we

836
00:30:16,950 --> 00:30:14,960
get a kick from a chemical and then we

837
00:30:18,950 --> 00:30:16,960
coast and then use gravity of course you

838
00:30:20,470 --> 00:30:18,960

know to to steer us and navigate where

839
00:30:21,830 --> 00:30:20,480
we want to go with solar electric

840
00:30:24,389 --> 00:30:21,840
propulsion right you can have that

841
00:30:25,990 --> 00:30:24,399
continuous thrust what we see today in

842
00:30:27,669 --> 00:30:26,000
the world of solar electric propulsion

843
00:30:29,590 --> 00:30:27,679
there's there's plenty of examples of it

844
00:30:31,590 --> 00:30:29,600
today you can find in many satellites

845
00:30:33,430 --> 00:30:31,600
but to get to high power levels you need

846
00:30:35,190 --> 00:30:33,440
bigger arrays our ability to collect the

847
00:30:36,710 --> 00:30:35,200
sun's energy and the solar rays many of

848
00:30:38,470 --> 00:30:36,720
you seen those right on terrestrial

849
00:30:40,549 --> 00:30:38,480
homes and roofs well we use the same

850
00:30:42,230 --> 00:30:40,559
kind of arrays in space modified of

851
00:30:43,750 --> 00:30:42,240
course for that harsh environment but we

852
00:30:45,430 --> 00:30:43,760
need bigger arrays we got to collect

853
00:30:47,350 --> 00:30:45,440
more of the sun's energy and so it's

854
00:30:48,710 --> 00:30:47,360
kind of right now the big challenge is

855
00:30:51,510 --> 00:30:48,720
in that structural and thermal how do

856
00:30:53,590 --> 00:30:51,520
you deploy this 100 foot or longer type

857
00:30:55,190 --> 00:30:53,600
array and how do you keep it stable how

858
00:31:01,590 --> 00:30:55,200
do you control it and so that's some of

859
00:31:04,389 --> 00:31:02,470
so

860
00:31:07,509 --> 00:31:04,399
give us a summary of what you would see

861
00:31:09,750 --> 00:31:07,519
the the top three technology areas

862
00:31:11,269 --> 00:31:09,760
uh specific projects so for example the

863
00:31:12,470 --> 00:31:11,279

solar sail being one but what are some

864
00:31:14,389 --> 00:31:12,480
of the other ones

865
00:31:15,750 --> 00:31:14,399
right so we uh it's an interesting

866
00:31:17,430 --> 00:31:15,760
question about technology one of the

867
00:31:19,350 --> 00:31:17,440
things is where do you invest technology

868
00:31:20,789 --> 00:31:19,360
it's been any any technology program

869
00:31:23,029 --> 00:31:20,799
always faces this challenge you know

870
00:31:24,630 --> 00:31:23,039
where do you you can often view it as an

871
00:31:25,990 --> 00:31:24,640
investment right where do you because we

872
00:31:27,830 --> 00:31:26,000
need some lead time we have to get some

873
00:31:29,430 --> 00:31:27,840
technology ready and so how do you place

874
00:31:31,669 --> 00:31:29,440
your bets make your investments if you

875
00:31:33,350 --> 00:31:31,679
will what problems do we solve well one

876
00:31:35,750 --> 00:31:33,360
of the ways we figure that out right is

877
00:31:37,990 --> 00:31:35,760
by one we ask our customer

878
00:31:40,310 --> 00:31:38,000
what do you need and uh we got a good

879
00:31:42,230 --> 00:31:40,320
strong list from bill the other thing we

880
00:31:44,470 --> 00:31:42,240
did is we turned outside to the national

881
00:31:46,389 --> 00:31:44,480
academies of science and we asked expert

882
00:31:48,070 --> 00:31:46,399
teams from across the country to to

883
00:31:50,230 --> 00:31:48,080
develop road maps in these technical

884
00:31:51,830 --> 00:31:50,240
areas so that's the framework of the

885
00:31:53,950 --> 00:31:51,840
answer and the answer to that especially

886
00:31:55,909 --> 00:31:53,960
for human space flight uh early

887
00:31:59,190 --> 00:31:55,919
architecture studies have said couple

888
00:32:01,350 --> 00:31:59,200

things one one big area is in propulsion

889
00:32:03,509 --> 00:32:01,360
so uh in the chemical side it's

890
00:32:05,909 --> 00:32:03,519
cryogenic propellant storage so in the

891
00:32:07,110 --> 00:32:05,919
use of chemicals we want to use cryogens

892
00:32:08,710 --> 00:32:07,120
to store these you know you might have

893
00:32:10,230 --> 00:32:08,720
seen liquid nitrogen if any of the kids

894
00:32:11,750 --> 00:32:10,240
have been in a science lab you put a

895
00:32:13,269 --> 00:32:11,760
banana in a liquid nitrogen you know

896
00:32:15,430 --> 00:32:13,279
freeze all right so those really really

897
00:32:17,190 --> 00:32:15,440
cold liquids right or what we need you

898
00:32:19,190 --> 00:32:17,200
know for rocket propulsion but we got to

899
00:32:21,669 --> 00:32:19,200
store them and they boil off and today's

900
00:32:23,830 --> 00:32:21,679
state of the art maybe they last in the

901
00:32:25,430 --> 00:32:23,840
upper stage of about nine hours and for

902
00:32:27,029 --> 00:32:25,440
what we see for future exploration we

903
00:32:28,789 --> 00:32:27,039
need to turn that into nine months and

904
00:32:31,029 --> 00:32:28,799
so how do you go do that so cryogenic

905
00:32:32,870 --> 00:32:31,039
repellent storage and transfer is one of

906
00:32:34,549 --> 00:32:32,880
the challenges the second one is solar

907
00:32:36,710 --> 00:32:34,559
electric propulsion you know we talked

908
00:32:39,029 --> 00:32:36,720
about that earlier so those are i'd say

909
00:32:40,470 --> 00:32:39,039
two our top two the third one you know

910
00:32:42,710 --> 00:32:40,480
you can kind of debate depending on what

911
00:32:44,630 --> 00:32:42,720
team you ask but probably be in optical

912
00:32:46,870 --> 00:32:44,640
communication or especially for the high

913
00:32:48,070 --> 00:32:46,880

rate video and the images that we need

914
00:32:49,509 --> 00:32:48,080
our ability like i said mentioned

915
00:32:50,950 --> 00:32:49,519
earlier to transmit that data is a big

916
00:32:54,389 --> 00:32:50,960
challenge and so those are three is

917
00:32:56,389 --> 00:32:54,399
example of our of our big projects

918
00:32:57,430 --> 00:32:56,399
and if you could also introduce yourself

919
00:32:58,470 --> 00:32:57,440
if you could give us your name that

920
00:33:01,029 --> 00:32:58,480
would be great

921
00:33:03,430 --> 00:33:01,039
hi i'm aiden

922
00:33:05,350 --> 00:33:03,440
and i have a question

923
00:33:07,909 --> 00:33:05,360
since there's seven robonauts on the

924
00:33:11,909 --> 00:33:07,919
space station are there more boys or

925
00:33:16,230 --> 00:33:13,110
see

926
00:33:19,269 --> 00:33:17,509
right now i'm going through all their

927
00:33:21,029 --> 00:33:19,279
names

928
00:33:23,830 --> 00:33:21,039
so right now they're all they're all

929
00:33:26,310 --> 00:33:23,840
boys and and but we have two robots on

930
00:33:28,230 --> 00:33:26,320
board space station at least two we have

931
00:33:30,630 --> 00:33:28,240
we have robonaut on the inside that mike

932
00:33:32,149 --> 00:33:30,640
talked about then on the outside as we

933
00:33:34,870 --> 00:33:32,159
sit here today there's a robot on the

934
00:33:36,710 --> 00:33:34,880
outside a canadian robot called dexter

935
00:33:38,710 --> 00:33:36,720
and it looks a lot like the robot you

936
00:33:40,230 --> 00:33:38,720
would see an industrial machine plant

937
00:33:42,549 --> 00:33:40,240
that actually builds cars you know it's

938
00:33:44,950 --> 00:33:42,559

an industrial robot with big hunky arms

939
00:33:47,350 --> 00:33:44,960
and a fancy little gripper at the end

940
00:33:50,310 --> 00:33:47,360
and so so the joke kind of we have is

941
00:33:52,870 --> 00:33:50,320
that robonaut or is is very looks like a

942
00:33:55,110 --> 00:33:52,880
human has dexterous hands and fingers

943
00:33:57,509 --> 00:33:55,120
whereas dexter on the outside or this

944
00:33:59,909 --> 00:33:57,519
the the canadian robot it just has a

945
00:34:02,230 --> 00:33:59,919
machine interface so we say the robot on

946
00:34:04,070 --> 00:34:02,240
the outside really has a face that only

947
00:34:06,470 --> 00:34:04,080
an engineer can love

948
00:34:08,069 --> 00:34:06,480
so so you can relate to robonaut because

949
00:34:10,230 --> 00:34:08,079
it looks humanoid

950
00:34:12,069 --> 00:34:10,240
you can't relate quite as well to the

951
00:34:14,389 --> 00:34:12,079
external robot that's on the outside and

952
00:34:16,710 --> 00:34:14,399
right today as we sit here it's actually

953
00:34:18,790 --> 00:34:16,720
doing a task on board space station to

954
00:34:20,790 --> 00:34:18,800
look at going up to a spacecraft and

955
00:34:23,190 --> 00:34:20,800
removing a

956
00:34:24,869 --> 00:34:23,200
propellant fill valve that was never

957
00:34:26,149 --> 00:34:24,879
meant to be serviced in space it's

958
00:34:28,470 --> 00:34:26,159
demonstrating whether you can actually

959
00:34:30,470 --> 00:34:28,480
do that remotely from the ground remove

960
00:34:32,389 --> 00:34:30,480
that the open the valve up and actually

961
00:34:33,909 --> 00:34:32,399
transfer propellant into a spacecraft so

962
00:34:36,869 --> 00:34:33,919
we're actually demonstrating that we can

963
00:34:38,629 --> 00:34:36,879

refuel a spacecraft in space with the

964
00:34:40,230 --> 00:34:38,639
with the canadian robot on the outside

965
00:34:42,550 --> 00:34:40,240
of space station today as we sit here

966
00:34:44,310 --> 00:34:42,560
today so pretty exciting activities not

967
00:34:46,869 --> 00:34:44,320
only from the human standpoint on board

968
00:34:48,470 --> 00:34:46,879
station but also the robot portion on

969
00:34:50,230 --> 00:34:48,480
station but i guess i guess the one

970
00:34:52,550 --> 00:34:50,240
question we didn't answer is r2 you know

971
00:34:54,069 --> 00:34:52,560
is that a boy or a girl i i i i have to

972
00:34:56,790 --> 00:34:54,079
go back to rob ambrose and ask him i

973
00:34:58,310 --> 00:34:56,800
don't know maybe we should have a yeah

974
00:35:00,150 --> 00:34:58,320
that's a good question we need to go

975
00:35:01,510 --> 00:35:00,160
look at that why don't we have a

976
00:35:02,950 --> 00:35:01,520
female-oriented robot oriented robots

977
00:35:04,150 --> 00:35:02,960
good question aidan you've given them

978
00:35:05,829 --> 00:35:04,160
something to think yeah i'm gonna take

979
00:35:07,829 --> 00:35:05,839
that one back i didn't get an action out

980
00:35:09,030 --> 00:35:07,839
of this but i think i uh i think

981
00:35:11,030 --> 00:35:09,040
give me work

982
00:35:12,710 --> 00:35:11,040
that's great i

983
00:35:14,069 --> 00:35:12,720
do we have any other questions on this

984
00:35:15,349 --> 00:35:14,079
side

985
00:35:18,630 --> 00:35:15,359
and if you could also tell us where

986
00:35:21,829 --> 00:35:18,640
you're from in addition to your name

987
00:35:24,870 --> 00:35:21,839
i'm from chapel hill north carolina um

988
00:35:28,069 --> 00:35:24,880

so i know the sls is in progress right

989
00:35:30,390 --> 00:35:28,079
now but how close do you think we are to

990
00:35:35,030 --> 00:35:30,400
uh building a launch system

991
00:35:40,790 --> 00:35:37,750
yeah i mean sls is designed to really

992
00:35:43,430 --> 00:35:40,800
take crews beyond low earth orbit it it

993
00:35:45,670 --> 00:35:43,440
starts out to lift roughly

994
00:35:47,910 --> 00:35:45,680
you know 70 metric tons to low earth

995
00:35:49,910 --> 00:35:47,920
orbit so it's it's really designed to

996
00:35:52,230 --> 00:35:49,920
carry large pieces of hardware and then

997
00:35:54,790 --> 00:35:52,240
it can grow and get bigger

998
00:35:56,150 --> 00:35:54,800
as as we progress and so it'll

999
00:35:58,630 --> 00:35:56,160
eventually get to where it can carry

1000
00:36:00,790 --> 00:35:58,640
about 130 metric tons and then at that

1001
00:36:03,589 --> 00:36:00,800
point it can actually we'll need

1002
00:36:05,910 --> 00:36:03,599
actually we think six or seven launches

1003
00:36:07,750 --> 00:36:05,920
to actually take the amount of cargo and

1004
00:36:09,190 --> 00:36:07,760
supplies to take a crew to the surface

1005
00:36:10,790 --> 00:36:09,200
of mars so when you go out here and you

1006
00:36:12,950 --> 00:36:10,800
look at the space station mock-up and

1007
00:36:14,870 --> 00:36:12,960
you look at that picture where it's over

1008
00:36:17,510 --> 00:36:14,880
top of a football field it weighs

1009
00:36:19,829 --> 00:36:17,520
roughly 900 000 pounds in orbit we think

1010
00:36:22,390 --> 00:36:19,839
it'll take a roughly 900 000 pounds of

1011
00:36:24,710 --> 00:36:22,400
equipment gear propellant food supplies

1012
00:36:26,630 --> 00:36:24,720
and crew to get to the surface of mars

1013
00:36:29,109 --> 00:36:26,640

so roughly what you see out there on the

1014
00:36:30,550 --> 00:36:29,119
in the space station size is what will

1015
00:36:32,069 --> 00:36:30,560
need to go to mars and we want to do

1016
00:36:34,550 --> 00:36:32,079
that in fewer number of flights than it

1017
00:36:36,550 --> 00:36:34,560
took to build the space station

1018
00:36:38,950 --> 00:36:36,560
oh a clarification okay

1019
00:36:42,069 --> 00:36:38,960
i was asking about building it outside

1020
00:36:46,870 --> 00:36:44,310
well you know mike is kind of looking at

1021
00:36:48,470 --> 00:36:46,880
one piece we're looking at is cryogenic

1022
00:36:51,030 --> 00:36:48,480
propellant storage where we can keep

1023
00:36:53,589 --> 00:36:51,040
these super cold fluids or keep these

1024
00:36:55,510 --> 00:36:53,599
propellants cold so they don't all boil

1025
00:36:57,430 --> 00:36:55,520
off so we're looking potentially at

1026
00:36:59,109 --> 00:36:57,440
storing some of that in some regions and

1027
00:37:01,430 --> 00:36:59,119
then we might not actually build or

1028
00:37:03,190 --> 00:37:01,440
assemble the rocket there but we will

1029
00:37:05,430 --> 00:37:03,200
definitely be able to refuel it to go

1030
00:37:07,510 --> 00:37:05,440
some other places we also need to start

1031
00:37:09,670 --> 00:37:07,520
thinking about can we use like the the

1032
00:37:11,589 --> 00:37:09,680
regolith on the on the surface of the

1033
00:37:13,670 --> 00:37:11,599
moon can we use that material from the

1034
00:37:16,069 --> 00:37:13,680
moon as a as a material that we might

1035
00:37:18,069 --> 00:37:16,079
actually build or fabricate spacecraft

1036
00:37:20,310 --> 00:37:18,079
out of the first thing may be is it may

1037
00:37:22,470 --> 00:37:20,320
be used to provide radiation shielding

1038
00:37:24,710 --> 00:37:22,480

for for crews that are on the surface of

1039
00:37:26,630 --> 00:37:24,720
the moon we may look at building one of

1040
00:37:28,069 --> 00:37:26,640
these inflatable modules that i

1041
00:37:29,829 --> 00:37:28,079
discussed to you earlier we may actually

1042
00:37:31,829 --> 00:37:29,839
put that on the surface of the moon and

1043
00:37:33,670 --> 00:37:31,839
then we would essentially use astronauts

1044
00:37:35,990 --> 00:37:33,680
or use some type of robotic device to

1045
00:37:37,829 --> 00:37:36,000
put lunar soil over the top of that so

1046
00:37:39,589 --> 00:37:37,839
it provides shielding of the radiation

1047
00:37:41,030 --> 00:37:39,599
that's coming in from deep space so

1048
00:37:42,550 --> 00:37:41,040
we'll do a lot of things i think

1049
00:37:43,829 --> 00:37:42,560
starting to build there but but that's

1050
00:37:45,270 --> 00:37:43,839
something we need to start thinking

1051
00:37:46,870 --> 00:37:45,280
about as you go further and further

1052
00:37:48,470 --> 00:37:46,880
you're going to have to build stuff

1053
00:37:49,990 --> 00:37:48,480
where you start from where you start

1054
00:37:51,270 --> 00:37:50,000
that's it we're guys will add to that

1055
00:37:52,550 --> 00:37:51,280
too you know we talked about all the

1056
00:37:54,470 --> 00:37:52,560
mass that we talked about to go to

1057
00:37:55,910 --> 00:37:54,480
another surface the other probably maybe

1058
00:37:57,910 --> 00:37:55,920
the fourth area the big area for us is

1059
00:37:59,829 --> 00:37:57,920
our ability to actually slow down so

1060
00:38:01,510 --> 00:37:59,839
enough with all the propulsion stuff

1061
00:38:03,030 --> 00:38:01,520
what about our ability to slow down so

1062
00:38:05,109 --> 00:38:03,040
hopefully many of you were able to watch

1063
00:38:07,109 --> 00:38:05,119

the curiosity landing in august this

1064
00:38:10,710 --> 00:38:07,119
month i hope see some thought yeah yeah

1065
00:38:13,990 --> 00:38:12,550
we have a video clip of that landing by

1066
00:38:15,670 --> 00:38:14,000
the way there's many out there not every

1067
00:38:17,349 --> 00:38:15,680
time i show it using a talk i mean i

1068
00:38:19,430 --> 00:38:17,359
still get goose pimples you know about

1069
00:38:21,190 --> 00:38:19,440
that and so that's a metric ton on the

1070
00:38:22,390 --> 00:38:21,200
surface of mars and that's the most we

1071
00:38:23,910 --> 00:38:22,400
can do

1072
00:38:25,750 --> 00:38:23,920
we can't slow down fast enough you know

1073
00:38:27,190 --> 00:38:25,760
mars has a really frankly poor

1074
00:38:28,870 --> 00:38:27,200
atmosphere a poor excuse for an

1075
00:38:30,069 --> 00:38:28,880
atmosphere it's just enough that you

1076
00:38:31,430 --> 00:38:30,079
can't ignore it

1077
00:38:32,870 --> 00:38:31,440
but it doesn't really help you slow down

1078
00:38:35,109 --> 00:38:32,880
very much and so we're working on better

1079
00:38:37,670 --> 00:38:35,119
ways well to slow down and and they

1080
00:38:39,349 --> 00:38:37,680
often involve in one of the latest ideas

1081
00:38:41,589 --> 00:38:39,359
are inflatable technologies you know

1082
00:38:43,349 --> 00:38:41,599
inflate a an inner tube if you will a

1083
00:38:45,270 --> 00:38:43,359
big disc an umbrella

1084
00:38:46,710 --> 00:38:45,280
looking device that enables you to you

1085
00:38:48,390 --> 00:38:46,720
know fly through those really really

1086
00:38:49,910 --> 00:38:48,400
fast speeds you know thousands of

1087
00:38:51,910 --> 00:38:49,920
kilometers you know per second as you

1088
00:38:53,910 --> 00:38:51,920

come through that atmosphere and and

1089
00:38:56,310 --> 00:38:53,920
kind of slow down and take the heat and

1090
00:38:57,829 --> 00:38:56,320
all the aerodynamic dynamic lows and we

1091
00:38:59,109 --> 00:38:57,839
think that's one of the ways once we

1092
00:39:00,710 --> 00:38:59,119
build some of these things we're talking

1093
00:39:02,150 --> 00:39:00,720
about we can then get to the surface of

1094
00:39:03,430 --> 00:39:02,160
another planet

1095
00:39:05,910 --> 00:39:03,440
that's fantastic i think we have a

1096
00:39:08,470 --> 00:39:05,920
question over here

1097
00:39:11,349 --> 00:39:08,480
uh bob kowalczyk from college park

1098
00:39:14,310 --> 00:39:11,359
maryland it's about the solar paneling

1099
00:39:16,790 --> 00:39:14,320
the structure and and also the quality

1100
00:39:17,829 --> 00:39:16,800
we've had gallium arsenide and we've had

1101
00:39:20,950 --> 00:39:17,839
silicon

1102
00:39:22,390 --> 00:39:20,960
and i think the figures are about 14 15

1103
00:39:23,510 --> 00:39:22,400
20

1104
00:39:25,750 --> 00:39:23,520
effective

1105
00:39:31,270 --> 00:39:25,760
what kind of effectivity have we

1106
00:39:35,510 --> 00:39:32,790
yeah i don't know i don't have the

1107
00:39:37,270 --> 00:39:35,520
specific numbers for orion

1108
00:39:38,950 --> 00:39:37,280
when you go out in the lobby and you

1109
00:39:40,710 --> 00:39:38,960
take a look at orion

1110
00:39:43,990 --> 00:39:40,720
i'll tell you a secret you see those

1111
00:39:46,150 --> 00:39:44,000
nice round solar rays that are out there

1112
00:39:48,230 --> 00:39:46,160
we just made a deal the other day with

1113
00:39:49,750 --> 00:39:48,240

the europeans to have them build the

1114
00:39:51,910 --> 00:39:49,760
service module that's a little piece

1115
00:39:54,390 --> 00:39:51,920
that sits behind orion you're now going

1116
00:39:57,190 --> 00:39:54,400
to see arrays that now stick out in

1117
00:39:58,390 --> 00:39:57,200
panels not no longer the round array so

1118
00:39:59,750 --> 00:39:58,400
you're going to see a different change

1119
00:40:01,510 --> 00:39:59,760
there but i don't know the specific

1120
00:40:03,589 --> 00:40:01,520
efficiency maybe we can get one of our

1121
00:40:05,270 --> 00:40:03,599
folks to get that data for you yeah i

1122
00:40:06,550 --> 00:40:05,280
know on advanced technology we're

1123
00:40:08,069 --> 00:40:06,560
looking at trying to get efficiencies

1124
00:40:09,589 --> 00:40:08,079
maybe as high as up to close to 30

1125
00:40:11,030 --> 00:40:09,599
percent but you know it's still in early

1126
00:40:12,390 --> 00:40:11,040
stages of whether or not we can do that

1127
00:40:13,510 --> 00:40:12,400
or not

1128
00:40:15,349 --> 00:40:13,520
and we're looking at things as

1129
00:40:17,190 --> 00:40:15,359
concentrators as another example too the

1130
00:40:18,870 --> 00:40:17,200
ability to try to focus as much sunlight

1131
00:40:20,790 --> 00:40:18,880
as we can but again those are in early

1132
00:40:22,870 --> 00:40:20,800
stages not ready for space flight but it

1133
00:40:24,069 --> 00:40:22,880
is a it is a top problem

1134
00:40:27,270 --> 00:40:24,079
and i believe we have a question from

1135
00:40:31,030 --> 00:40:27,280
our social media platforms

1136
00:40:33,910 --> 00:40:31,040
from twitter at jp major asks will there

1137
00:40:37,030 --> 00:40:33,920
really be a crude orion moon mission in

1138
00:40:38,870 --> 00:40:37,040

2021 landing or orbital

1139
00:40:41,270 --> 00:40:38,880
it'll be an orbital probably some type

1140
00:40:44,069 --> 00:40:41,280
of orbital mission in 2021 with the crew

1141
00:40:50,150 --> 00:40:47,670
that's very exciting very exciting

1142
00:40:56,550 --> 00:40:50,160
let's see if i can track one of our mic

1143
00:40:59,829 --> 00:40:57,829
we'll go with this young lady in the

1144
00:41:01,430 --> 00:40:59,839
front

1145
00:41:03,030 --> 00:41:01,440
oh sorry good morning character friends

1146
00:41:04,309 --> 00:41:03,040
from san diego

1147
00:41:06,790 --> 00:41:04,319
last been going on the past couple years

1148
00:41:08,870 --> 00:41:06,800
i was fortunate enough to attend 135

1149
00:41:10,710 --> 00:41:08,880
nasa tweet up and then today and i was

1150
00:41:12,630 --> 00:41:10,720
also headquarters for the curiosity

1151
00:41:14,790 --> 00:41:12,640
landing so i'd love to hear from you

1152
00:41:17,190 --> 00:41:14,800
guys what has excited or delighted you

1153
00:41:20,470 --> 00:41:17,200
the most in the past couple years

1154
00:41:22,309 --> 00:41:20,480
regarding nasa and your jobs

1155
00:41:24,230 --> 00:41:22,319
wow yeah yeah

1156
00:41:26,069 --> 00:41:24,240
i don't know i'm meaning it i have one

1157
00:41:27,349 --> 00:41:26,079
view yeah you start that's a great

1158
00:41:31,030 --> 00:41:27,359
question

1159
00:41:34,710 --> 00:41:33,030
for me and i missed this may sound kind

1160
00:41:36,710 --> 00:41:34,720
of corn but it is really it is really

1161
00:41:38,309 --> 00:41:36,720
true it is the people so we do a lot of

1162
00:41:39,589 --> 00:41:38,319
investments in technology we talked a

1163
00:41:41,430 --> 00:41:39,599

lot about all these different

1164
00:41:42,710 --> 00:41:41,440
applications but when you go out into

1165
00:41:43,990 --> 00:41:42,720
the field and meet some of the folks

1166
00:41:46,870 --> 00:41:44,000
that are working on what we're doing in

1167
00:41:48,390 --> 00:41:46,880
the lab in the test field um

1168
00:41:49,910 --> 00:41:48,400
it's it's incredible to see to the

1169
00:41:51,430 --> 00:41:49,920
passion and their energy of what they

1170
00:41:52,790 --> 00:41:51,440
want to go do and how to accomplish you

1171
00:41:54,390 --> 00:41:52,800
know at the end of the day it really is

1172
00:41:56,069 --> 00:41:54,400
an investment of people even in the

1173
00:41:58,230 --> 00:41:56,079
technology the history of technology has

1174
00:42:00,550 --> 00:41:58,240
shown it really is about a community of

1175
00:42:02,710 --> 00:42:00,560
innovators right talking to each other

1176
00:42:04,630 --> 00:42:02,720
often technology technical leaps occur

1177
00:42:06,710 --> 00:42:04,640
in history for leaps and bounds it's not

1178
00:42:07,990 --> 00:42:06,720
a very linear process at all and so part

1179
00:42:09,990 --> 00:42:08,000
of space tech for example is building

1180
00:42:11,349 --> 00:42:10,000
that community so for me when i go out

1181
00:42:13,589 --> 00:42:11,359
to the field and meet some of the folks

1182
00:42:15,349 --> 00:42:13,599
and see what they're doing

1183
00:42:16,870 --> 00:42:15,359
my job is really to enable that i don't

1184
00:42:18,870 --> 00:42:16,880
really get to do anything anymore right

1185
00:42:20,710 --> 00:42:18,880
you know um spread you know spreadsheets

1186
00:42:22,870 --> 00:42:20,720
and sound bites but but i can't enable

1187
00:42:24,790 --> 00:42:22,880
that right and that's what i for me is

1188
00:42:26,550 --> 00:42:24,800

is what i take something away from does

1189
00:42:28,710 --> 00:42:26,560
that give you enough time yep and so

1190
00:42:30,870 --> 00:42:28,720
what i would say is that

1191
00:42:32,309 --> 00:42:30,880
when i'd get a chance to get in the

1192
00:42:33,910 --> 00:42:32,319
morning or the evening and you know you

1193
00:42:36,150 --> 00:42:33,920
can now get the app that will tell you

1194
00:42:37,829 --> 00:42:36,160
when space station is flying overhead

1195
00:42:39,589 --> 00:42:37,839
and i get a chance to watch this little

1196
00:42:41,030 --> 00:42:39,599
white thing go across the sky and you

1197
00:42:43,030 --> 00:42:41,040
can look at the model out there and see

1198
00:42:44,550 --> 00:42:43,040
how big it is and then if i drag my

1199
00:42:46,390 --> 00:42:44,560
neighbors out i bring pictures of the

1200
00:42:48,390 --> 00:42:46,400
crew that are on orbit at the same time

1201
00:42:50,069 --> 00:42:48,400
so then i show my neighbors

1202
00:42:51,750 --> 00:42:50,079
these six folks are on board the space

1203
00:42:53,910 --> 00:42:51,760
station on that little white dot going

1204
00:42:55,510 --> 00:42:53,920
overhead i think about the amount of

1205
00:42:57,109 --> 00:42:55,520
effort that went in to build that the

1206
00:42:59,190 --> 00:42:57,119
number of shuttle flights the number of

1207
00:43:00,870 --> 00:42:59,200
spacewalks you know i think on the order

1208
00:43:02,710 --> 00:43:00,880
of four months of spacewalks on the

1209
00:43:04,390 --> 00:43:02,720
outside to actually build that thing

1210
00:43:06,870 --> 00:43:04,400
built from an international partner

1211
00:43:08,790 --> 00:43:06,880
community of 16 countries all working

1212
00:43:10,630 --> 00:43:08,800
together to make that happen and then

1213
00:43:12,550 --> 00:43:10,640

know we're actually getting really

1214
00:43:14,630 --> 00:43:12,560
productive research out of that facility

1215
00:43:16,390 --> 00:43:14,640
is pretty amazing to me so you get a

1216
00:43:17,990 --> 00:43:16,400
chance to see all your hard work

1217
00:43:19,349 --> 00:43:18,000
actually fly over in the morning or

1218
00:43:20,950 --> 00:43:19,359
evening and that's pretty special when

1219
00:43:22,309 --> 00:43:20,960
you get to go see that

1220
00:43:24,069 --> 00:43:22,319
and i'd like to take a hack at that

1221
00:43:25,990 --> 00:43:24,079
question as well one of my favorite

1222
00:43:27,990 --> 00:43:26,000
things about working for nasa is being

1223
00:43:29,510 --> 00:43:28,000
able to talk to the aidens of the world

1224
00:43:31,510 --> 00:43:29,520
being able to go out to classrooms or

1225
00:43:33,589 --> 00:43:31,520
skype into classrooms and tell them how

1226
00:43:35,270 --> 00:43:33,599
exciting our jobs are and then see it

1227
00:43:36,950 --> 00:43:35,280
reflected back in their excitement

1228
00:43:38,390 --> 00:43:36,960
that's probably and i say most of us who

1229
00:43:41,030 --> 00:43:38,400
have done that would say that's one of

1230
00:43:42,870 --> 00:43:41,040
the best highlights of working for nasa

1231
00:43:45,510 --> 00:43:42,880
we have another question here

1232
00:43:46,309 --> 00:43:45,520
thanks jeff wallace arlington virginia

1233
00:43:49,030 --> 00:43:46,319
uh

1234
00:43:51,589 --> 00:43:49,040
one of the things i heard about the nasa

1235
00:43:53,270 --> 00:43:51,599
jpl tweet up where we primarily

1236
00:43:54,950 --> 00:43:53,280
were the last people to see curiosity

1237
00:43:56,470 --> 00:43:54,960
before it all got all boxed up which was

1238
00:43:58,710 --> 00:43:56,480

great

1239
00:44:00,950 --> 00:43:58,720
was to hear about the nasa dawn

1240
00:44:03,030 --> 00:44:00,960
spacecraft and how that was in many

1241
00:44:06,069 --> 00:44:03,040
regards the first spacecraft that had a

1242
00:44:07,589 --> 00:44:06,079
true ion propulsion system and i just

1243
00:44:08,950 --> 00:44:07,599
you know haven't heard enough about that

1244
00:44:10,790 --> 00:44:08,960
because i think that's such a cool thing

1245
00:44:12,550 --> 00:44:10,800
right whenever they introduced it uh

1246
00:44:13,990 --> 00:44:12,560
they showed a picture of the tie fighter

1247
00:44:15,990 --> 00:44:14,000
from star wars and said hey here's the

1248
00:44:17,589 --> 00:44:16,000
first one like that so could you say a

1249
00:44:20,790 --> 00:44:17,599
little bit more about the success or how

1250
00:44:22,870 --> 00:44:20,800
that's all been perceived how that went

1251
00:44:24,150 --> 00:44:22,880
i i don't know much that's a great uh

1252
00:44:27,109 --> 00:44:24,160
that's a great but you're right dawn

1253
00:44:28,550 --> 00:44:27,119
dawn was a spacecraft that uh uh

1254
00:44:32,550 --> 00:44:28,560
visited uh

1255
00:44:35,670 --> 00:44:34,309
and use solar electric propulsion as you

1256
00:44:37,510 --> 00:44:35,680
say and it was one of the first pushes

1257
00:44:39,190 --> 00:44:37,520
in solar electric propulsion technology

1258
00:44:41,589 --> 00:44:39,200
and to be able to count on it and rely

1259
00:44:43,109 --> 00:44:41,599
on it and uh that that you know we're

1260
00:44:45,430 --> 00:44:43,119
taking that power level which i think

1261
00:44:47,109 --> 00:44:45,440
was uh maybe two two and a half

1262
00:44:48,870 --> 00:44:47,119
kilowatts you know we're trying now to

1263
00:44:50,710 --> 00:44:48,880

go to five kilowatts and then we're

1264
00:44:52,150 --> 00:44:50,720
working on thrusters at 10. so really

1265
00:44:54,069 --> 00:44:52,160
all we're doing is taking that knowledge

1266
00:44:55,750 --> 00:44:54,079
right in trying to get larger power

1267
00:44:58,470 --> 00:44:55,760
levels but absolutely right you know

1268
00:45:00,150 --> 00:44:58,480
visiting an asteroid right uh visiting

1269
00:45:02,470 --> 00:45:00,160
and using solar propulsion is a great

1270
00:45:03,750 --> 00:45:02,480
mission john grunsfeld who's the head of

1271
00:45:04,790 --> 00:45:03,760
the science mission directorate i think

1272
00:45:06,710 --> 00:45:04,800
we'll be

1273
00:45:08,230 --> 00:45:06,720
on a panel later today too and he can

1274
00:45:09,829 --> 00:45:08,240
probably give you more details on that

1275
00:45:11,430 --> 00:45:09,839
from the science mission directorate but

1276
00:45:13,109 --> 00:45:11,440
a great mission and really you know

1277
00:45:14,470 --> 00:45:13,119
pioneered the way into some of the great

1278
00:45:16,829 --> 00:45:14,480
kind of work you know that the agency

1279
00:45:22,390 --> 00:45:16,839
gets to do

1280
00:45:25,910 --> 00:45:24,069
hi thank you i'm elizabeth wallace i'm

1281
00:45:27,190 --> 00:45:25,920
from takoma park maryland one of the

1282
00:45:29,829 --> 00:45:27,200
things that's actually i've only

1283
00:45:31,829 --> 00:45:29,839
recently gotten interested in nasa

1284
00:45:33,270 --> 00:45:31,839
but one of the things i love is is going

1285
00:45:35,430 --> 00:45:33,280
back into the history and hearing about

1286
00:45:37,990 --> 00:45:35,440
apollo 11 and and how everybody in the

1287
00:45:40,309 --> 00:45:38,000
world when they did the tour said we did

1288
00:45:41,990 --> 00:45:40,319

it and when the astronauts from the iss

1289
00:45:43,589 --> 00:45:42,000
come back and they say well it was the

1290
00:45:45,190 --> 00:45:43,599
international corporation that really

1291
00:45:48,150 --> 00:45:45,200
they remember the most

1292
00:45:49,910 --> 00:45:48,160
and you did mention that the orion we do

1293
00:45:51,750 --> 00:45:49,920
have a european partner for that can you

1294
00:45:53,990 --> 00:45:51,760
tell us a little bit more about how this

1295
00:45:56,950 --> 00:45:54,000
is an international effort and how we

1296
00:45:59,829 --> 00:45:56,960
can really we have a different funding

1297
00:46:01,829 --> 00:45:59,839
process here than european space agency

1298
00:46:03,430 --> 00:46:01,839
depends on and other agencies that we

1299
00:46:05,349 --> 00:46:03,440
partner with and how can you help to

1300
00:46:08,550 --> 00:46:05,359
make sure that we don't

1301
00:46:10,710 --> 00:46:08,560
disappoint them in the future

1302
00:46:12,470 --> 00:46:10,720
well it's it you boy you characterized

1303
00:46:14,470 --> 00:46:12,480
it really well i

1304
00:46:16,390 --> 00:46:14,480
you know i i grew up here in the u.s and

1305
00:46:18,150 --> 00:46:16,400
i speak one language except unless you

1306
00:46:21,510 --> 00:46:18,160
count math then i maybe speak two

1307
00:46:23,109 --> 00:46:21,520
languages so i feel really uh

1308
00:46:25,190 --> 00:46:23,119
it's amazing when i go to international

1309
00:46:27,270 --> 00:46:25,200
forums and i and i interact with my

1310
00:46:29,349 --> 00:46:27,280
counterparts from europe and they speak

1311
00:46:31,030 --> 00:46:29,359
four or five different languages

1312
00:46:32,550 --> 00:46:31,040
i've been exposed to many different

1313
00:46:34,230 --> 00:46:32,560

cultures i've got to work hand in hand

1314
00:46:35,750 --> 00:46:34,240
with the russians in the russian space

1315
00:46:37,109 --> 00:46:35,760
agency

1316
00:46:38,069 --> 00:46:37,119
you know i was over there for a year i

1317
00:46:39,750 --> 00:46:38,079
actually lived with them in their

1318
00:46:41,430 --> 00:46:39,760
control center actually operated on

1319
00:46:44,470 --> 00:46:41,440
console with them hand in hand for a

1320
00:46:46,470 --> 00:46:44,480
year so we really have really kind of

1321
00:46:48,309 --> 00:46:46,480
transcended our own cultural bounds our

1322
00:46:50,390 --> 00:46:48,319
own international balance and we really

1323
00:46:52,230 --> 00:46:50,400
are reaching for that higher that

1324
00:46:54,230 --> 00:46:52,240
challenge and it really requires all of

1325
00:46:56,150 --> 00:46:54,240
us to work together and it's really neat

1326
00:46:57,990 --> 00:46:56,160
to see that interdependence you know at

1327
00:46:59,990 --> 00:46:58,000
first you can kind of cooperate and not

1328
00:47:01,910 --> 00:47:00,000
really be dependent on each other but at

1329
00:47:03,750 --> 00:47:01,920
this point in time right while we're

1330
00:47:05,829 --> 00:47:03,760
building the the commercial crew

1331
00:47:07,990 --> 00:47:05,839
capability comes online we're using the

1332
00:47:10,069 --> 00:47:08,000
russian soyuz to transport our crews to

1333
00:47:11,750 --> 00:47:10,079
and from space station so here we are

1334
00:47:13,589 --> 00:47:11,760
totally dependent upon the russians for

1335
00:47:16,150 --> 00:47:13,599
our crew transport we work with them

1336
00:47:17,910 --> 00:47:16,160
hand in hand they we trust our crews to

1337
00:47:19,430 --> 00:47:17,920
them i'll go meet with the technicians

1338
00:47:21,430 --> 00:47:19,440

in russia the first words the

1339
00:47:23,589 --> 00:47:21,440
technicians will usually tell me is i'm

1340
00:47:26,150 --> 00:47:23,599
doing my job exactly right so you don't

1341
00:47:29,510 --> 00:47:26,160
have to worry about your crew so here's

1342
00:47:31,510 --> 00:47:29,520
an amazing discussion of myself with a

1343
00:47:33,349 --> 00:47:31,520
technician that doesn't even speak or

1344
00:47:35,510 --> 00:47:33,359
maybe speaks a little english speaks

1345
00:47:37,349 --> 00:47:35,520
mostly russian but his first thing is to

1346
00:47:38,950 --> 00:47:37,359
make sure that he knows that he's

1347
00:47:41,510 --> 00:47:38,960
conveyed to me that our crews will be

1348
00:47:42,870 --> 00:47:41,520
taken care of so to be able to operate

1349
00:47:44,950 --> 00:47:42,880
and count on each other like that is

1350
00:47:46,790 --> 00:47:44,960
just phenomenal so we need to talk much

1351
00:47:48,950 --> 00:47:46,800
more about that i believe as we go do

1352
00:47:50,230 --> 00:47:48,960
exploration and we do these bigger tasks

1353
00:47:51,670 --> 00:47:50,240
we're not going to be able to do them as

1354
00:47:53,910 --> 00:47:51,680
a single nation we're going to have to

1355
00:47:55,990 --> 00:47:53,920
do them in a cooperative manner and and

1356
00:47:57,910 --> 00:47:56,000
it's just it's amazing when you think

1357
00:47:59,829 --> 00:47:57,920
about that space station many components

1358
00:48:02,069 --> 00:47:59,839
came from different countries some

1359
00:48:03,910 --> 00:48:02,079
systems were designed with metric units

1360
00:48:05,670 --> 00:48:03,920
they're designed in english units we had

1361
00:48:07,030 --> 00:48:05,680
to make all those interfaces all work

1362
00:48:08,790 --> 00:48:07,040
we've plugged them all together many

1363
00:48:10,950 --> 00:48:08,800

times for the first time in space and

1364
00:48:12,710 --> 00:48:10,960
somehow it all worked so

1365
00:48:14,309 --> 00:48:12,720
it's it's a pretty testament a pretty

1366
00:48:16,150 --> 00:48:14,319
strong testimony that we can all work

1367
00:48:17,829 --> 00:48:16,160
together and the last point i would say

1368
00:48:19,430 --> 00:48:17,839
is you know we often talk about the

1369
00:48:21,030 --> 00:48:19,440
hardware at least as an engineer but i

1370
00:48:22,870 --> 00:48:21,040
honestly believe it's really the people

1371
00:48:25,510 --> 00:48:22,880
that that really make all this stuff

1372
00:48:27,510 --> 00:48:25,520
happen and and that's really what drives

1373
00:48:29,750 --> 00:48:27,520
this agency and drives us to do these

1374
00:48:31,910 --> 00:48:29,760
things is working together as a team and

1375
00:48:33,510 --> 00:48:31,920
and really trying to to know that it

1376
00:48:41,430 --> 00:48:33,520
cannot be accomplished as an individual

1377
00:48:45,829 --> 00:48:43,109
we'll take a question from here

1378
00:48:48,549 --> 00:48:45,839
hi i'm ching yu damascus maryland

1379
00:48:50,069 --> 00:48:48,559
my question is more towards the life

1380
00:48:52,390 --> 00:48:50,079
aspect of it

1381
00:48:54,150 --> 00:48:52,400
like long term space travel like going

1382
00:48:56,790 --> 00:48:54,160
to mars for example

1383
00:48:57,829 --> 00:48:56,800
and have you guys done any exploratory

1384
00:49:00,630 --> 00:48:57,839
work on

1385
00:49:02,630 --> 00:49:00,640
you know having supplies long term

1386
00:49:05,030 --> 00:49:02,640
supplies for crew and what's your

1387
00:49:07,670 --> 00:49:05,040
comment on mars one

1388
00:49:09,430 --> 00:49:07,680

we're doing a lot of things to uh to

1389
00:49:11,910 --> 00:49:09,440
look at that right now we've we've done

1390
00:49:13,829 --> 00:49:11,920
some things where we're looking at uh

1391
00:49:15,750 --> 00:49:13,839
at pharmaceutical storage if you think

1392
00:49:17,190 --> 00:49:15,760
about it if you're gonna go someplace

1393
00:49:18,870 --> 00:49:17,200
for three years

1394
00:49:20,950 --> 00:49:18,880
can the drugs you want to take with you

1395
00:49:22,309 --> 00:49:20,960
will they degrade in space will they be

1396
00:49:24,549 --> 00:49:22,319
handled differently so we've been doing

1397
00:49:26,390 --> 00:49:24,559
some studies along those lines

1398
00:49:27,829 --> 00:49:26,400
and 2015 we're going to actually have a

1399
00:49:30,390 --> 00:49:27,839
crew that will stay on board the space

1400
00:49:32,390 --> 00:49:30,400
station for one year a u.s and a russian

1401
00:49:33,750 --> 00:49:32,400
crew member will actually live on space

1402
00:49:35,430 --> 00:49:33,760
station for a year so that'll be

1403
00:49:37,190 --> 00:49:35,440
intriguing to see if there's anything

1404
00:49:39,349 --> 00:49:37,200
there that changes the russians have

1405
00:49:41,270 --> 00:49:39,359
done it before they've flown crews

1406
00:49:43,510 --> 00:49:41,280
you know almost a year slightly beyond a

1407
00:49:45,670 --> 00:49:43,520
year so it's not that you can't do it

1408
00:49:47,589 --> 00:49:45,680
but we really want to now take the new

1409
00:49:49,510 --> 00:49:47,599
investigation tools we've got and see

1410
00:49:51,910 --> 00:49:49,520
how the physical body changes over time

1411
00:49:54,309 --> 00:49:51,920
we know very well how the body changes

1412
00:49:55,829 --> 00:49:54,319
in space when you go to space

1413
00:49:58,390 --> 00:49:55,839

one thing that occurs is your immune

1414
00:50:00,470 --> 00:49:58,400
system doesn't work as effectively as it

1415
00:50:02,069 --> 00:50:00,480
does on the ground there's bone loss

1416
00:50:03,829 --> 00:50:02,079
that occurs there's lots of

1417
00:50:05,910 --> 00:50:03,839
physiological changes that occur as you

1418
00:50:08,069 --> 00:50:05,920
go into space we have it characterized

1419
00:50:09,829 --> 00:50:08,079
very well how that lasts for this for

1420
00:50:11,349 --> 00:50:09,839
the six month period but we don't know

1421
00:50:12,790 --> 00:50:11,359
much beyond the six month period so

1422
00:50:15,510 --> 00:50:12,800
we're going to go experiment with that

1423
00:50:17,270 --> 00:50:15,520
so it'll be very interesting to see how

1424
00:50:19,030 --> 00:50:17,280
we can use the space station to do that

1425
00:50:21,030 --> 00:50:19,040
we also need life support systems the

1426
00:50:23,190 --> 00:50:21,040
systems that generate the oxygen and

1427
00:50:24,790 --> 00:50:23,200
remove the carbon dioxide those systems

1428
00:50:26,230 --> 00:50:24,800
have to operate now

1429
00:50:28,309 --> 00:50:26,240
essentially for three or four years

1430
00:50:29,750 --> 00:50:28,319
onboard space station maybe they work

1431
00:50:31,270 --> 00:50:29,760
for about a month and then we've got to

1432
00:50:33,589 --> 00:50:31,280
change something out something doesn't

1433
00:50:35,109 --> 00:50:33,599
work exactly right so we've got a lot of

1434
00:50:36,950 --> 00:50:35,119
technology that we've got to do in life

1435
00:50:37,990 --> 00:50:36,960
support systems to get a very low

1436
00:50:39,910 --> 00:50:38,000
maintenance

1437
00:50:42,549 --> 00:50:39,920
system that we can go operate the other

1438
00:50:44,470 --> 00:50:42,559

big thing is also resupply stuff you

1439
00:50:46,230 --> 00:50:44,480
know we recycle almost everything on

1440
00:50:49,270 --> 00:50:46,240
board space station the urine gets

1441
00:50:51,270 --> 00:50:49,280
recycled as you sweat or perspire that

1442
00:50:52,950 --> 00:50:51,280
gets recycled back into the system and

1443
00:50:54,710 --> 00:50:52,960
you get to drink that again as a crew

1444
00:50:59,349 --> 00:50:54,720
member so we don't do that at nasa

1445
00:51:02,630 --> 00:51:00,230
yes

1446
00:51:04,470 --> 00:51:02,640
we all tested for that

1447
00:51:06,390 --> 00:51:04,480
and uh but anyway so but it's an

1448
00:51:08,470 --> 00:51:06,400
interesting and intriguing thing to make

1449
00:51:10,230 --> 00:51:08,480
sure that how do we really do you talk

1450
00:51:11,910 --> 00:51:10,240
about green systems here on the ground

1451
00:51:13,670 --> 00:51:11,920
right how do you make an efficient house

1452
00:51:15,750 --> 00:51:13,680
or an efficient building

1453
00:51:17,190 --> 00:51:15,760
the most efficient things we can do are

1454
00:51:19,670 --> 00:51:17,200
really on the space station we're trying

1455
00:51:21,510 --> 00:51:19,680
to recycle repurpose reuse everything on

1456
00:51:22,710 --> 00:51:21,520
board stations so it's it's neat that

1457
00:51:24,870 --> 00:51:22,720
we're actually

1458
00:51:26,710 --> 00:51:24,880
solving problems in space that benefit

1459
00:51:28,870 --> 00:51:26,720
us here and and on the cruise pen i

1460
00:51:31,270 --> 00:51:28,880
always wear the the crew that's flying

1461
00:51:32,870 --> 00:51:31,280
pin on my lapel and i do that so i know

1462
00:51:34,790 --> 00:51:32,880
why i really work and i'm working for

1463
00:51:36,230 --> 00:51:34,800

those six folks on orbit and on the

1464
00:51:39,109 --> 00:51:36,240
bottom of their pen they have a nice

1465
00:51:41,510 --> 00:51:39,119
little statement it says off the earth

1466
00:51:43,589 --> 00:51:41,520
for the earth and that is such a cool

1467
00:51:46,549 --> 00:51:43,599
statement that they have committed their

1468
00:51:48,630 --> 00:51:46,559
lives to take six months and probably

1469
00:51:51,430 --> 00:51:48,640
two years worth of training to be away

1470
00:51:53,349 --> 00:51:51,440
from their families for to do this

1471
00:51:55,270 --> 00:51:53,359
research in space but they're doing it

1472
00:51:57,270 --> 00:51:55,280
for benefit of us here on the earth so

1473
00:51:59,349 --> 00:51:57,280
what a tremendous testimony to their

1474
00:52:01,430 --> 00:51:59,359
statement that they carry on their pen

1475
00:52:03,190 --> 00:52:01,440
that is that is pretty amazing and what

1476
00:52:04,790 --> 00:52:03,200
what it's really all about and they're

1477
00:52:06,790 --> 00:52:04,800
willing to do it even with recycled

1478
00:52:08,230 --> 00:52:06,800
urine yes

1479
00:52:13,990 --> 00:52:08,240
i think we have time for one more

1480
00:52:19,430 --> 00:52:17,190
hi i'm angela gibson aidan's mom

1481
00:52:21,990 --> 00:52:19,440
and i'm from hampton virginia area near

1482
00:52:23,990 --> 00:52:22,000
nasa langley and you were talking about

1483
00:52:26,870 --> 00:52:24,000
the environmental and life support

1484
00:52:29,910 --> 00:52:26,880
issues for long-term space exploration i

1485
00:52:31,510 --> 00:52:29,920
know that astro wheels doug wetlock

1486
00:52:34,069 --> 00:52:31,520
was on the space station for a very long

1487
00:52:35,750 --> 00:52:34,079
time and when he talked to us at the msl

1488
00:52:37,589 --> 00:52:35,760

mars curiosity launch he talked about

1489
00:52:39,349 --> 00:52:37,599
how his eyesight was something that was

1490
00:52:41,430 --> 00:52:39,359
being researched and that it was a

1491
00:52:42,950 --> 00:52:41,440
long-term study is that still happening

1492
00:52:44,950 --> 00:52:42,960
and are there other things that other

1493
00:52:47,270 --> 00:52:44,960
astronauts are participating in when it

1494
00:52:49,589 --> 00:52:47,280
comes to the anatomy and physiology of

1495
00:52:51,510 --> 00:52:49,599
humans and astronauts yep there's there

1496
00:52:53,109 --> 00:52:51,520
sure is there's lots of studies going on

1497
00:52:55,430 --> 00:52:53,119
that's one of the emerging problems that

1498
00:52:57,430 --> 00:52:55,440
we didn't even know we had is that that

1499
00:52:59,430 --> 00:52:57,440
your eyes your eyesight actually changes

1500
00:53:01,349 --> 00:52:59,440
the fluid shifts and the pressure in

1501
00:53:03,670 --> 00:53:01,359
your brain actually increases a little

1502
00:53:05,349 --> 00:53:03,680
bit it causes the eye to deform and it

1503
00:53:07,430 --> 00:53:05,359
can actually cause the retina to

1504
00:53:09,109 --> 00:53:07,440
actually move or get folds in the back

1505
00:53:10,870 --> 00:53:09,119
of your eye

1506
00:53:12,710 --> 00:53:10,880
most times it always recovers upon

1507
00:53:14,230 --> 00:53:12,720
return but this is a new phenomenon we

1508
00:53:15,829 --> 00:53:14,240
didn't really perceive until we started

1509
00:53:17,510 --> 00:53:15,839
flying these longer durations so now

1510
00:53:19,510 --> 00:53:17,520
we're trying to understand what really

1511
00:53:21,910 --> 00:53:19,520
causes that is it it's more than a fluid

1512
00:53:23,510 --> 00:53:21,920
shift because it appears to be there

1513
00:53:24,630 --> 00:53:23,520

even after flight

1514
00:53:26,549 --> 00:53:24,640
the other thing that we're looking at

1515
00:53:29,430 --> 00:53:26,559
right now is we're looking at the the

1516
00:53:31,270 --> 00:53:29,440
human spine if you want to get taller

1517
00:53:33,109 --> 00:53:31,280
you can go to space you'll grow about

1518
00:53:34,950 --> 00:53:33,119
two to three inches once you get in

1519
00:53:36,790 --> 00:53:34,960
space when there's no gravity loading on

1520
00:53:38,390 --> 00:53:36,800
your spine so you know if you've always

1521
00:53:39,990 --> 00:53:38,400
wanted to be taller you need to go sign

1522
00:53:42,150 --> 00:53:40,000
up to be an astronaut you can grow tower

1523
00:53:43,829 --> 00:53:42,160
but except it goes away when you come

1524
00:53:45,829 --> 00:53:43,839
back you shrink right back down to your

1525
00:53:47,349 --> 00:53:45,839
normal size but we're looking now at how

1526
00:53:49,349 --> 00:53:47,359
the spine changes so we're using

1527
00:53:52,150 --> 00:53:49,359
ultrasound now to actually ultrasound

1528
00:53:54,150 --> 00:53:52,160
the spines of our astronauts on orbit to

1529
00:53:56,390 --> 00:53:54,160
see how the vertebrae actually move to

1530
00:53:57,829 --> 00:53:56,400
see where the elongation occurs and to

1531
00:53:59,510 --> 00:53:57,839
see if there's any kind of things that

1532
00:54:01,270 --> 00:53:59,520
could be problematic if you're exposed

1533
00:54:02,710 --> 00:54:01,280
to that for a long duration what's

1534
00:54:04,230 --> 00:54:02,720
intriguing about that is on in

1535
00:54:06,150 --> 00:54:04,240
terrestrial applications if you have a

1536
00:54:07,910 --> 00:54:06,160
back problem you would typically always

1537
00:54:09,990 --> 00:54:07,920
go get an x-ray they would never

1538
00:54:11,910 --> 00:54:10,000

typically use ultrasound but we don't

1539
00:54:14,390 --> 00:54:11,920
have an x-ray device on station so we

1540
00:54:16,069 --> 00:54:14,400
had no choice but to use ultrasound now

1541
00:54:17,829 --> 00:54:16,079
we nasa are starting to use ultrasound

1542
00:54:20,230 --> 00:54:17,839
we expose that to the medical community

1543
00:54:22,230 --> 00:54:20,240
and they go oh hey maybe we ought to be

1544
00:54:25,190 --> 00:54:22,240
trying this so now i'm starting to see

1545
00:54:27,190 --> 00:54:25,200
hospitals that clinics start to pick up

1546
00:54:28,870 --> 00:54:27,200
using ultrasound now as a diagnostic

1547
00:54:30,630 --> 00:54:28,880
tool for backs it will still be

1548
00:54:32,230 --> 00:54:30,640
predominantly x-ray but you're starting

1549
00:54:34,870 --> 00:54:32,240
to see now because we had to do it a

1550
00:54:36,710 --> 00:54:34,880
different way we expose them to thinking

1551
00:54:38,710 --> 00:54:36,720
in a different manner so that's one of

1552
00:54:40,390 --> 00:54:38,720
the benefits that comes from space and

1553
00:54:41,990 --> 00:54:40,400
and pushing into new environment it's

1554
00:54:43,910 --> 00:54:42,000
like when you go on vacation to a

1555
00:54:46,069 --> 00:54:43,920
foreign location right you learn

1556
00:54:47,430 --> 00:54:46,079
something more about yourself by going

1557
00:54:49,589 --> 00:54:47,440
and putting yourself in that different

1558
00:54:51,109 --> 00:54:49,599
environment by going to space we're

1559
00:54:53,510 --> 00:54:51,119
going to learn more about how the human

1560
00:54:55,030 --> 00:54:53,520
body really functions by forcing it and

1561
00:54:56,710 --> 00:54:55,040
seeing how it adapts to that new

1562
00:54:58,710 --> 00:54:56,720
environment so the medical and

1563
00:55:00,549 --> 00:54:58,720

biological changes in space are really

1564
00:55:02,150 --> 00:55:00,559
intriguing and and we'll spawn a lot of

1565
00:55:03,030 --> 00:55:02,160
research again that will help us down

1566
00:55:04,309 --> 00:55:03,040
here

1567
00:55:06,390 --> 00:55:04,319
so i think one thing is clear we have

1568
00:55:07,750 --> 00:55:06,400
many challenges left but certainly we

1569
00:55:09,270 --> 00:55:07,760
have many things that we're working

1570
00:55:10,870 --> 00:55:09,280
towards for the future of human space

1571
00:55:12,549 --> 00:55:10,880
flight i'd like to thank our panelists

1572
00:55:13,990 --> 00:55:12,559
mr gerstenmaier and dr gazarick for

1573
00:55:15,829 --> 00:55:14,000
being with us today and answering our

1574
00:55:32,950 --> 00:55:15,839
questions on the future of human space

1575
00:55:37,910 --> 00:55:35,109
everyone knows that nasa works hard to

1576
00:55:39,990 --> 00:55:37,920
keep its astronauts safe in space but

1577
00:55:42,390 --> 00:55:40,000
did you know that spin-offs from space

1578
00:55:45,030 --> 00:55:42,400
technology are saving lives here on

1579
00:55:46,630 --> 00:55:45,040
earth every day

1580
00:55:48,870 --> 00:55:46,640
nasa-funded research created

1581
00:55:51,750 --> 00:55:48,880
rocket-powered parachutes that can save

1582
00:55:53,349 --> 00:55:51,760
entire airplanes along with their pilots

1583
00:55:55,829 --> 00:55:53,359
and passengers

1584
00:55:58,630 --> 00:55:55,839
a life raft originally designed for the

1585
00:56:01,510 --> 00:55:58,640
apollo missions has saved hundreds of

1586
00:56:04,230 --> 00:56:01,520
sailors stranded at sea

1587
00:56:06,789 --> 00:56:04,240
and a tiny cardiac pump developed with

1588
00:56:09,910 --> 00:56:06,799

the help of technology used to design

1589
00:56:13,349 --> 00:56:09,920
rocket engines has extended the lives of

1590
00:56:15,750 --> 00:56:13,359
hundreds of patients with failing hearts

1591
00:56:17,910 --> 00:56:15,760
nasa's innovation even led to personal

1592
00:56:21,190 --> 00:56:17,920
locator beacons which have helped save

1593
00:56:24,710 --> 00:56:21,200
more than 30 thousand sailors pilots and

1594
00:56:27,190 --> 00:56:24,720
adventurers in distress worldwide

1595
00:56:29,670 --> 00:56:27,200
together with its partners nasa

1596
00:56:32,710 --> 00:56:29,680
continues to develop technologies that

1597
00:56:34,710 --> 00:56:32,720
protect life both in space

1598
00:56:36,470 --> 00:56:34,720
and on earth

1599
00:56:37,589 --> 00:56:36,480
there's more space in your life than you

1600
00:56:50,630 --> 00:56:37,599
think

1601
00:56:54,710 --> 00:56:52,710
that was will wheaton as soon you can

1602
00:56:55,910 --> 00:56:54,720
know was a famous for star trek you know

1603
00:56:58,309 --> 00:56:55,920
will and some other folks have been

1604
00:56:59,910 --> 00:56:58,319
connecting with us on social media

1605
00:57:01,510 --> 00:56:59,920
that's been a real good venue for us is

1606
00:57:03,190 --> 00:57:01,520
to connect directly with the public so

1607
00:57:04,549 --> 00:57:03,200
remember to follow us on at nasa if you

1608
00:57:06,470 --> 00:57:04,559
want to learn more about what we're

1609
00:57:08,549 --> 00:57:06,480
doing as an agency also for today's

1610
00:57:10,710 --> 00:57:08,559
event if you want to ask us a question

1611
00:57:12,390 --> 00:57:10,720
the hashtag is poundassnasa we're also

1612
00:57:14,950 --> 00:57:12,400
streaming this on youtube on ustream

1613
00:57:18,950 --> 00:57:14,960

exact excuse me and the url for that is

1614
00:57:21,510 --> 00:57:19,990
nasa

1615
00:57:24,069 --> 00:57:21,520
hdtv

1616
00:57:25,910 --> 00:57:24,079
follow along and ask a question

1617
00:57:27,510 --> 00:57:25,920
investments in aviation and space

1618
00:57:29,750 --> 00:57:27,520
technology and innovation enable new

1619
00:57:30,950 --> 00:57:29,760
missions stimulate the economy

1620
00:57:32,309 --> 00:57:30,960
contribute to the nation's global

1621
00:57:36,230 --> 00:57:32,319
competitive

1622
00:57:37,430 --> 00:57:36,240
next generation of scientists engineers

1623
00:57:39,670 --> 00:57:37,440
and astronauts

1624
00:57:41,349 --> 00:57:39,680
nearly every aircraft today has a

1625
00:57:42,870 --> 00:57:41,359
nasa-supported technology on board that

1626
00:57:44,789 --> 00:57:42,880
helps the vehicle fly more safely and

1627
00:57:46,309 --> 00:57:44,799
efficiently from improved welding

1628
00:57:48,470 --> 00:57:46,319
techniques that help manufacturers weld

1629
00:57:51,270 --> 00:57:48,480
higher strength alloys to flame

1630
00:57:53,510 --> 00:57:51,280
materials that help first responders

1631
00:57:54,950 --> 00:57:53,520
keep safe during emergencies

1632
00:57:56,470 --> 00:57:54,960
technological advance is first used to

1633
00:57:58,390 --> 00:57:56,480
send astronauts and robots to space

1634
00:57:59,670 --> 00:57:58,400
improving technologies and processes

1635
00:58:02,150 --> 00:57:59,680
here on earth

1636
00:58:03,589 --> 00:58:02,160
our panel moderator jennifer gustetic

1637
00:58:05,190 --> 00:58:03,599
from the office of g technologists will

1638
00:58:07,349 --> 00:58:05,200

introduce our next panel who will talk

1639
00:58:09,109 --> 00:58:07,359
about about innovation technology

1640
00:58:10,710 --> 00:58:09,119
improving the economy and the space

1641
00:58:12,470 --> 00:58:10,720
program jennifer

1642
00:58:13,750 --> 00:58:12,480
hello good morning

1643
00:58:15,349 --> 00:58:13,760
i'm really pleased to be here this

1644
00:58:16,789 --> 00:58:15,359
morning to introduce a great panel

1645
00:58:19,190 --> 00:58:16,799
that's going to talk to you a bit today

1646
00:58:21,589 --> 00:58:19,200
about the benefits of nasa technology on

1647
00:58:23,109 --> 00:58:21,599
each of y'all's lives every day so get

1648
00:58:24,950 --> 00:58:23,119
ready to ask some good questions about

1649
00:58:26,870 --> 00:58:24,960
maybe unexpected nasa technology that

1650
00:58:28,549 --> 00:58:26,880
you see every day in your life we've got

1651
00:58:31,349 --> 00:58:28,559
mason peck with us today as well as

1652
00:58:34,390 --> 00:58:31,359
jaewon shin mason peck is my boss he's

1653
00:58:36,069 --> 00:58:34,400
the chief technologist for nasa he's uh

1654
00:58:37,990 --> 00:58:36,079
and in that capacity he acts as the

1655
00:58:40,470 --> 00:58:38,000
agency's principal advisor and advocate

1656
00:58:43,030 --> 00:58:40,480
on matters concerning technology policy

1657
00:58:45,750 --> 00:58:43,040
and programs he actually before coming

1658
00:58:48,069 --> 00:58:45,760
to nasa um has been a faculty member at

1659
00:58:51,750 --> 00:58:48,079
cornell for many years focusing on a

1660
00:58:54,549 --> 00:58:51,760
variety of small spacecraft topics he

1661
00:58:56,789 --> 00:58:54,559
spent 20 years in industry in academia

1662
00:58:59,030 --> 00:58:56,799
as well as having authored 90 academic

1663
00:59:00,789 --> 00:58:59,040

articles and about he holds about 17

1664
00:59:02,390 --> 00:59:00,799
patents that's a lot of innovation

1665
00:59:05,270 --> 00:59:02,400
himself

1666
00:59:07,910 --> 00:59:05,280
he holds a phd from ul uh ucla in

1667
00:59:10,069 --> 00:59:07,920
aerospace engineering as well as

1668
00:59:11,910 --> 00:59:10,079
a masters in medieval

1669
00:59:14,710 --> 00:59:11,920
english literature from the university

1670
00:59:16,950 --> 00:59:14,720
of chicago so mason is a diverse boss

1671
00:59:19,670 --> 00:59:16,960
and in addition to being an expert in

1672
00:59:21,670 --> 00:59:19,680
medieval english literature he also uh

1673
00:59:23,510 --> 00:59:21,680
is really passionate about baking which

1674
00:59:25,750 --> 00:59:23,520
i find very interesting um especially

1675
00:59:27,829 --> 00:59:25,760
because of its its science elements as

1676
00:59:29,670 --> 00:59:27,839
well and he also speaks uh he also

1677
00:59:31,349 --> 00:59:29,680
speaks fluent japanese so a little bit

1678
00:59:33,430 --> 00:59:31,359
about mason not just as a rocket

1679
00:59:36,390 --> 00:59:33,440
scientist but also as a person

1680
00:59:37,829 --> 00:59:36,400
um moving on to dr jaiwan shin doctor

1681
00:59:39,349 --> 00:59:37,839
jaywan chin is the associate

1682
00:59:40,789 --> 00:59:39,359
administrator for the aeronautics

1683
00:59:42,950 --> 00:59:40,799
research and mission direct mission

1684
00:59:44,789 --> 00:59:42,960
directorate here at nasa

1685
00:59:47,430 --> 00:59:44,799
and in that capacity he manages the

1686
00:59:49,430 --> 00:59:47,440
agency's aeronautics research portfolio

1687
00:59:51,589 --> 00:59:49,440
and guides its strategic direction he's

1688
00:59:53,990 --> 00:59:51,599

had a long history here at nasa and

1689
00:59:55,670 --> 00:59:54,000
prior to having this role he used to

1690
00:59:57,829 --> 00:59:55,680
serve as the chief of aeronautics

1691
00:59:59,510 --> 00:59:57,839
projects at the at nasa glenn

1692
01:00:01,430 --> 00:59:59,520
research center which is up in cleveland

1693
01:00:03,349 --> 01:00:01,440
ohio where i was born

1694
01:00:05,190 --> 01:00:03,359
he received his phd in mechanical

1695
01:00:08,470 --> 01:00:05,200
engineering from virginia polytechnic

1696
01:00:11,270 --> 01:00:08,480
institute in blacksburg virginia and he

1697
01:00:12,870 --> 01:00:11,280
has a a bunch of awards from nasa

1698
01:00:14,710 --> 01:00:12,880
ranging from the

1699
01:00:17,349 --> 01:00:14,720
nasa outstanding leadership medal to the

1700
01:00:19,190 --> 01:00:17,359
2008 presidential rank award so he's

1701
01:00:21,750 --> 01:00:19,200
truly a great public servant who we have

1702
01:00:23,589 --> 01:00:21,760
here on this panel today and he as well

1703
01:00:25,190 --> 01:00:23,599
is very smart obviously and has

1704
01:00:26,470 --> 01:00:25,200
co-authored more than 20 technical and

1705
01:00:28,390 --> 01:00:26,480
journal papers

1706
01:00:31,670 --> 01:00:28,400
as well but he's not all about business

1707
01:00:33,750 --> 01:00:31,680
he also likes to have fun um and uh he

1708
01:00:35,990 --> 01:00:33,760
one of his his fun facts is that he

1709
01:00:37,589 --> 01:00:36,000
can't fly a fighter jet but he does like

1710
01:00:41,270 --> 01:00:37,599
to drive fast cars

1711
01:00:42,630 --> 01:00:41,280
um so segwaying into a a short video

1712
01:00:44,309 --> 01:00:42,640
that the aeronautics folks would like to

1713
01:00:46,230 --> 01:00:44,319

show you guys real quick

1714
01:00:48,150 --> 01:00:46,240
i know a question that dr shin will have

1715
01:01:55,589 --> 01:00:48,160
for you later is did you know nasa is

1716
01:02:01,670 --> 01:01:56,870
all right so we'll go ahead and start

1717
01:02:05,109 --> 01:02:03,589
i can start them off with one while we

1718
01:02:07,270 --> 01:02:05,119
while we get them ginned up i'm

1719
01:02:09,430 --> 01:02:07,280
interested from y'all's perspective

1720
01:02:11,750 --> 01:02:09,440
which spin-off technology you think is

1721
01:02:14,150 --> 01:02:11,760
the most unexpected that folks in this

1722
01:02:16,390 --> 01:02:14,160
audience and watching online might not

1723
01:02:17,670 --> 01:02:16,400
know is actually a nasa technology

1724
01:02:19,430 --> 01:02:17,680
mason

1725
01:02:20,630 --> 01:02:19,440
uh let's see i guess

1726
01:02:22,470 --> 01:02:20,640
one of my favorites because it's so

1727
01:02:24,870 --> 01:02:22,480
unexpected is

1728
01:02:27,510 --> 01:02:24,880
baby food so it turns out that there's a

1729
01:02:29,829 --> 01:02:27,520
compound that's used in 90 to 95 of baby

1730
01:02:31,349 --> 01:02:29,839
food worldwide it was developed

1731
01:02:33,190 --> 01:02:31,359
originally for astronaut nutrition out

1732
01:02:34,870 --> 01:02:33,200
of algae believe it or not but our

1733
01:02:36,309 --> 01:02:34,880
research into that

1734
01:02:37,670 --> 01:02:36,319
created this uh

1735
01:02:39,589 --> 01:02:37,680
created an understanding of how we could

1736
01:02:42,150 --> 01:02:39,599
in fact promote brain growth and nervous

1737
01:02:45,270 --> 01:02:42,160
system development in infants and that's

1738
01:02:46,390 --> 01:02:45,280

had a huge impact worldwide so it's

1739
01:02:48,870 --> 01:02:46,400
evidence of what we were talking about

1740
01:02:50,870 --> 01:02:48,880
that really when we invest in

1741
01:02:52,950 --> 01:02:50,880
space we are not spending that money in

1742
01:02:54,309 --> 01:02:52,960
space we spend it here on the ground

1743
01:02:56,630 --> 01:02:54,319
you know we don't dump shovel pools of

1744
01:02:58,870 --> 01:02:56,640
cash onto the moon we're we are in fact

1745
01:03:01,589 --> 01:02:58,880
uh promoting american

1746
01:03:03,430 --> 01:03:01,599
innovation and growing our economy and

1747
01:03:04,630 --> 01:03:03,440
these uh these kinds of benefits whether

1748
01:03:06,390 --> 01:03:04,640
it's baby food or some of the things you

1749
01:03:08,549 --> 01:03:06,400
heard about in will wheaton's talk uh

1750
01:03:10,390 --> 01:03:08,559
really uh are infused within our lives i

1751
01:03:11,510 --> 01:03:10,400
think it'd be hard to imagine a world

1752
01:03:13,270 --> 01:03:11,520
without nasa whether you're whether

1753
01:03:15,589 --> 01:03:13,280
you're an infant drinking formula or uh

1754
01:03:16,630 --> 01:03:15,599
or older i think it's true

1755
01:03:17,910 --> 01:03:16,640
how about you

1756
01:03:20,630 --> 01:03:17,920
yeah

1757
01:03:23,829 --> 01:03:20,640
while our friends and colleagues in the

1758
01:03:27,430 --> 01:03:23,839
space side of this wonderful agency have

1759
01:03:31,829 --> 01:03:27,440
been doing some really amazing stuff

1760
01:03:32,630 --> 01:03:31,839
by the way stuff is a technical term

1761
01:03:34,870 --> 01:03:32,640
and

1762
01:03:37,109 --> 01:03:34,880
i mean i just cannot imagine what

1763
01:03:39,589 --> 01:03:37,119

wonderful things a space side of the

1764
01:03:40,549 --> 01:03:39,599
agency has done

1765
01:03:43,510 --> 01:03:40,559
but

1766
01:03:46,069 --> 01:03:43,520
in the aeronautics side everything we do

1767
01:03:48,309 --> 01:03:46,079
is a direct benefit to all of us to

1768
01:03:49,589 --> 01:03:48,319
flying public there is nothing that we

1769
01:03:52,549 --> 01:03:49,599
need to

1770
01:03:55,270 --> 01:03:52,559
spin off or regenerate or

1771
01:03:57,510 --> 01:03:55,280
morph to benefit you so

1772
01:03:58,549 --> 01:03:57,520
you know i always start asking the

1773
01:04:00,789 --> 01:03:58,559
audience

1774
01:04:02,230 --> 01:04:00,799
whenever i engage with the public

1775
01:04:04,390 --> 01:04:02,240
how many of you

1776
01:04:06,950 --> 01:04:04,400
at least flown once

1777
01:04:08,950 --> 01:04:06,960
last year

1778
01:04:10,630 --> 01:04:08,960
virtually everyone in the room so that

1779
01:04:12,630 --> 01:04:10,640
that's the testimony

1780
01:04:13,829 --> 01:04:12,640
several decades ago

1781
01:04:17,670 --> 01:04:13,839
flying was

1782
01:04:21,029 --> 01:04:17,680
somewhat a novelty that you had to have

1783
01:04:23,190 --> 01:04:21,039
a pretty good resource means to fly and

1784
01:04:25,910 --> 01:04:23,200
it's not everyday transportation but

1785
01:04:29,270 --> 01:04:25,920
nowadays if you go to airport

1786
01:04:32,309 --> 01:04:29,280
any airport busy airport it's like

1787
01:04:34,069 --> 01:04:32,319
what used to be greyhound bus station

1788
01:04:38,150 --> 01:04:34,079

and um

1789
01:04:40,470 --> 01:04:38,160
i'll throw some a few numbers and just

1790
01:04:41,270 --> 01:04:40,480
to share some information

1791
01:04:43,990 --> 01:04:41,280
that

1792
01:04:45,109 --> 01:04:44,000
our nation employs about 10 million

1793
01:04:47,750 --> 01:04:45,119
people

1794
01:04:48,549 --> 01:04:47,760
in aviation related industry

1795
01:04:51,430 --> 01:04:48,559
and

1796
01:04:55,029 --> 01:04:51,440
our commercial airlines spent

1797
01:04:57,430 --> 01:04:55,039
about 60 billion dollars for fuel only

1798
01:04:59,910 --> 01:04:57,440
last year that's six zero

1799
01:05:01,349 --> 01:04:59,920
and it's not m it's b

1800
01:05:03,589 --> 01:05:01,359
so

1801
01:05:04,950 --> 01:05:03,599
it's a huge industry

1802
01:05:10,230 --> 01:05:04,960
and um

1803
01:05:13,430 --> 01:05:10,240
if you fly uh randomly once every day

1804
01:05:16,150 --> 01:05:13,440
the the possibility or probability of

1805
01:05:17,029 --> 01:05:16,160
you getting into fatal accident

1806
01:05:23,670 --> 01:05:17,039
is

1807
01:05:26,230 --> 01:05:23,680
000 years and we all know we're not

1808
01:05:28,950 --> 01:05:26,240
going to live that long so

1809
01:05:32,069 --> 01:05:28,960
it is extremely safe in fact it's the

1810
01:05:33,349 --> 01:05:32,079
safest mode of transportation

1811
01:05:35,190 --> 01:05:33,359
anywhere

1812
01:05:36,549 --> 01:05:35,200
and our country

1813
01:05:39,829 --> 01:05:36,559

is at the

1814
01:05:41,750 --> 01:05:39,839
forefront of this industry so

1815
01:05:43,990 --> 01:05:41,760
the reason why i'm

1816
01:05:45,510 --> 01:05:44,000
explaining all this is as jennifer

1817
01:05:48,789 --> 01:05:45,520
mentioned

1818
01:05:51,910 --> 01:05:48,799
nasa aeronautics is the dna

1819
01:05:54,950 --> 01:05:51,920
of almost all modern commercial aircraft

1820
01:05:55,910 --> 01:05:54,960
for sure but many military aircraft as

1821
01:05:58,470 --> 01:05:55,920
well

1822
01:06:00,549 --> 01:05:58,480
and we are the world leader

1823
01:06:02,549 --> 01:06:00,559
there is no dispute about that

1824
01:06:05,109 --> 01:06:02,559
and i think

1825
01:06:07,190 --> 01:06:05,119
nasa aeronautics has done tremendous

1826
01:06:09,589 --> 01:06:07,200
contribution and service to the nation

1827
01:06:11,430 --> 01:06:09,599
that we all benefit

1828
01:06:13,510 --> 01:06:11,440
we are not stopping here

1829
01:06:16,390 --> 01:06:13,520
we have exciting

1830
01:06:18,870 --> 01:06:16,400
future and new technology that we've

1831
01:06:21,990 --> 01:06:18,880
been working on as we have always been

1832
01:06:24,870 --> 01:06:22,000
so unmanned aerial vehicle uh

1833
01:06:26,549 --> 01:06:24,880
that you know who knows uh 20 years

1834
01:06:27,670 --> 01:06:26,559
later when this

1835
01:06:30,870 --> 01:06:27,680
young

1836
01:06:33,829 --> 01:06:30,880
boy and girl growing up to our age they

1837
01:06:37,029 --> 01:06:33,839
may be ordering a pizza at home and

1838
01:06:38,390 --> 01:06:37,039

uas will drop a pizza

1839
01:06:40,150 --> 01:06:38,400
your dose there

1840
01:06:42,309 --> 01:06:40,160
who knows

1841
01:06:43,510 --> 01:06:42,319
and we are working on also very

1842
01:06:44,829 --> 01:06:43,520
different

1843
01:06:46,390 --> 01:06:44,839
airplane

1844
01:06:48,069 --> 01:06:46,400
configuration

1845
01:06:49,829 --> 01:06:48,079
shape of the airplane is completely

1846
01:06:51,750 --> 01:06:49,839
different so

1847
01:06:54,309 --> 01:06:51,760
in 20 years

1848
01:06:56,950 --> 01:06:54,319
we may be flying in a completely

1849
01:06:59,109 --> 01:06:56,960
different looking airplane than what we

1850
01:07:00,950 --> 01:06:59,119
call tuber and wing

1851
01:07:03,750 --> 01:07:00,960
to save

1852
01:07:06,870 --> 01:07:03,760
fuel consumption so

1853
01:07:09,270 --> 01:07:06,880
we're very excited about

1854
01:07:11,750 --> 01:07:09,280
providing the direct benefit

1855
01:07:15,190 --> 01:07:11,760
to the flying public and

1856
01:07:18,309 --> 01:07:15,200
along with a space side of the agency

1857
01:07:20,150 --> 01:07:18,319
that also provides a tremendous value to

1858
01:07:22,470 --> 01:07:20,160
the country through all kinds of

1859
01:07:24,710 --> 01:07:22,480
technologies we are very proud to be

1860
01:07:26,710 --> 01:07:24,720
part of the year thank you dr chen and

1861
01:07:28,150 --> 01:07:26,720
before we get into the questions mason

1862
01:07:30,789 --> 01:07:28,160
is there anything you want to add

1863
01:07:32,549 --> 01:07:30,799

generally about technology at the agency

1864
01:07:33,829 --> 01:07:32,559
and all of the spin-off work and all of

1865
01:07:35,349 --> 01:07:33,839
the good work that we do in infusing

1866
01:07:36,789 --> 01:07:35,359
technology into the nation well there's

1867
01:07:38,950 --> 01:07:36,799
so much we could say i'll tell you i

1868
01:07:40,549 --> 01:07:38,960
could i could geek out forever over the

1869
01:07:42,230 --> 01:07:40,559
awesome things that nasa does that's

1870
01:07:43,829 --> 01:07:42,240
really to benefit the nation but also

1871
01:07:45,510 --> 01:07:43,839
just in space generally and in

1872
01:07:46,630 --> 01:07:45,520
aeronautics

1873
01:07:48,549 --> 01:07:46,640
i'll tell you i don't know about you it

1874
01:07:50,789 --> 01:07:48,559
does feel like once a day i am finding

1875
01:07:52,950 --> 01:07:50,799
flying randomly somewhere uh that's

1876
01:07:55,349 --> 01:07:52,960
that's one of the things we do here we

1877
01:07:56,870 --> 01:07:55,359
we do reach out at nasa

1878
01:07:58,710 --> 01:07:56,880
and something i think is also not

1879
01:08:01,190 --> 01:07:58,720
commonly understood is the extent to

1880
01:08:03,430 --> 01:08:01,200
which nasa works with businesses small

1881
01:08:05,990 --> 01:08:03,440
and large also even individuals

1882
01:08:07,349 --> 01:08:06,000
to make our future in space and air

1883
01:08:09,510 --> 01:08:07,359
possible

1884
01:08:11,270 --> 01:08:09,520
we do do a lot of fantastic research

1885
01:08:12,789 --> 01:08:11,280
within nasa but we also engage with

1886
01:08:13,990 --> 01:08:12,799
universities small businesses large

1887
01:08:15,430 --> 01:08:14,000
businesses

1888
01:08:18,470 --> 01:08:15,440

we also have international partners

1889
01:08:20,070 --> 01:08:18,480
where we work on hard problems when we

1890
01:08:22,470 --> 01:08:20,080
set these difficult

1891
01:08:24,229 --> 01:08:22,480
goals for ourselves sending astronauts

1892
01:08:26,229 --> 01:08:24,239
to rendezvous with an asteroid and

1893
01:08:27,910 --> 01:08:26,239
someday to mars when we set those

1894
01:08:29,749 --> 01:08:27,920
difficult goals

1895
01:08:31,669 --> 01:08:29,759
we're trying to reach for something

1896
01:08:34,229 --> 01:08:31,679
extraordinary in the process though we

1897
01:08:35,910 --> 01:08:34,239
learn so many new things it's because we

1898
01:08:37,590 --> 01:08:35,920
set these hard goals for ourselves

1899
01:08:39,749 --> 01:08:37,600
because we challenge ourselves that

1900
01:08:42,229 --> 01:08:39,759
we're able to grow um as a nation and

1901
01:08:44,789 --> 01:08:42,239
also uh as uh as an agency of course in

1902
01:08:46,789 --> 01:08:44,799
our ability to solve hard problems so uh

1903
01:08:49,030 --> 01:08:46,799
even if you're not a space nut like i am

1904
01:08:52,149 --> 01:08:49,040
or or an aerodynamics not like i am or

1905
01:08:53,590 --> 01:08:52,159
like giant one is you know the fact is

1906
01:08:55,430 --> 01:08:53,600
you should be interested in the hard

1907
01:08:57,910 --> 01:08:55,440
problems the difficulty that we're

1908
01:08:59,669 --> 01:08:57,920
challenging ourselves with um it's it's

1909
01:09:02,229 --> 01:08:59,679
one of the things that makes us unique i

1910
01:09:03,669 --> 01:09:02,239
think as a nation certainly as nasa um

1911
01:09:05,669 --> 01:09:03,679
but it's those hard problems that really

1912
01:09:07,349 --> 01:09:05,679
are why we have the solutions we have

1913
01:09:09,510 --> 01:09:07,359

today i'll mention cell phone cameras

1914
01:09:11,030 --> 01:09:09,520
just because because why not right um

1915
01:09:12,870 --> 01:09:11,040
you know the the cmos cameras in your

1916
01:09:13,990 --> 01:09:12,880
cell phone that's actually based on

1917
01:09:15,749 --> 01:09:14,000
technology developed at the jet

1918
01:09:18,309 --> 01:09:15,759
propulsion lab the folks who brought you

1919
01:09:20,789 --> 01:09:18,319
the mars science laboratory that landed

1920
01:09:22,630 --> 01:09:20,799
so successfully this past august um

1921
01:09:24,630 --> 01:09:22,640
in probably most see hands who's got a

1922
01:09:26,070 --> 01:09:24,640
cell phone in their uh possession right

1923
01:09:27,349 --> 01:09:26,080
now yeah i thought maybe that would be

1924
01:09:29,110 --> 01:09:27,359
the case i'm surprised not everyone is

1925
01:09:31,110 --> 01:09:29,120
wrong raised hand but

1926
01:09:34,390 --> 01:09:31,120
you know maybe maybe your two kids

1927
01:09:35,430 --> 01:09:34,400
don't have your own

1928
01:09:37,430 --> 01:09:35,440
so i mean

1929
01:09:38,950 --> 01:09:37,440
the pervasiveness of nasa technology is

1930
01:09:40,550 --> 01:09:38,960
everywhere and the reason why the cell

1931
01:09:41,990 --> 01:09:40,560
phone camera

1932
01:09:43,590 --> 01:09:42,000
became popular of course was because

1933
01:09:45,110 --> 01:09:43,600
there's a there's a motivation a

1934
01:09:47,590 --> 01:09:45,120
business case to be made

1935
01:09:49,510 --> 01:09:47,600
for using phones using imagery for all

1936
01:09:51,430 --> 01:09:49,520
sorts of purposes it doesn't have to be

1937
01:09:52,709 --> 01:09:51,440
you know serious scientific exploration

1938
01:09:53,910 --> 01:09:52,719

in order for it to be valuable for the

1939
01:09:56,070 --> 01:09:53,920
economy

1940
01:09:57,990 --> 01:09:56,080
so anyway nasa does reach out we have

1941
01:09:59,990 --> 01:09:58,000
programs now uh thanks to the space

1942
01:10:02,310 --> 01:10:00,000
technology program in part that can

1943
01:10:03,830 --> 01:10:02,320
engage with technology students at

1944
01:10:05,990 --> 01:10:03,840
universities providing grants to them

1945
01:10:08,149 --> 01:10:06,000
also for faculty we have ways of

1946
01:10:09,830 --> 01:10:08,159
engaging with small companies also

1947
01:10:12,310 --> 01:10:09,840
universities and large companies to

1948
01:10:14,310 --> 01:10:12,320
launch small satellites and i'll go off

1949
01:10:16,550 --> 01:10:14,320
rip on that a little bit later but you

1950
01:10:17,830 --> 01:10:16,560
know these days it's not unheard of that

1951
01:10:19,750 --> 01:10:17,840
universities even some high school

1952
01:10:21,750 --> 01:10:19,760
students can launch spacecraft the size

1953
01:10:23,990 --> 01:10:21,760
of a grapefruit uh they're called

1954
01:10:25,430 --> 01:10:24,000
cubesats and uh we have a program at

1955
01:10:27,750 --> 01:10:25,440
nasa that can launch them for free for

1956
01:10:29,990 --> 01:10:27,760
universities so it's a great time to be

1957
01:10:31,830 --> 01:10:30,000
engaged in space and in aeronautics

1958
01:10:33,510 --> 01:10:31,840
there's never been a more exciting time

1959
01:10:35,110 --> 01:10:33,520
in my view to be working on these kinds

1960
01:10:38,550 --> 01:10:35,120
of problems

1961
01:10:40,310 --> 01:10:38,560
great so let's go to the first question

1962
01:10:42,870 --> 01:10:40,320
here we go jeff wallace from arlington

1963
01:10:44,310 --> 01:10:42,880

virginia rockman 528 on twitter i was

1964
01:10:46,229 --> 01:10:44,320
fortunate enough to see you speak at the

1965
01:10:48,229 --> 01:10:46,239
nasa veda innovative advanced concept

1966
01:10:50,310 --> 01:10:48,239
symposium this last fall

1967
01:10:52,149 --> 01:10:50,320
and just throw you a softball out there

1968
01:10:53,750 --> 01:10:52,159
to to talk a little bit about that tell

1969
01:10:56,149 --> 01:10:53,760
people about that and to know what were

1970
01:10:57,350 --> 01:10:56,159
some of the the really great things or

1971
01:10:59,430 --> 01:10:57,360
the things that interested you

1972
01:11:01,189 --> 01:10:59,440
personally that came out of this year's

1973
01:11:03,590 --> 01:11:01,199
uh new projects

1974
01:11:05,750 --> 01:11:03,600
a great question so the nasa innovative

1975
01:11:07,830 --> 01:11:05,760
advanced concepts program is part of the

1976
01:11:09,990 --> 01:11:07,840
overall space technology program

1977
01:11:12,630 --> 01:11:10,000
it's our

1978
01:11:14,149 --> 01:11:12,640
our focus on these very powerful ideas

1979
01:11:16,149 --> 01:11:14,159
far out in time

1980
01:11:18,149 --> 01:11:16,159
at least a decade in the future maybe 20

1981
01:11:21,030 --> 01:11:18,159
or even 30 years into the future we're

1982
01:11:24,149 --> 01:11:21,040
trying to seed our technology pipeline

1983
01:11:25,750 --> 01:11:24,159
with ideas that will make sense for us

1984
01:11:27,669 --> 01:11:25,760
in the decades to come

1985
01:11:29,030 --> 01:11:27,679
they've got to be based on real physics

1986
01:11:31,110 --> 01:11:29,040
at the moment we are not pursuing warp

1987
01:11:34,390 --> 01:11:31,120
drives we're not pursuing uh transporter

1988
01:11:35,830 --> 01:11:34,400

beams uh but if the physics enables that

1989
01:11:38,390 --> 01:11:35,840
naya could be the place where that would

1990
01:11:39,510 --> 01:11:38,400
happen uh anyway nia a fantastic program

1991
01:11:41,030 --> 01:11:39,520
a lot of great ideas have come out of

1992
01:11:42,550 --> 01:11:41,040
this thing over the years

1993
01:11:44,470 --> 01:11:42,560
in the recent past one of my favorites i

1994
01:11:46,229 --> 01:11:44,480
think folks will resonate with is based

1995
01:11:47,990 --> 01:11:46,239
on 3d printing or what they call

1996
01:11:49,030 --> 01:11:48,000
additive manufacturing

1997
01:11:51,270 --> 01:11:49,040
you know now it's actually not that

1998
01:11:53,110 --> 01:11:51,280
difficult to buy a machine that will

1999
01:11:55,030 --> 01:11:53,120
allow you to print three-dimensional

2000
01:11:57,750 --> 01:11:55,040
objects from your home computer that you

2001
01:11:59,669 --> 01:11:57,760
can build your own if you really want to

2002
01:12:01,750 --> 01:11:59,679
those 3d printers

2003
01:12:04,870 --> 01:12:01,760
imagine a time when we could launch a

2004
01:12:06,870 --> 01:12:04,880
large 3d printer and use lunar soil or

2005
01:12:08,950 --> 01:12:06,880
regolith to print up structures on the

2006
01:12:10,630 --> 01:12:08,960
surface of the moon one of the nia

2007
01:12:12,950 --> 01:12:10,640
projects this past year actually looked

2008
01:12:14,790 --> 01:12:12,960
into what that would take and although

2009
01:12:15,910 --> 01:12:14,800
we don't have the technology yet

2010
01:12:18,229 --> 01:12:15,920
we've now

2011
01:12:19,590 --> 01:12:18,239
thanks to that project we've

2012
01:12:20,790 --> 01:12:19,600
we think we understand the path to get

2013
01:12:22,950 --> 01:12:20,800

from here to there

2014
01:12:24,870 --> 01:12:22,960
so these ideas that are now informing

2015
01:12:26,310 --> 01:12:24,880
how we live every day 3d printers to

2016
01:12:28,310 --> 01:12:26,320
make some things easy

2017
01:12:30,709 --> 01:12:28,320
even the kinds of communications and

2018
01:12:32,709 --> 01:12:30,719
computational capability in cell phones

2019
01:12:34,550 --> 01:12:32,719
this is finding its way into nasa we

2020
01:12:36,470 --> 01:12:34,560
talk about spin-offs a lot but there's

2021
01:12:37,990 --> 01:12:36,480
also a spin in phenomenon where we're

2022
01:12:39,430 --> 01:12:38,000
reaching out and bringing in technology

2023
01:12:41,910 --> 01:12:39,440
that's been developed for for folks like

2024
01:12:43,510 --> 01:12:41,920
you for us to use to motivate new kinds

2025
01:12:44,790 --> 01:12:43,520
of exploration in space and new kinds of

2026
01:12:45,750 --> 01:12:44,800
aeronautics

2027
01:12:48,550 --> 01:12:45,760
great

2028
01:12:54,470 --> 01:12:51,110
you go ahead then i'll repeat it okay

2029
01:12:56,149 --> 01:12:54,480
uh jamie rich jimmer3294 on twitter mr

2030
01:12:59,110 --> 01:12:56,159
shin you were mentioning

2031
01:13:01,510 --> 01:12:59,120
just how much fuel aircraft go through

2032
01:13:03,910 --> 01:13:01,520
like gillions of gallons

2033
01:13:06,070 --> 01:13:03,920
um the question to me is are we doing

2034
01:13:08,149 --> 01:13:06,080
research into how that kind of usage

2035
01:13:10,630 --> 01:13:08,159
also affects our environment and how we

2036
01:13:12,550 --> 01:13:10,640
can maybe ameliorate some of those

2037
01:13:14,149 --> 01:13:12,560
effects so i'll repeat the question real

2038
01:13:15,669 --> 01:13:14,159

quick for the folks listening and the

2039
01:13:17,830 --> 01:13:15,679
question was about how the amount of

2040
01:13:20,550 --> 01:13:17,840
fuel that airlines consumes might have

2041
01:13:23,350 --> 01:13:20,560
environmental effects yes thanks for the

2042
01:13:25,669 --> 01:13:23,360
question it is it is one of the

2043
01:13:29,110 --> 01:13:25,679
most important questions

2044
01:13:31,189 --> 01:13:29,120
of today that we are working on because

2045
01:13:32,390 --> 01:13:31,199
certainly as you mentioned not only the

2046
01:13:34,390 --> 01:13:32,400
quantity

2047
01:13:36,950 --> 01:13:34,400
of fuel that we are

2048
01:13:40,310 --> 01:13:36,960
consuming that we are putting out this

2049
01:13:41,030 --> 01:13:40,320
emission at a very high altitude

2050
01:13:42,709 --> 01:13:41,040
so

2051
01:13:45,189 --> 01:13:42,719
that in that altitude you're not

2052
01:13:48,149 --> 01:13:45,199
supposed to pollute that altitude for

2053
01:13:51,510 --> 01:13:48,159
all of us so um just to

2054
01:13:54,470 --> 01:13:51,520
give you the idea uh co2 emission from

2055
01:13:57,990 --> 01:13:54,480
worldwide aviation uh scholars are

2056
01:14:01,270 --> 01:13:58,000
thinking about three percent uh

2057
01:14:03,110 --> 01:14:01,280
due to the aviation so it's debatable

2058
01:14:05,910 --> 01:14:03,120
but nonetheless

2059
01:14:07,189 --> 01:14:05,920
however small that percentage may be

2060
01:14:09,430 --> 01:14:07,199
we have to

2061
01:14:12,229 --> 01:14:09,440
protect our environment so

2062
01:14:14,950 --> 01:14:12,239
we are very very happy nasa aeronautics

2063
01:14:16,229 --> 01:14:14,960

is very heavy on developing technologies

2064
01:14:18,709 --> 01:14:16,239
from both

2065
01:14:23,510 --> 01:14:18,719
aircraft technologies and

2066
01:14:26,310 --> 01:14:23,520
engine technologies to reduce this fuel

2067
01:14:28,870 --> 01:14:26,320
consumption due to fuel consumption

2068
01:14:30,310 --> 01:14:28,880
to impact environment impact as

2069
01:14:31,990 --> 01:14:30,320
an example

2070
01:14:34,709 --> 01:14:32,000
the concept that we're working on you

2071
01:14:35,910 --> 01:14:34,719
can see uh the scale model outside in

2072
01:14:38,550 --> 01:14:35,920
the lobby

2073
01:14:41,590 --> 01:14:38,560
which is a blended wing body as we call

2074
01:14:43,590 --> 01:14:41,600
it so it looks like a stingray

2075
01:14:44,790 --> 01:14:43,600
so you could you could almost think it

2076
01:14:47,189 --> 01:14:44,800
as a

2077
01:14:48,229 --> 01:14:47,199
flying wing but it's a different actual

2078
01:14:49,350 --> 01:14:48,239
concept

2079
01:14:53,750 --> 01:14:49,360
that

2080
01:14:56,630 --> 01:14:53,760
material and

2081
01:14:59,750 --> 01:14:56,640
advanced engines could save fuel

2082
01:15:01,669 --> 01:14:59,760
consumption by fifty percent five zero

2083
01:15:03,590 --> 01:15:01,679
so that's the kind of revolutionary

2084
01:15:06,229 --> 01:15:03,600
technologies that we're working on

2085
01:15:08,630 --> 01:15:06,239
certainly we're helping the current uh

2086
01:15:09,830 --> 01:15:08,640
aircraft and propulsion system as well

2087
01:15:12,390 --> 01:15:09,840
to save

2088
01:15:15,270 --> 01:15:12,400

fuel as much as we can and we're also

2089
01:15:17,990 --> 01:15:15,280
working on alternative fuel uh with

2090
01:15:19,510 --> 01:15:18,000
renewable alternative fuels that can

2091
01:15:20,709 --> 01:15:19,520
reduce the

2092
01:15:24,390 --> 01:15:20,719
emittance

2093
01:15:25,910 --> 01:15:24,400
from the fossil fuels significantly so

2094
01:15:27,590 --> 01:15:25,920
so for full disclosure i got my

2095
01:15:29,189 --> 01:15:27,600
undergraduate degree at the university

2096
01:15:31,669 --> 01:15:29,199
of texas so i have to throw you a

2097
01:15:32,709 --> 01:15:31,679
softball here that's right okay

2098
01:15:34,390 --> 01:15:32,719
um

2099
01:15:36,709 --> 01:15:34,400
so i'm throwing a softball here which is

2100
01:15:39,189 --> 01:15:36,719
um these things called winglets now what

2101
01:15:41,350 --> 01:15:39,199
are they again yes

2102
01:15:44,149 --> 01:15:41,360
you see this uh little

2103
01:15:46,390 --> 01:15:44,159
uh device uh at the at the end of the

2104
01:15:48,470 --> 01:15:46,400
wing exercise this is like longhorn on

2105
01:15:49,430 --> 01:15:48,480
camera right yeah hence the texas yeah

2106
01:15:51,510 --> 01:15:49,440
yeah i think and that's actually

2107
01:15:53,750 --> 01:15:51,520
developed at youtube texas rendering of

2108
01:15:57,669 --> 01:15:53,760
doing this

2109
01:15:59,270 --> 01:15:57,679
that that was uh the idea was originated

2110
01:16:03,430 --> 01:15:59,280
from nasa

2111
01:16:05,030 --> 01:16:03,440
research as a matter of fact and it

2112
01:16:08,070 --> 01:16:05,040
reduces the

2113
01:16:09,350 --> 01:16:08,080

wingtip so-called wingtip vortex and to

2114
01:16:12,870 --> 01:16:09,360
make it uh

2115
01:16:15,830 --> 01:16:12,880
as a layman's thermal everyday's term

2116
01:16:19,189 --> 01:16:15,840
it reduces the air uh turbulence or

2117
01:16:22,390 --> 01:16:19,199
disturbance at the wingtip so that by

2118
01:16:24,390 --> 01:16:22,400
installing those small devices

2119
01:16:25,910 --> 01:16:24,400
uh reduces quite a bit of fuel

2120
01:16:29,030 --> 01:16:25,920
consumption that's why

2121
01:16:29,950 --> 01:16:29,040
um i think southwest uh retrofitted all

2122
01:16:33,669 --> 01:16:29,960
the

2123
01:16:34,550 --> 01:16:33,679
0.737 airplanes with this little device

2124
01:16:36,630 --> 01:16:34,560
and

2125
01:16:38,790 --> 01:16:36,640
that's the that's a great

2126
01:16:40,390 --> 01:16:38,800
software that he gave me so that's the

2127
01:16:42,790 --> 01:16:40,400
kind of a real

2128
01:16:45,590 --> 01:16:42,800
contribution that we're making and

2129
01:16:49,910 --> 01:16:45,600
hopefully the fuel saving will improve

2130
01:16:53,030 --> 01:16:49,920
uh or protect environment and also

2131
01:16:54,229 --> 01:16:53,040
come to a little bit cheaper airfare for

2132
01:16:55,910 --> 01:16:54,239
all of us i don't want to get the

2133
01:16:58,070 --> 01:16:55,920
figures wrong but i understand it's been

2134
01:16:59,910 --> 01:16:58,080
millions of pounds of carbon saved from

2135
01:17:01,669 --> 01:16:59,920
emission into the atmosphere as well as

2136
01:17:03,750 --> 01:17:01,679
maybe as much as two or three billion in

2137
01:17:05,830 --> 01:17:03,760
fuel costs uh just up until up to the

2138
01:17:07,830 --> 01:17:05,840

present uh it's had a big impact and

2139
01:17:09,590 --> 01:17:07,840
that's just what it's apparently a small

2140
01:17:11,910 --> 01:17:09,600
thing you know but it's a result of

2141
01:17:13,430 --> 01:17:11,920
research right you gotta you gotta spend

2142
01:17:15,590 --> 01:17:13,440
money to make money you've got to put

2143
01:17:17,830 --> 01:17:15,600
some effort into that upfront

2144
01:17:19,270 --> 01:17:17,840
ideation or creation of concepts in

2145
01:17:21,030 --> 01:17:19,280
order for us to to have the

2146
01:17:23,030 --> 01:17:21,040
technological advantage we need

2147
01:17:26,390 --> 01:17:23,040
for us to remain competitive if i may

2148
01:17:29,430 --> 01:17:26,400
just add one more

2149
01:17:32,790 --> 01:17:29,440
you all hear this big noise

2150
01:17:34,630 --> 01:17:32,800
coming off from the jet engines and

2151
01:17:37,030 --> 01:17:34,640
also we are doing a lot of research to

2152
01:17:40,790 --> 01:17:37,040
reduce the jet noise to reduce the

2153
01:17:43,910 --> 01:17:40,800
footprint we cannot remove eliminate all

2154
01:17:46,550 --> 01:17:43,920
jet noise it is a violation of physics

2155
01:17:48,630 --> 01:17:46,560
but we can certainly reduce

2156
01:17:51,830 --> 01:17:48,640
the footprint and

2157
01:17:55,510 --> 01:17:51,840
as an example chicago o'hare

2158
01:17:58,310 --> 01:17:55,520
all of our 25 or so major airports are

2159
01:17:59,510 --> 01:17:58,320
landlocked meaning that they they cannot

2160
01:18:02,390 --> 01:17:59,520
expand

2161
01:18:04,470 --> 01:18:02,400
any in any direction because they're all

2162
01:18:05,830 --> 01:18:04,480
surrounded by this neighborhood

2163
01:18:07,990 --> 01:18:05,840

and

2164
01:18:09,910 --> 01:18:08,000
chicago o'hare is one of the busiest

2165
01:18:12,390 --> 01:18:09,920
airports and they run

2166
01:18:16,310 --> 01:18:12,400
three or four runways

2167
01:18:18,950 --> 01:18:16,320
two three runways simultaneously

2168
01:18:21,030 --> 01:18:18,960
the houses around the chicago

2169
01:18:24,790 --> 01:18:21,040
ohio airport

2170
01:18:27,030 --> 01:18:24,800
faa has has been spending about 30 to 40

2171
01:18:28,550 --> 01:18:27,040
thousand dollars per house

2172
01:18:32,149 --> 01:18:28,560
to seal off

2173
01:18:34,550 --> 01:18:32,159
uh all the windows and so on uh to

2174
01:18:38,390 --> 01:18:34,560
reduce that noise impact to the

2175
01:18:41,510 --> 01:18:38,400
neighbors um that is certainly uh

2176
01:18:44,390 --> 01:18:41,520
one way to do it but in combination of

2177
01:18:47,270 --> 01:18:44,400
that we gotta work on technologies to

2178
01:18:50,470 --> 01:18:47,280
reduce uh noise and make these airplanes

2179
01:18:51,910 --> 01:18:50,480
quiet quieter so if you stand by the

2180
01:18:55,590 --> 01:18:51,920
airport as

2181
01:18:58,310 --> 01:18:55,600
as mason said i'm an airplane nut

2182
01:19:00,390 --> 01:18:58,320
if you enjoy stay standing next to the

2183
01:19:03,990 --> 01:19:00,400
airport and listening to it

2184
01:19:08,870 --> 01:19:04,000
the boeing 787 compared to

2185
01:19:11,110 --> 01:19:08,880
707 or 727 or whatever the old models

2186
01:19:13,270 --> 01:19:11,120
will be markedly quiet

2187
01:19:15,750 --> 01:19:13,280
and you'll notice that you don't need

2188
01:19:19,430 --> 01:19:15,760

any scientific measurement you you will

2189
01:19:22,790 --> 01:19:19,440
notice markedly quiet airplane coming

2190
01:19:23,910 --> 01:19:22,800
off from that jets and you'll see also

2191
01:19:25,189 --> 01:19:23,920
this

2192
01:19:27,669 --> 01:19:25,199
sawtooth

2193
01:19:30,229 --> 01:19:27,679
shape nozzle and in the video you might

2194
01:19:32,310 --> 01:19:30,239
have cat catch that if you haven't

2195
01:19:34,550 --> 01:19:32,320
please come and visit our website and

2196
01:19:36,390 --> 01:19:34,560
there's ample information about what we

2197
01:19:38,950 --> 01:19:36,400
call chevron nozzle

2198
01:19:41,510 --> 01:19:38,960
and that is also collaboration

2199
01:19:44,470 --> 01:19:41,520
the idea came from us in collaboration

2200
01:19:46,070 --> 01:19:44,480
with nasa and industry and to reduce

2201
01:19:49,590 --> 01:19:46,080
that engine noise

2202
01:19:51,669 --> 01:19:49,600
by just like winglet by putting this uh

2203
01:19:55,030 --> 01:19:51,679
sawtooth serrated

2204
01:19:57,030 --> 01:19:55,040
nozzle uh shape it's reducing the engine

2205
01:19:58,310 --> 01:19:57,040
noise significantly

2206
01:20:00,470 --> 01:19:58,320
great thank you guys so i think we have

2207
01:20:02,630 --> 01:20:00,480
a question now from social media we do

2208
01:20:04,709 --> 01:20:02,640
we have a question from twitter connor

2209
01:20:06,870 --> 01:20:04,719
schmidt asks how did these spin-off

2210
01:20:08,950 --> 01:20:06,880
technologies get into the private sector

2211
01:20:11,270 --> 01:20:08,960
do companies see and adopt them or do

2212
01:20:13,350 --> 01:20:11,280
you bring them to industry

2213
01:20:15,430 --> 01:20:13,360

well it's really i'll take that i guess

2214
01:20:17,189 --> 01:20:15,440
um it's really a it's a combination of

2215
01:20:18,709 --> 01:20:17,199
different uh mechanisms that we use to

2216
01:20:21,189 --> 01:20:18,719
make that happen

2217
01:20:23,510 --> 01:20:21,199
you can go to spinoff.nasa.gov to learn

2218
01:20:24,390 --> 01:20:23,520
about some of the spin-offs we've also

2219
01:20:26,229 --> 01:20:24,400
got

2220
01:20:28,149 --> 01:20:26,239
a technology.nasa.gov

2221
01:20:30,390 --> 01:20:28,159
where we describe the tech transfer

2222
01:20:31,830 --> 01:20:30,400
process which is maybe a little the sort

2223
01:20:32,709 --> 01:20:31,840
of thing that maybe aiden and sophie

2224
01:20:34,310 --> 01:20:32,719
won't be too interested in so i'm not

2225
01:20:35,590 --> 01:20:34,320
going to go into that so much here but i

2226
01:20:37,189 --> 01:20:35,600
will point out that we have a number of

2227
01:20:39,110 --> 01:20:37,199
different ways of doing this including

2228
01:20:40,950 --> 01:20:39,120
licensing technologies

2229
01:20:42,950 --> 01:20:40,960
including simply disseminating our

2230
01:20:45,270 --> 01:20:42,960
information through

2231
01:20:47,270 --> 01:20:45,280
technology reports um remember what we

2232
01:20:49,750 --> 01:20:47,280
do here is taxpayer funded we owe it to

2233
01:20:51,270 --> 01:20:49,760
the country to give this kind of uh

2234
01:20:53,510 --> 01:20:51,280
information these kinds of technologies

2235
01:20:54,950 --> 01:20:53,520
back to the public and so it's it's

2236
01:20:56,629 --> 01:20:54,960
important for us to achieve that i think

2237
01:20:57,910 --> 01:20:56,639
we do actually very good job of it in

2238
01:21:00,790 --> 01:20:57,920

fact if you look across the federal

2239
01:21:02,709 --> 01:21:00,800
agencies nasa's the leader in invention

2240
01:21:04,229 --> 01:21:02,719
disclosures it was last year

2241
01:21:05,270 --> 01:21:04,239
ahead of other agencies with larger

2242
01:21:06,870 --> 01:21:05,280
budgets

2243
01:21:08,870 --> 01:21:06,880
i think what that speaks to is first the

2244
01:21:10,149 --> 01:21:08,880
kind of innovation we do but also that

2245
01:21:12,830 --> 01:21:10,159
we really are quite good at this whole

2246
01:21:15,270 --> 01:21:12,840
tech transfer thing and we take it quite

2247
01:21:17,830 --> 01:21:15,280
seriously are there any other questions

2248
01:21:19,350 --> 01:21:17,840
over here if you say it i'll repeat it

2249
01:21:20,709 --> 01:21:19,360
my name is hillary i work over the

2250
01:21:22,709 --> 01:21:20,719
national archives

2251
01:21:27,510 --> 01:21:22,719
media and so it kind of funds with a lot

2252
01:21:29,030 --> 01:21:27,520
of older nasa records oh thank you so uh

2253
01:21:31,189 --> 01:21:29,040
interesting to uh

2254
01:21:33,030 --> 01:21:31,199
to hear it obviously before it comes to

2255
01:21:35,030 --> 01:21:33,040
us years later as a record

2256
01:21:37,189 --> 01:21:35,040
um i also have a degree in medieval

2257
01:21:40,229 --> 01:21:37,199
studies and so i'm sort of interested in

2258
01:21:44,070 --> 01:21:41,669
there we're out there secret

2259
01:21:45,350 --> 01:21:44,080
medievalists um i find it interesting

2260
01:21:46,870 --> 01:21:45,360
that you both sort of brought up that

2261
01:21:49,110 --> 01:21:46,880
you're interested in other things that

2262
01:21:50,550 --> 01:21:49,120
you speak other languages i'm wondering

2263
01:21:52,470 --> 01:21:50,560

you know you work in science you work

2264
01:21:54,629 --> 01:21:52,480
with scientists but do you think

2265
01:21:56,229 --> 01:21:54,639
that you're more flexible and more open

2266
01:21:58,629 --> 01:21:56,239
to using things in a different way

2267
01:22:01,590 --> 01:21:58,639
because you have interests that are not

2268
01:22:03,110 --> 01:22:01,600
necessarily just hard science

2269
01:22:04,470 --> 01:22:03,120
plugging one for the liberal arts people

2270
01:22:05,590 --> 01:22:04,480
here

2271
01:22:06,790 --> 01:22:05,600
should i try that one or do you want

2272
01:22:09,910 --> 01:22:06,800
google okay

2273
01:22:13,030 --> 01:22:09,920
uh i yeah i think to be honest over the

2274
01:22:15,270 --> 01:22:13,040
years i've come to appreciate that

2275
01:22:17,510 --> 01:22:15,280
what people normally take to be

2276
01:22:18,950 --> 01:22:17,520
disparate uh fields of endeavor you know

2277
01:22:20,470 --> 01:22:18,960
let's say the humanities versus the

2278
01:22:21,750 --> 01:22:20,480
sciences

2279
01:22:23,430 --> 01:22:21,760
at the core there's something just

2280
01:22:24,870 --> 01:22:23,440
fundamentally human about all of that

2281
01:22:26,229 --> 01:22:24,880
you know i think that the

2282
01:22:27,990 --> 01:22:26,239
skills that one develops in thinking

2283
01:22:30,070 --> 01:22:28,000
about literature for example or history

2284
01:22:31,990 --> 01:22:30,080
or or the social sciences or other

2285
01:22:33,430 --> 01:22:32,000
things like that uh do translate

2286
01:22:35,350 --> 01:22:33,440
actually pretty well into technical

2287
01:22:37,430 --> 01:22:35,360
areas because it really at its heart

2288
01:22:39,110 --> 01:22:37,440

it's about being creative being rigorous

2289
01:22:40,870 --> 01:22:39,120
in investigation

2290
01:22:42,709 --> 01:22:40,880
and trying to look deeply into something

2291
01:22:44,310 --> 01:22:42,719
and understand it you know those kinds

2292
01:22:45,910 --> 01:22:44,320
of tools really

2293
01:22:47,910 --> 01:22:45,920
when you distill them out aren't that

2294
01:22:50,070 --> 01:22:47,920
different from one discipline to another

2295
01:22:52,629 --> 01:22:50,080
now obviously calculus does not come up

2296
01:22:54,870 --> 01:22:52,639
too often in medieval literature

2297
01:22:56,790 --> 01:22:54,880
but those are the sort of specifics

2298
01:22:58,629 --> 01:22:56,800
that's kind of the veneer of the tools

2299
01:23:01,590 --> 01:22:58,639
that one would want to use i guess i

2300
01:23:03,430 --> 01:23:01,600
would so i know a person who works on

2301
01:23:04,550 --> 01:23:03,440
spacecraft mode and fault architecture

2302
01:23:06,629 --> 01:23:04,560
which is the

2303
01:23:08,310 --> 01:23:06,639
the the software within a spacecraft

2304
01:23:10,149 --> 01:23:08,320
that makes sure that it doesn't make

2305
01:23:12,149 --> 01:23:10,159
mistakes or when it does it can

2306
01:23:13,750 --> 01:23:12,159
self-correct for them a very you know

2307
01:23:15,350 --> 01:23:13,760
abstruse kind of topic that has to do

2308
01:23:17,430 --> 01:23:15,360
with a lot of technical stuff but he has

2309
01:23:18,870 --> 01:23:17,440
a phd in our history

2310
01:23:21,030 --> 01:23:18,880
what i'm suggesting here is that i don't

2311
01:23:23,669 --> 01:23:21,040
think that really technology is all that

2312
01:23:26,229 --> 01:23:23,679
different or distant from what we

2313
01:23:28,070 --> 01:23:26,239

generally can achieve as people i

2314
01:23:30,870 --> 01:23:28,080
dislike this notion that people say i'm

2315
01:23:32,070 --> 01:23:30,880
i'm good at math or i'm bad at

2316
01:23:33,189 --> 01:23:32,080
english for these sorts of things i

2317
01:23:34,870 --> 01:23:33,199
think it's just a matter of what you're

2318
01:23:37,669 --> 01:23:34,880
really passionate about and i i think

2319
01:23:39,830 --> 01:23:37,679
there um the lesson certainly for sophie

2320
01:23:41,430 --> 01:23:39,840
and aiden uh is find something you're

2321
01:23:43,189 --> 01:23:41,440
really interested in and don't give up

2322
01:23:45,830 --> 01:23:43,199
on it you know really work it hard

2323
01:23:47,590 --> 01:23:45,840
there's no substitute for hard work

2324
01:23:49,030 --> 01:23:47,600
so i do think that being creative though

2325
01:23:51,110 --> 01:23:49,040
is also at the core of a lot of these

2326
01:23:52,390 --> 01:23:51,120
things one of the reasons i enjoy my job

2327
01:23:53,430 --> 01:23:52,400
at nasa is i get to think about the

2328
01:23:55,510 --> 01:23:53,440
future

2329
01:23:57,510 --> 01:23:55,520
my kids call me nasa's head inventor and

2330
01:23:59,430 --> 01:23:57,520
that's maybe true i don't know others

2331
01:24:00,149 --> 01:23:59,440
might disagree

2332
01:24:01,110 --> 01:24:00,159
but

2333
01:24:03,110 --> 01:24:01,120
again

2334
01:24:04,390 --> 01:24:03,120
with engineering i think typically

2335
01:24:05,910 --> 01:24:04,400
people don't see that it's a creative

2336
01:24:07,510 --> 01:24:05,920
discipline you know something about

2337
01:24:08,870 --> 01:24:07,520
engineers we can't dress ourselves well

2338
01:24:11,350 --> 01:24:08,880

we uh you know we have a hard time

2339
01:24:13,110 --> 01:24:11,360
interacting with people uh that's not to

2340
01:24:14,790 --> 01:24:13,120
be mistaken for failing to be creative

2341
01:24:16,870 --> 01:24:14,800
though and i think a lot of the passion

2342
01:24:18,790 --> 01:24:16,880
that you see among nasa employees and

2343
01:24:20,629 --> 01:24:18,800
people who work with nasa

2344
01:24:22,629 --> 01:24:20,639
is because they want the opportunity to

2345
01:24:24,070 --> 01:24:22,639
create the future and that creativity i

2346
01:24:25,350 --> 01:24:24,080
think really drives

2347
01:24:26,790 --> 01:24:25,360
how people work on these kinds of

2348
01:24:28,950 --> 01:24:26,800
technical projects

2349
01:24:31,990 --> 01:24:28,960
yeah i think that's a great point and

2350
01:24:34,390 --> 01:24:32,000
that's a great question by the way

2351
01:24:37,189 --> 01:24:34,400
i think i can bring my own personal

2352
01:24:39,110 --> 01:24:37,199
experience that i came to this country

2353
01:24:41,030 --> 01:24:39,120
uh 30 years ago

2354
01:24:42,229 --> 01:24:41,040
from originally korea

2355
01:24:44,629 --> 01:24:42,239
and

2356
01:24:46,629 --> 01:24:44,639
if you go back to korea which is very

2357
01:24:49,830 --> 01:24:46,639
homogeneous society

2358
01:24:52,310 --> 01:24:49,840
you you see people just like me looking

2359
01:24:55,430 --> 01:24:52,320
just like me but look around this room

2360
01:24:58,709 --> 01:24:55,440
and we all have very diverse

2361
01:25:00,550 --> 01:24:58,719
in all aspects not just gender or

2362
01:25:02,149 --> 01:25:00,560
ethnicity but

2363
01:25:04,070 --> 01:25:02,159

what i think what makes

2364
01:25:06,629 --> 01:25:04,080
our country great

2365
01:25:08,310 --> 01:25:06,639
i i think i can really say great nation

2366
01:25:11,030 --> 01:25:08,320
in the world

2367
01:25:13,350 --> 01:25:11,040
is this diversity so

2368
01:25:15,189 --> 01:25:13,360
not just technical disciplines not just

2369
01:25:17,990 --> 01:25:15,199
anything gender or

2370
01:25:21,030 --> 01:25:18,000
any other dimensions but all aspects and

2371
01:25:23,110 --> 01:25:21,040
all inclusive dimensions of diversity i

2372
01:25:25,110 --> 01:25:23,120
think when we have that

2373
01:25:28,709 --> 01:25:25,120
we can come up with some great

2374
01:25:32,709 --> 01:25:28,719
innovation and great thinking and ideas

2375
01:25:35,110 --> 01:25:32,719
and i see that happening on daily basis

2376
01:25:37,270 --> 01:25:35,120
working in this agency so

2377
01:25:38,830 --> 01:25:37,280
it's very gratifying

2378
01:25:41,590 --> 01:25:38,840
great

2379
01:25:43,110 --> 01:25:41,600
question uh just uh we are down to one

2380
01:25:45,110 --> 01:25:43,120
microphone so please remember to wait

2381
01:25:46,870 --> 01:25:45,120
for the mic uh when you raise it raise

2382
01:25:48,950 --> 01:25:46,880
your hand high wait for the mic and

2383
01:25:50,870 --> 01:25:48,960
state your name and where you're from uh

2384
01:25:52,070 --> 01:25:50,880
we have time for a couple more questions

2385
01:25:54,550 --> 01:25:52,080
and there's one in the back thank you

2386
01:25:57,910 --> 01:25:54,560
for that john

2387
01:25:59,669 --> 01:25:57,920
hello i'm dory ansa walker a special

2388
01:26:01,830 --> 01:25:59,679

needs teacher from georgia

2389
01:26:04,070 --> 01:26:01,840
and um colonel bowling mentioned the

2390
01:26:06,229 --> 01:26:04,080
external cells in how it's being used in

2391
01:26:08,470 --> 01:26:06,239
space and he also mentioned that it is

2392
01:26:10,470 --> 01:26:08,480
now being used

2393
01:26:12,790 --> 01:26:10,480
looking to be used for disabled

2394
01:26:14,870 --> 01:26:12,800
you know people are there any other

2395
01:26:16,709 --> 01:26:14,880
technologies that they have

2396
01:26:19,430 --> 01:26:16,719
brought from space to use for our

2397
01:26:22,229 --> 01:26:19,440
disabled people

2398
01:26:23,189 --> 01:26:22,239
uh this well do you have any ideas okay

2399
01:26:24,790 --> 01:26:23,199
well i mean

2400
01:26:26,070 --> 01:26:24,800
i'll give you a couple of examples of uh

2401
01:26:28,229 --> 01:26:26,080
some of the spin-offs that have come

2402
01:26:30,470 --> 01:26:28,239
from nasa that have uh really had a big

2403
01:26:32,310 --> 01:26:30,480
impact on medicine generally now bill

2404
01:26:33,590 --> 01:26:32,320
gerstenmaier in the previous talk gave

2405
01:26:36,229 --> 01:26:33,600
you some great examples of things that

2406
01:26:38,310 --> 01:26:36,239
are current and uh let me just for a bit

2407
01:26:39,750 --> 01:26:38,320
of a throwback to the past i'll mention

2408
01:26:41,910 --> 01:26:39,760
some of the medical imaging that we take

2409
01:26:43,990 --> 01:26:41,920
for granted today say through ultrasound

2410
01:26:47,030 --> 01:26:44,000
or mammograms for example these have

2411
01:26:49,350 --> 01:26:47,040
revolutionized diagnosis of disease and

2412
01:26:52,790 --> 01:26:49,360
even treatment in some cases

2413
01:26:55,750 --> 01:26:52,800

that came originally from nasa's science

2414
01:26:57,510 --> 01:26:55,760
from our need to process images and take

2415
01:26:58,629 --> 01:26:57,520
large amounts of data filter them

2416
01:27:00,390 --> 01:26:58,639
appropriately and come up with

2417
01:27:01,669 --> 01:27:00,400
information that we extract sort of data

2418
01:27:04,229 --> 01:27:01,679
mining from that

2419
01:27:05,910 --> 01:27:04,239
so from you know from space to you is is

2420
01:27:07,830 --> 01:27:05,920
that story

2421
01:27:09,669 --> 01:27:07,840
there have been actually a number of uh

2422
01:27:10,950 --> 01:27:09,679
different uh medicines developed thanks

2423
01:27:12,629 --> 01:27:10,960
to the space program there's been a

2424
01:27:14,550 --> 01:27:12,639
number of uh research areas that have

2425
01:27:16,149 --> 01:27:14,560
started up thanks to microgravity it

2426
01:27:18,229 --> 01:27:16,159
turns out that certain kinds of protein

2427
01:27:20,310 --> 01:27:18,239
crystals grow particularly well in zero

2428
01:27:23,270 --> 01:27:20,320
gravity and it might be that the ability

2429
01:27:25,990 --> 01:27:23,280
to um grow crystals from let's say

2430
01:27:27,510 --> 01:27:26,000
instead of 90 or 80 purity or

2431
01:27:29,669 --> 01:27:27,520
perfection which we can do on the ground

2432
01:27:31,750 --> 01:27:29,679
to near 100 which we can do in space can

2433
01:27:33,510 --> 01:27:31,760
make all the difference in new kinds of

2434
01:27:35,110 --> 01:27:33,520
drugs so there's a lot of exciting work

2435
01:27:36,550 --> 01:27:35,120
going on i don't want to

2436
01:27:37,510 --> 01:27:36,560
be overly speculative about where we'll

2437
01:27:39,510 --> 01:27:37,520
leave because you know health is

2438
01:27:41,030 --> 01:27:39,520

something that i'll take quite seriously

2439
01:27:42,070 --> 01:27:41,040
but i can assure you that nasa

2440
01:27:43,910 --> 01:27:42,080
particularly the international space

2441
01:27:45,669 --> 01:27:43,920
station will continue to be a resource

2442
01:27:47,110 --> 01:27:45,679
that will have a big impact on medicine

2443
01:27:48,390 --> 01:27:47,120
for the future

2444
01:27:51,030 --> 01:27:48,400
great we have another question from

2445
01:27:53,910 --> 01:27:51,040
social media we do have a question from

2446
01:27:56,550 --> 01:27:53,920
twitter it's a technology question at

2447
01:27:59,110 --> 01:27:56,560
storytelling asks how do you design

2448
01:28:01,030 --> 01:27:59,120
spacesuits for iss astronauts

2449
01:28:03,270 --> 01:28:01,040
if they grow two to three inches in

2450
01:28:04,629 --> 01:28:03,280
space

2451
01:28:07,350 --> 01:28:04,639
this is actually not the best question

2452
01:28:09,590 --> 01:28:07,360
for me to answer however i will offer a

2453
01:28:11,910 --> 01:28:09,600
couple of things first of all

2454
01:28:13,110 --> 01:28:11,920
how we design spaces in general let me

2455
01:28:15,270 --> 01:28:13,120
point out a couple of mechanisms

2456
01:28:17,430 --> 01:28:15,280
certainly we work with companies we also

2457
01:28:19,430 --> 01:28:17,440
have our internal experts on these kinds

2458
01:28:21,189 --> 01:28:19,440
of technologies but another mechanism

2459
01:28:22,550 --> 01:28:21,199
that we use for designing things like

2460
01:28:25,910 --> 01:28:22,560
spacesuits in fact specifically

2461
01:28:27,990 --> 01:28:25,920
spacesuits is prize competitions now

2462
01:28:29,910 --> 01:28:28,000
miscostatic here is actually our program

2463
01:28:31,350 --> 01:28:29,920

executive poor prizes at the agency it's

2464
01:28:32,550 --> 01:28:31,360
a long story she could probably tell you

2465
01:28:34,550 --> 01:28:32,560
better than i will but just in this

2466
01:28:36,229 --> 01:28:34,560
context we just recently held a prize

2467
01:28:38,470 --> 01:28:36,239
competition for designing a new

2468
01:28:40,629 --> 01:28:38,480
astronaut glove uh and the winner won i

2469
01:28:41,910 --> 01:28:40,639
think it was a 200 000 prize for coming

2470
01:28:43,830 --> 01:28:41,920
up with a design that we had never seen

2471
01:28:45,110 --> 01:28:43,840
before that answers a lot of open

2472
01:28:46,390 --> 01:28:45,120
questions and is actually better

2473
01:28:47,350 --> 01:28:46,400
performing than things we'd had in the

2474
01:28:49,910 --> 01:28:47,360
past

2475
01:28:52,310 --> 01:28:49,920
this general category of ideas is called

2476
01:28:53,990 --> 01:28:52,320
open innovation uh we're trying hard and

2477
01:28:55,669 --> 01:28:54,000
i think we're succeeding at nasa to

2478
01:28:57,270 --> 01:28:55,679
bring in the best ideas from wherever

2479
01:28:59,430 --> 01:28:57,280
they can be found whether it's through

2480
01:29:02,070 --> 01:28:59,440
traditional mechanisms like grants and

2481
01:29:04,790 --> 01:29:02,080
contracts with companies or academia or

2482
01:29:06,629 --> 01:29:04,800
also incentivizing new ideas through

2483
01:29:07,669 --> 01:29:06,639
prize competitions there's some very

2484
01:29:09,350 --> 01:29:07,679
exciting prizes we're going to be

2485
01:29:10,629 --> 01:29:09,360
offering in the near future some of the

2486
01:29:12,550 --> 01:29:10,639
ones we've currently got going on

2487
01:29:14,390 --> 01:29:12,560
include the night rover challenge where

2488
01:29:16,390 --> 01:29:14,400

we're trying to encourage the develop of

2489
01:29:18,229 --> 01:29:16,400
new battery technologies uh for

2490
01:29:20,950 --> 01:29:18,239
application things like letting a rover

2491
01:29:22,390 --> 01:29:20,960
survive the 14-day lunar night it's a

2492
01:29:24,390 --> 01:29:22,400
very difficult and interesting challenge

2493
01:29:25,910 --> 01:29:24,400
that involves all aspects of space

2494
01:29:27,590 --> 01:29:25,920
travel and interesting technology

2495
01:29:29,110 --> 01:29:27,600
problems uh one that we recently

2496
01:29:30,950 --> 01:29:29,120
completed which i think jay could talk

2497
01:29:32,870 --> 01:29:30,960
about is the so-called green flight

2498
01:29:35,270 --> 01:29:32,880
challenge where we offered a prize purse

2499
01:29:37,830 --> 01:29:35,280
of i think 1.6 million or so

2500
01:29:39,910 --> 01:29:37,840
to incentivize the development of a

2501
01:29:41,030 --> 01:29:39,920
hybrid electric aircraft a green

2502
01:29:42,310 --> 01:29:41,040
aviation

2503
01:29:44,950 --> 01:29:42,320
in fact the requirement i think was

2504
01:29:47,270 --> 01:29:44,960
something 200 passenger miles per gallon

2505
01:29:48,550 --> 01:29:47,280
or miles per gallon per passenger

2506
01:29:51,350 --> 01:29:48,560
the winner of that competition the

2507
01:29:53,510 --> 01:29:51,360
so-called pipetrol aircraft achieved 400

2508
01:29:54,950 --> 01:29:53,520
miles per gallon per passenger so we

2509
01:29:57,510 --> 01:29:54,960
were talking about the impact of nasa

2510
01:29:58,950 --> 01:29:57,520
research on the environment just that

2511
01:30:01,669 --> 01:29:58,960
one event might have blown the doors

2512
01:30:03,350 --> 01:30:01,679
open on hybrid electric aviation

2513
01:30:04,790 --> 01:30:03,360

through you know prizes and other kinds

2514
01:30:06,629 --> 01:30:04,800
of challenges like this we can

2515
01:30:08,390 --> 01:30:06,639
incentivize technology development from

2516
01:30:11,350 --> 01:30:08,400
very non-traditional sources so it gets

2517
01:30:13,110 --> 01:30:11,360
that um you know the the diversity of

2518
01:30:14,790 --> 01:30:13,120
ideas that are available in our nation

2519
01:30:16,629 --> 01:30:14,800
and also to be frank we only pay when we

2520
01:30:17,910 --> 01:30:16,639
get results you know if no one won that

2521
01:30:18,950 --> 01:30:17,920
prize we still have the money and we

2522
01:30:20,709 --> 01:30:18,960
give you spending on other things as

2523
01:30:22,629 --> 01:30:20,719
well so it's a great way for us to

2524
01:30:24,629 --> 01:30:22,639
leverage our resources and a great way

2525
01:30:28,950 --> 01:30:24,639
to involve the entire nation in solving

2526
01:30:28,960 --> 01:30:37,669
i believe there's a question over here

2527
01:30:42,149 --> 01:30:40,470
no no question over here

2528
01:30:43,430 --> 01:30:42,159
okay so then i will go there's one over

2529
01:30:45,030 --> 01:30:43,440
here but we'll wait for the microphone

2530
01:30:46,629 --> 01:30:45,040
to run around again

2531
01:30:48,149 --> 01:30:46,639
sorry folks uh watching online we're

2532
01:30:49,350 --> 01:30:48,159
working with one microphone like john

2533
01:30:51,830 --> 01:30:49,360
said

2534
01:30:53,430 --> 01:30:51,840
but a very quick microphone runner

2535
01:30:55,270 --> 01:30:53,440
thank you hi my name is elizabeth

2536
01:30:56,550 --> 01:30:55,280
wallace from takoma park maryland one of

2537
01:30:57,590 --> 01:30:56,560
the questions that kind of comes up in

2538
01:30:59,350 --> 01:30:57,600

some of the

2539
01:31:01,350 --> 01:30:59,360
smaller meetings that i go to outside of

2540
01:31:02,629 --> 01:31:01,360
a nasa open house

2541
01:31:04,629 --> 01:31:02,639
is um

2542
01:31:07,189 --> 01:31:04,639
when you have spin-offs and you license

2543
01:31:09,110 --> 01:31:07,199
those technologies to organizations and

2544
01:31:11,350 --> 01:31:09,120
i know we've paid for them and we get

2545
01:31:13,030 --> 01:31:11,360
them back through these organizations

2546
01:31:15,189 --> 01:31:13,040
that have to develop them i mean i

2547
01:31:17,189 --> 01:31:15,199
didn't license one of those technologies

2548
01:31:18,390 --> 01:31:17,199
personally so

2549
01:31:20,550 --> 01:31:18,400
um

2550
01:31:23,030 --> 01:31:20,560
my understanding is it's free and it may

2551
01:31:25,110 --> 01:31:23,040
be wrong um but isn't there a way to

2552
01:31:27,669 --> 01:31:25,120
maybe take a look at that again so that

2553
01:31:29,270 --> 01:31:27,679
maybe when you license you actually they

2554
01:31:31,910 --> 01:31:29,280
actually pay you for nasa for the

2555
01:31:34,229 --> 01:31:31,920
license so that you can fund future uh

2556
01:31:36,790 --> 01:31:34,239
space exploration

2557
01:31:37,910 --> 01:31:36,800
really bad question nasty question

2558
01:31:40,310 --> 01:31:37,920
that's a great it's a great question i

2559
01:31:41,990 --> 01:31:40,320
mean i think what it gets at its core is

2560
01:31:43,270 --> 01:31:42,000
you know how can we uh how can we get

2561
01:31:44,629 --> 01:31:43,280
more resources at nasa for doing the

2562
01:31:45,990 --> 01:31:44,639
work that we want to do and i i

2563
01:31:47,910 --> 01:31:46,000

certainly appreciate the passion and the

2564
01:31:49,590 --> 01:31:47,920
public for wanting nasa to be supported

2565
01:31:51,189 --> 01:31:49,600
well i think that you know again we are

2566
01:31:52,470 --> 01:31:51,199
uh supported the space technology

2567
01:31:54,709 --> 01:31:52,480
program as an example which you heard

2568
01:31:56,629 --> 01:31:54,719
about just recently does enjoy uh broad

2569
01:31:58,870 --> 01:31:56,639
bipartisan support and support from from

2570
01:32:02,229 --> 01:31:58,880
congress for uh for spin-offs

2571
01:32:03,750 --> 01:32:02,239
specifically or tech transfer you know

2572
01:32:06,070 --> 01:32:03,760
virtually all of the research that

2573
01:32:08,470 --> 01:32:06,080
happens at nasa maybe all of it in fact

2574
01:32:10,310 --> 01:32:08,480
by law is available publicly uh it's

2575
01:32:12,070 --> 01:32:10,320
written up in technical reports written

2576
01:32:13,430 --> 01:32:12,080
in journal papers uh you can also

2577
01:32:14,709 --> 01:32:13,440
contact us at people and talk to us

2578
01:32:16,550 --> 01:32:14,719
about these things it's one of the great

2579
01:32:17,669 --> 01:32:16,560
things about working at nasa unlike

2580
01:32:19,669 --> 01:32:17,679
let's say working on classified

2581
01:32:22,870 --> 01:32:19,679
technology we are in fact working on

2582
01:32:25,270 --> 01:32:22,880
ideas that are directly available to the

2583
01:32:27,270 --> 01:32:25,280
public for for our benefit

2584
01:32:29,189 --> 01:32:27,280
in terms of bringing in money it sort of

2585
01:32:31,110 --> 01:32:29,199
depends on the license and and what the

2586
01:32:32,790 --> 01:32:31,120
technology is kind of a long story but

2587
01:32:35,990 --> 01:32:32,800
i'll say that one thing we've innovated

2588
01:32:37,510 --> 01:32:36,000

is an online tool the so-called

2589
01:32:39,750 --> 01:32:37,520
online partnering tool if you go to

2590
01:32:40,950 --> 01:32:39,760
again technology.nasa.gov

2591
01:32:42,870 --> 01:32:40,960
there's a quick little web form you can

2592
01:32:44,550 --> 01:32:42,880
fill out you send that in uh there's

2593
01:32:46,470 --> 01:32:44,560
some processing on that that happens and

2594
01:32:48,070 --> 01:32:46,480
you get to talk to an actual nasa person

2595
01:32:49,830 --> 01:32:48,080
about your technology interests and we

2596
01:32:51,750 --> 01:32:49,840
can help make those connections much

2597
01:32:53,189 --> 01:32:51,760
more effectively so you know we are in

2598
01:32:54,950 --> 01:32:53,199
fact entering the 20th century when it

2599
01:32:56,229 --> 01:32:54,960
comes to how to interact with people in

2600
01:32:59,510 --> 01:32:56,239
businesses using the internet believe it

2601
01:33:01,510 --> 01:32:59,520
or not to enable this process um

2602
01:33:04,070 --> 01:33:01,520
we're going even farther and faster in

2603
01:33:05,910 --> 01:33:04,080
this general area um if you keep an eye

2604
01:33:07,669 --> 01:33:05,920
on the news you'll see some other great

2605
01:33:09,030 --> 01:33:07,679
work that we're doing in how to transfer

2606
01:33:10,149 --> 01:33:09,040
technology even more effectively in the

2607
01:33:11,990 --> 01:33:10,159
future

2608
01:33:14,950 --> 01:33:12,000
i'd just like to

2609
01:33:17,910 --> 01:33:14,960
thank you uh your support as well um i

2610
01:33:18,709 --> 01:33:17,920
think the public support uh exhibited uh

2611
01:33:19,910 --> 01:33:18,719
like

2612
01:33:23,189 --> 01:33:19,920
right now

2613
01:33:25,350 --> 01:33:23,199

is what we need and certainly

2614
01:33:27,350 --> 01:33:25,360
as a public organization we got to do

2615
01:33:30,149 --> 01:33:27,360
our best to

2616
01:33:32,390 --> 01:33:30,159
use taxpayers dollars in the most

2617
01:33:35,350 --> 01:33:32,400
effective and efficient way so we'll

2618
01:33:38,629 --> 01:33:35,360
continue to do that but i think

2619
01:33:39,750 --> 01:33:38,639
we all recognize that nasa is our

2620
01:33:43,830 --> 01:33:39,760
pride

2621
01:33:45,350 --> 01:33:43,840
and one of the privileges

2622
01:33:47,510 --> 01:33:45,360
and

2623
01:33:51,350 --> 01:33:47,520
most gratifying things that

2624
01:33:52,950 --> 01:33:51,360
people working at nasa sometimes get is

2625
01:33:54,470 --> 01:33:52,960
when we travel

2626
01:33:55,510 --> 01:33:54,480
foreign countries

2627
01:33:57,910 --> 01:33:55,520
and

2628
01:34:00,629 --> 01:33:57,920
it could be just any casual dinner

2629
01:34:03,510 --> 01:34:00,639
we will just talk about nasa stuff again

2630
01:34:06,310 --> 01:34:03,520
i said stuff is a technical term

2631
01:34:07,590 --> 01:34:06,320
nasa stuff at dinner yeah

2632
01:34:10,229 --> 01:34:07,600
and

2633
01:34:13,110 --> 01:34:10,239
it happened to me a very nice

2634
01:34:15,510 --> 01:34:13,120
family sitting behind us just turned

2635
01:34:16,709 --> 01:34:15,520
around and do you work for nasa so he

2636
01:34:19,910 --> 01:34:16,719
said yes

2637
01:34:22,470 --> 01:34:19,920
and we just started talking

2638
01:34:24,310 --> 01:34:22,480

they were just fascinated by what we do

2639
01:34:26,629 --> 01:34:24,320
and i think you all know

2640
01:34:29,990 --> 01:34:26,639
both in aeronautics and space side we do

2641
01:34:32,550 --> 01:34:30,000
some unimaginable things and

2642
01:34:36,709 --> 01:34:32,560
the rest of the world knows about it and

2643
01:34:38,709 --> 01:34:36,719
they appreciate that and they respect

2644
01:34:40,390 --> 01:34:38,719
what our country can do

2645
01:34:42,229 --> 01:34:40,400
through nasa so

2646
01:34:45,430 --> 01:34:42,239
i continue to

2647
01:34:47,830 --> 01:34:45,440
be grateful for public support but

2648
01:34:49,350 --> 01:34:47,840
that's the type of support we need to

2649
01:34:51,189 --> 01:34:49,360
continue to have

2650
01:34:52,870 --> 01:34:51,199
i want to take a moment to thank dr shin

2651
01:34:54,149 --> 01:34:52,880
and dr peck for being with us today on

2652
01:34:55,590 --> 01:34:54,159
this panel and thanking all of you for

2653
01:34:57,510 --> 01:34:55,600
your great questions not only in the

2654
01:34:58,629 --> 01:34:57,520
audience but on social media

2655
01:35:00,390 --> 01:34:58,639
i hope you all learned a little bit

2656
01:35:02,390 --> 01:35:00,400
about tech transfer and some of nasa's

2657
01:35:04,550 --> 01:35:02,400
technology work today and walk away with

2658
01:35:05,750 --> 01:35:04,560
some interesting elevator stories to

2659
01:35:07,669 --> 01:35:05,760
tell your friends about the types of

2660
01:35:34,790 --> 01:35:07,679
things that nasa's doing so with that

2661
01:36:54,629 --> 01:36:16,629
so

2662
01:36:58,390 --> 01:36:56,390
welcome back for those uh in the

2663
01:36:59,510 --> 01:36:58,400

audience again just a reminder when you

2664
01:37:00,950 --> 01:36:59,520
have a question raise your hand really

2665
01:37:03,669 --> 01:37:00,960
really high so we can see you and get to

2666
01:37:05,669 --> 01:37:03,679
you uh we'll we'll do our best um the

2667
01:37:07,910 --> 01:37:05,679
latest uh robotic space technology

2668
01:37:09,830 --> 01:37:07,920
spinoff derived from nasa's robonaut 2

2669
01:37:11,270 --> 01:37:09,840
project may somebody held astronauts

2670
01:37:13,350 --> 01:37:11,280
stay healthier in space with an added

2671
01:37:14,470 --> 01:37:13,360
benefit of assisting paraplegics down

2672
01:37:16,550 --> 01:37:14,480
here on earth

2673
01:37:18,310 --> 01:37:16,560
nasa and the florida institute of human

2674
01:37:20,149 --> 01:37:18,320
and machine cognition of pennsylvania

2675
01:37:22,310 --> 01:37:20,159
florida with the help of engineers from

2676
01:37:23,669 --> 01:37:22,320
oceaneering space systems of houston

2677
01:37:25,830 --> 01:37:23,679
had jointly developed a robotic

2678
01:37:27,750 --> 01:37:25,840
exoskeleton called x1

2679
01:37:29,669 --> 01:37:27,760
the 57-pound device is a robot that

2680
01:37:32,550 --> 01:37:29,679
humans could wear over his or her body

2681
01:37:34,870 --> 01:37:32,560
either to assist or inhibit movement

2682
01:37:37,030 --> 01:37:34,880
of leg joints in the hip and mode the

2683
01:37:39,350 --> 01:37:37,040
robot device would be used in space

2684
01:37:40,870 --> 01:37:39,360
exercise machine to supply resistance

2685
01:37:42,629 --> 01:37:40,880
against leg movement

2686
01:37:43,830 --> 01:37:42,639
the same technology used to reverse on

2687
01:37:46,149 --> 01:37:43,840
the ground potentially helping some

2688
01:37:47,270 --> 01:37:46,159

individuals walk for the first time to

2689
01:37:48,550 --> 01:37:47,280
tell us more about the development of

2690
01:37:50,950 --> 01:37:48,560
the exoskeleton

2691
01:37:53,030 --> 01:37:50,960
is bill bluthman the deputy branch chief

2692
01:37:54,790 --> 01:37:53,040
of the robotic systems technology branch

2693
01:37:59,109 --> 01:37:54,800
in the software robotics and simulation

2694
01:38:03,189 --> 01:38:01,030
and demonstrating the exoskeleton and

2695
01:38:05,669 --> 01:38:03,199
the project our project engineers roger

2696
01:38:13,030 --> 01:38:05,679
rob rovkamp and jonathan rogers

2697
01:38:16,229 --> 01:38:14,390
thank you john

2698
01:38:17,830 --> 01:38:16,239
so i'm really honored to be here with a

2699
01:38:18,870 --> 01:38:17,840
couple of our bright young engineers

2700
01:38:20,229 --> 01:38:18,880
here today

2701
01:38:23,270 --> 01:38:20,239
um we're going to talk a little bit

2702
01:38:24,950 --> 01:38:23,280
about um i have another job besides the

2703
01:38:28,149 --> 01:38:24,960
branch job which is

2704
01:38:29,910 --> 01:38:28,159
i lead a project called human

2705
01:38:32,149 --> 01:38:29,920
human robotic systems within space

2706
01:38:33,590 --> 01:38:32,159
technology here and when when i think of

2707
01:38:35,910 --> 01:38:33,600
human robotic systems i think of a

2708
01:38:37,990 --> 01:38:35,920
system that is a robot that really makes

2709
01:38:40,470 --> 01:38:38,000
an astronaut's job easier

2710
01:38:42,070 --> 01:38:40,480
um whether that be working shoulder to

2711
01:38:44,149 --> 01:38:42,080
shoulder with an astronaut doing some of

2712
01:38:45,910 --> 01:38:44,159
the dull dangerous and dirty which are

2713
01:38:47,669 --> 01:38:45,920

kind of the traditional

2714
01:38:49,109 --> 01:38:47,679
three things that robots really are good

2715
01:38:50,229 --> 01:38:49,119
for

2716
01:38:51,830 --> 01:38:50,239
when working

2717
01:38:53,270 --> 01:38:51,840
you know with or side by side with

2718
01:38:55,669 --> 01:38:53,280
humans kind of do the stuff that we

2719
01:38:58,229 --> 01:38:55,679
don't want to do i also think of

2720
01:39:00,310 --> 01:38:58,239
machines that astronauts might ride on

2721
01:39:01,830 --> 01:39:00,320
top of or inside of

2722
01:39:03,750 --> 01:39:01,840
and then maybe another thing that's

2723
01:39:04,790 --> 01:39:03,760
maybe a little bit less clear is robots

2724
01:39:07,030 --> 01:39:04,800
uh

2725
01:39:08,790 --> 01:39:07,040
operating ahead of crews arrival to

2726
01:39:10,310 --> 01:39:08,800
destination so maybe doing some scouting

2727
01:39:11,990 --> 01:39:10,320
beforehand

2728
01:39:14,310 --> 01:39:12,000
and then after cruise departure maybe

2729
01:39:15,990 --> 01:39:14,320
cleaning up and uh

2730
01:39:18,550 --> 01:39:16,000
doing some work

2731
01:39:21,109 --> 01:39:18,560
afterwards kind of collecting samples or

2732
01:39:23,910 --> 01:39:21,119
you know doing some post-scene analysis

2733
01:39:25,669 --> 01:39:23,920
um and then there's this new concept of

2734
01:39:26,629 --> 01:39:25,679
a human robotic system and we have a

2735
01:39:29,830 --> 01:39:26,639
couple that we're going to show you here

2736
01:39:31,669 --> 01:39:29,840
today that are wearable uh robots uh

2737
01:39:33,910 --> 01:39:31,679
roger's wearing the x1 exoskeleton is

2738
01:39:35,750 --> 01:39:33,920

the lower body ex skeleton

2739
01:39:37,189 --> 01:39:35,760
and as john mentioned it was

2740
01:39:38,229 --> 01:39:37,199
developed in partnership with the

2741
01:39:40,070 --> 01:39:38,239
institute

2742
01:39:41,990 --> 01:39:40,080
for human machine cognition in pensacola

2743
01:39:43,830 --> 01:39:42,000
florida and jonathan is wearing a

2744
01:39:46,470 --> 01:39:43,840
roboglove which was developed in

2745
01:39:49,109 --> 01:39:46,480
partnership with general motors

2746
01:39:50,550 --> 01:39:49,119
so within nasa it's really important to

2747
01:39:52,709 --> 01:39:50,560
find these partnerships because it

2748
01:39:54,950 --> 01:39:52,719
really gives us a nice conduit to bring

2749
01:39:55,990 --> 01:39:54,960
our space technologies really back to

2750
01:39:57,270 --> 01:39:56,000
earth

2751
01:39:58,629 --> 01:39:57,280
but as we set these up it's really

2752
01:40:00,550 --> 01:39:58,639
important for us not just to pick

2753
01:40:03,430 --> 01:40:00,560
anybody but we really need to find

2754
01:40:05,189 --> 01:40:03,440
organizations that have a shared vision

2755
01:40:06,629 --> 01:40:05,199
as you can imagine

2756
01:40:08,790 --> 01:40:06,639
in the case of romanov which we're

2757
01:40:09,990 --> 01:40:08,800
really not talking about today but

2758
01:40:12,790 --> 01:40:10,000
you know these are in the robonaut

2759
01:40:15,270 --> 01:40:12,800
family tree we have this shared vision

2760
01:40:16,149 --> 01:40:15,280
of humans robots working shoulder to

2761
01:40:18,390 --> 01:40:16,159
shoulder

2762
01:40:19,669 --> 01:40:18,400
in space with astronauts and then on the

2763
01:40:21,189 --> 01:40:19,679

factory floor

2764
01:40:24,149 --> 01:40:21,199
uh with humans

2765
01:40:26,149 --> 01:40:24,159
in in the same proximity as robots uh

2766
01:40:28,390 --> 01:40:26,159
that's not the case it is now they tend

2767
01:40:30,950 --> 01:40:28,400
to have light shields around any robots

2768
01:40:33,109 --> 01:40:30,960
in manufacturing and if a human walks in

2769
01:40:36,550 --> 01:40:33,119
that the robot stops and line stops so

2770
01:40:38,790 --> 01:40:36,560
we really have that shared vision

2771
01:40:39,669 --> 01:40:38,800
um as far as exoskeletons are concerned

2772
01:40:41,830 --> 01:40:39,679
you know when i think of this

2773
01:40:44,950 --> 01:40:41,840
exoskeleton i think of the iron man suit

2774
01:40:47,510 --> 01:40:44,960
maybe the power loaders from aliens

2775
01:40:50,149 --> 01:40:47,520
um these machines that really augment

2776
01:40:51,750 --> 01:40:50,159
the capabilities of humans

2777
01:40:52,790 --> 01:40:51,760
maybe in some cases weaponizing the

2778
01:40:54,149 --> 01:40:52,800
humans

2779
01:40:56,870 --> 01:40:54,159
and that's really not what we're going

2780
01:40:57,910 --> 01:40:56,880
to do at least initially

2781
01:41:00,709 --> 01:40:57,920
our

2782
01:41:02,709 --> 01:41:00,719
job is again to make humans

2783
01:41:05,189 --> 01:41:02,719
work a little bit easier so in the case

2784
01:41:06,229 --> 01:41:05,199
of rubber glove our space application

2785
01:41:09,189 --> 01:41:06,239
might be

2786
01:41:10,709 --> 01:41:09,199
that uh they integrate with a spacesuit

2787
01:41:11,990 --> 01:41:10,719
so when our astronauts put on a

2788
01:41:13,830 --> 01:41:12,000

spacesuit

2789
01:41:15,750 --> 01:41:13,840
we pressurize them and the hands really

2790
01:41:16,950 --> 01:41:15,760
want to stay open

2791
01:41:18,709 --> 01:41:16,960
and it takes

2792
01:41:19,990 --> 01:41:18,719
work for the astronauts to close their

2793
01:41:21,750 --> 01:41:20,000
grips

2794
01:41:23,430 --> 01:41:21,760
if with a device like this rubber glove

2795
01:41:24,950 --> 01:41:23,440
when you close the grip

2796
01:41:27,270 --> 01:41:24,960
when you trigger a sensor it'll hold

2797
01:41:28,709 --> 01:41:27,280
that position allowing the person inside

2798
01:41:30,470 --> 01:41:28,719
to relax

2799
01:41:32,950 --> 01:41:30,480
you can have a very similar type

2800
01:41:35,189 --> 01:41:32,960
application with

2801
01:41:36,470 --> 01:41:35,199
folks on a factory floor where

2802
01:41:37,830 --> 01:41:36,480
as they

2803
01:41:39,350 --> 01:41:37,840
work their stuff they could let the

2804
01:41:42,070 --> 01:41:39,360
machine carry some of the load and they

2805
01:41:43,510 --> 01:41:42,080
would do more than fine positioning

2806
01:41:45,750 --> 01:41:43,520
possibly reducing repetitive stress

2807
01:41:47,350 --> 01:41:45,760
injuries what we've seen is that

2808
01:41:49,270 --> 01:41:47,360
typically you know running your wrist is

2809
01:41:50,390 --> 01:41:49,280
pretty easy but when you do it with your

2810
01:41:52,470 --> 01:41:50,400
when you're holding something you run

2811
01:41:53,990 --> 01:41:52,480
your wrist uh you feel a little bit more

2812
01:41:54,870 --> 01:41:54,000
strained so i think you know anybody out

2813
01:41:55,990 --> 01:41:54,880

there could do this and feel the

2814
01:41:57,910 --> 01:41:56,000
difference between just moving your

2815
01:42:01,109 --> 01:41:57,920
wrists naturally and then

2816
01:42:03,830 --> 01:42:01,119
doing holding a fist and doing the same

2817
01:42:06,390 --> 01:42:03,840
i know with exoskeleton our initial

2818
01:42:08,790 --> 01:42:06,400
application of space really going to be

2819
01:42:10,390 --> 01:42:08,800
the kind of things of measuring what the

2820
01:42:12,550 --> 01:42:10,400
astronaut's strength is so it really

2821
01:42:15,990 --> 01:42:12,560
allows us to target very specific joints

2822
01:42:17,830 --> 01:42:16,000
on the body for how much strength and

2823
01:42:19,590 --> 01:42:17,840
right now how we do it is before the

2824
01:42:21,109 --> 01:42:19,600
mission then after the mission we

2825
01:42:22,870 --> 01:42:21,119
measure the astronauts the thought being

2826
01:42:24,950 --> 01:42:22,880
with some a device like this

2827
01:42:27,109 --> 01:42:24,960
is that we could

2828
01:42:28,550 --> 01:42:27,119
really frequently measure to see how

2829
01:42:31,270 --> 01:42:28,560
their strength

2830
01:42:32,790 --> 01:42:31,280
changes over the course of their mission

2831
01:42:34,149 --> 01:42:32,800
and then maybe the next application

2832
01:42:35,510 --> 01:42:34,159
would be instead of augmenting the

2833
01:42:37,270 --> 01:42:35,520
strength

2834
01:42:39,270 --> 01:42:37,280
of the crew we'd really resist them

2835
01:42:40,790 --> 01:42:39,280
leading to a very very compact exercise

2836
01:42:42,229 --> 01:42:40,800
device

2837
01:42:43,590 --> 01:42:42,239
that's enough talking about me how about

2838
01:42:45,990 --> 01:42:43,600

we hand things over to roger and

2839
01:42:47,430 --> 01:42:46,000
jonathan uh let them show you the robots

2840
01:42:49,669 --> 01:42:47,440
and talk a little about them roger why

2841
01:42:50,550 --> 01:42:49,679
don't you go first thank you uh so as

2842
01:42:53,189 --> 01:42:50,560
well mentioned there are a number

2843
01:42:56,070 --> 01:42:53,199
applications for the x1 uh we have

2844
01:42:58,310 --> 01:42:56,080
assisted mobility uh resist resistant

2845
01:43:00,070 --> 01:42:58,320
mobility which is exercise and then

2846
01:43:02,790 --> 01:43:00,080
strength measurement which is also

2847
01:43:05,109 --> 01:43:02,800
called dynamometry uh but

2848
01:43:07,030 --> 01:43:05,119
the a little bit about the hardware

2849
01:43:09,510 --> 01:43:07,040
we have four active degrees of freedom

2850
01:43:10,790 --> 01:43:09,520
which active essentially means powered

2851
01:43:13,750 --> 01:43:10,800
and passive degrees of freedom we have

2852
01:43:15,189 --> 01:43:13,760
six of those uh we have motor drivers

2853
01:43:17,350 --> 01:43:15,199
which essentially talk directly to the

2854
01:43:18,950 --> 01:43:17,360
motors located at each joint and then we

2855
01:43:21,270 --> 01:43:18,960
have a higher level computer that sends

2856
01:43:23,750 --> 01:43:21,280
commands to those motor drivers

2857
01:43:26,310 --> 01:43:23,760
in a sort of general sense and uh allows

2858
01:43:27,910 --> 01:43:26,320
for precise uh control of the device uh

2859
01:43:29,430 --> 01:43:27,920
we also have a lot of adjustability we

2860
01:43:31,430 --> 01:43:29,440
wanted a a lot of people to be able to

2861
01:43:32,229 --> 01:43:31,440
get in this device so we could evaluate

2862
01:43:33,750 --> 01:43:32,239
its

2863
01:43:34,950 --> 01:43:33,760

efficacy for these different

2864
01:43:36,629 --> 01:43:34,960
applications

2865
01:43:39,750 --> 01:43:36,639
so we have adjustability in the thighs

2866
01:43:43,270 --> 01:43:39,760
and then the ankles and then the hips so

2867
01:43:48,229 --> 01:43:46,629
little demonstrations so we have

2868
01:43:50,470 --> 01:43:48,239
limit stops

2869
01:43:52,310 --> 01:43:50,480
in key places to protect the

2870
01:43:54,149 --> 01:43:52,320
the person in the suit and that is a

2871
01:43:55,910 --> 01:43:54,159
that's a very important application and

2872
01:43:58,870 --> 01:43:55,920
so one of the things with this project

2873
01:44:00,550 --> 01:43:58,880
um we leveraged a lot of r2 technology

2874
01:44:02,470 --> 01:44:00,560
and r2 went through a lot of safety

2875
01:44:04,629 --> 01:44:02,480
reviews to fly it on

2876
01:44:06,070 --> 01:44:04,639
board iss and so we're able to learn

2877
01:44:08,390 --> 01:44:06,080
from that and impart a lot of that

2878
01:44:11,590 --> 01:44:08,400
technology into this system to make it a

2879
01:44:14,870 --> 01:44:13,270
so that's what i have on this sure

2880
01:44:16,550 --> 01:44:14,880
thanks roger

2881
01:44:18,229 --> 01:44:16,560
so while this this glove may not look a

2882
01:44:20,149 --> 01:44:18,239
whole lot like a robonaut

2883
01:44:21,750 --> 01:44:20,159
a lot of the technology is pulled right

2884
01:44:24,550 --> 01:44:21,760
from it and then adapted for a new

2885
01:44:26,390 --> 01:44:24,560
application and having those types of

2886
01:44:27,910 --> 01:44:26,400
technologies in our back pocket ready to

2887
01:44:29,990 --> 01:44:27,920
go for

2888
01:44:32,870 --> 01:44:30,000

a challenge that might come up is is key

2889
01:44:33,750 --> 01:44:32,880
to what we're trying to do at jsc

2890
01:44:36,310 --> 01:44:33,760
so

2891
01:44:39,189 --> 01:44:36,320
in here i've got four motors that then

2892
01:44:40,629 --> 01:44:39,199
can pull tendons which run through

2893
01:44:43,189 --> 01:44:40,639
this glove

2894
01:44:44,390 --> 01:44:43,199
and supplement my grasp strength i i

2895
01:44:45,590 --> 01:44:44,400
brought

2896
01:44:47,669 --> 01:44:45,600
a bottle of water and while it's not

2897
01:44:49,750 --> 01:44:47,679
really heavy you can get the idea and

2898
01:44:51,910 --> 01:44:49,760
you can hear the the glove grip down on

2899
01:44:59,270 --> 01:44:51,920
it

2900
01:45:02,470 --> 01:44:59,280
simple thin button in my thumb

2901
01:45:04,550 --> 01:45:02,480
and when i press down and start a grasp

2902
01:45:07,030 --> 01:45:04,560
the the glove

2903
01:45:10,470 --> 01:45:07,040
supplements my uh my strength

2904
01:45:11,830 --> 01:45:10,480
so with a larger heavier item my arm and

2905
01:45:12,870 --> 01:45:11,840
shoulder are still bearing the weight of

2906
01:45:13,750 --> 01:45:12,880
that item

2907
01:45:16,470 --> 01:45:13,760
but

2908
01:45:19,109 --> 01:45:16,480
my my hand is not getting tired

2909
01:45:23,189 --> 01:45:21,750
on board we've got motor drivers that

2910
01:45:25,430 --> 01:45:23,199
are again robonaut technology just

2911
01:45:26,629 --> 01:45:25,440
packaged slightly differently

2912
01:45:33,109 --> 01:45:26,639
and

2913
01:45:34,950 --> 01:45:33,119

progress through it i've just got a

2914
01:45:36,550 --> 01:45:34,960
simple off-the-shelf battery pack that i

2915
01:45:37,910 --> 01:45:36,560
can wear on my belt our second

2916
01:45:39,350 --> 01:45:37,920
generation is looking at new

2917
01:45:41,830 --> 01:45:39,360
technologies different batteries that

2918
01:45:42,830 --> 01:45:41,840
are smaller and more compact and

2919
01:45:45,750 --> 01:45:42,840
have longer

2920
01:45:49,109 --> 01:45:45,760
life nasa's application for this has

2921
01:45:51,990 --> 01:45:49,119
been alluded to is for space walks

2922
01:45:53,830 --> 01:45:52,000
earlier mr gerstenmaier

2923
01:45:55,669 --> 01:45:53,840
said that we spent approximately three

2924
01:45:58,550 --> 01:45:55,679
or four months building the space

2925
01:46:01,030 --> 01:45:58,560
station just in spacewalk time alone

2926
01:46:03,510 --> 01:46:01,040
and the astronauts that go through that

2927
01:46:05,590 --> 01:46:03,520
uh are troopers it's a lot of hard work

2928
01:46:07,430 --> 01:46:05,600
and we commonly hear about

2929
01:46:09,590 --> 01:46:07,440
their hands being extremely tired and

2930
01:46:11,109 --> 01:46:09,600
blistered when they come back in and a

2931
01:46:13,669 --> 01:46:11,119
lot of that is just due to fighting the

2932
01:46:15,750 --> 01:46:13,679
force of the the ballooning of the glove

2933
01:46:17,590 --> 01:46:15,760
in the spacesuit so if we can apply a

2934
01:46:18,870 --> 01:46:17,600
technology like this to help them close

2935
01:46:21,109 --> 01:46:18,880
that glove and alleviate some of the

2936
01:46:23,030 --> 01:46:21,119
stress that's a huge payoff

2937
01:46:24,310 --> 01:46:23,040
and bill mentioned for our colleagues at

2938
01:46:26,709 --> 01:46:24,320

general motors

2939
01:46:29,189 --> 01:46:26,719
they have operators on assembly lines

2940
01:46:30,950 --> 01:46:29,199
moving heavy objects around uh all day

2941
01:46:32,629 --> 01:46:30,960
every day and if we can help them with

2942
01:46:35,830 --> 01:46:32,639
that it's a huge payoff there as well

2943
01:46:39,590 --> 01:46:37,669
okay with that that's kind of our brief

2944
01:46:41,109 --> 01:46:39,600
introduction we'd like to open up

2945
01:46:52,870 --> 01:46:41,119
to the audience for any questions you

2946
01:46:57,350 --> 01:46:55,910
been stool from uh mclean virginia um

2947
01:46:59,430 --> 01:46:57,360
what sort of computing power does it

2948
01:47:02,310 --> 01:46:59,440
take you know does it take a cell phone

2949
01:47:04,790 --> 01:47:02,320
or a calculator or a super computer what

2950
01:47:06,390 --> 01:47:04,800
does it take

2951
01:47:08,229 --> 01:47:06,400
um well for the extra scale to use

2952
01:47:10,790 --> 01:47:08,239
what's called a nano etx it was a small

2953
01:47:13,510 --> 01:47:10,800
computer that's uh packaged in the back

2954
01:47:14,790 --> 01:47:13,520
of the backpack so not as much as you

2955
01:47:15,669 --> 01:47:14,800
would think so with this system we

2956
01:47:17,189 --> 01:47:15,679
actually

2957
01:47:19,270 --> 01:47:17,199
uh allow a lot of the computing to

2958
01:47:20,870 --> 01:47:19,280
happen distributed through the uh

2959
01:47:23,270 --> 01:47:20,880
through the device so we actually have

2960
01:47:24,870 --> 01:47:23,280
multiple computers on board

2961
01:47:26,709 --> 01:47:24,880
but it's it's

2962
01:47:28,629 --> 01:47:26,719
very minimal

2963
01:47:31,109 --> 01:47:28,639

for robo glove we have a

2964
01:47:33,109 --> 01:47:31,119
small board here on the back side of the

2965
01:47:35,270 --> 01:47:33,119
glove

2966
01:47:37,510 --> 01:47:35,280
with the board we call the cufflink and

2967
01:47:40,229 --> 01:47:37,520
it's based around a netduino

2968
01:47:42,709 --> 01:47:40,239
and then there's two other boards here

2969
01:47:44,550 --> 01:47:42,719
that locally have processing power to

2970
01:47:49,510 --> 01:47:44,560
drive the motors to specified positions

2971
01:47:55,350 --> 01:47:51,910
jim edwards hewitt uh from alexandria

2972
01:47:57,030 --> 01:47:55,360
virginia uh redshift42 on twitter

2973
01:47:58,470 --> 01:47:57,040
um

2974
01:48:00,550 --> 01:47:58,480
i know these uh

2975
01:48:01,830 --> 01:48:00,560
these leg attachments are for measuring

2976
01:48:03,430 --> 01:48:01,840
strength uh

2977
01:48:05,189 --> 01:48:03,440
you know how far are we from having

2978
01:48:07,109 --> 01:48:05,199
since i know a number of people with

2979
01:48:09,030 --> 01:48:07,119
with bad knees who can't walk very far

2980
01:48:10,950 --> 01:48:09,040
and that kind of thing and there's only

2981
01:48:13,030 --> 01:48:10,960
so much medicine can do for them how far

2982
01:48:13,910 --> 01:48:13,040
away from having assistive devices that

2983
01:48:14,790 --> 01:48:13,920
would

2984
01:48:16,470 --> 01:48:14,800
uh

2985
01:48:17,510 --> 01:48:16,480
that would let them you know walk

2986
01:48:19,669 --> 01:48:17,520
normally

2987
01:48:21,750 --> 01:48:19,679
well so we're kind of engaging in this

2988
01:48:24,070 --> 01:48:21,760

really you know we're we are a research

2989
01:48:26,149 --> 01:48:24,080
organization as as are our uh partners

2990
01:48:28,229 --> 01:48:26,159
at uh itunes

2991
01:48:30,229 --> 01:48:28,239
um the concept is we really want to

2992
01:48:33,030 --> 01:48:30,239
develop the technology to pass the point

2993
01:48:34,470 --> 01:48:33,040
where we would hand that over to people

2994
01:48:36,550 --> 01:48:34,480
who professionally do these clinical

2995
01:48:37,990 --> 01:48:36,560
type trials

2996
01:48:39,430 --> 01:48:38,000
i don't i don't necessarily want to

2997
01:48:41,910 --> 01:48:39,440
guess but it could happen

2998
01:48:46,950 --> 01:48:41,920
within probably i don't know maybe one

2999
01:48:52,229 --> 01:48:48,229
more questions

3000
01:48:55,590 --> 01:48:52,239
hi i'm aiden i asked a question earlier

3001
01:48:57,990 --> 01:48:55,600
so my question is in the video

3002
01:49:00,709 --> 01:48:58,000
the x1 wrote

3003
01:49:01,430 --> 01:49:00,719
well the thing he's wearing

3004
01:49:05,189 --> 01:49:01,440
we

3005
01:49:06,229 --> 01:49:05,199
had two things that come out like this

3006
01:49:09,830 --> 01:49:06,239
and

3007
01:49:11,750 --> 01:49:09,840
but i don't see them right now

3008
01:49:13,589 --> 01:49:11,760
so i think right at the beginning aiden

3009
01:49:15,350 --> 01:49:13,599
is what you're talking about oh yeah so

3010
01:49:17,350 --> 01:49:15,360
the two parts you're referring to that

3011
01:49:18,950 --> 01:49:17,360
come out like this yeah those are those

3012
01:49:20,229 --> 01:49:18,960
are this part here at the time they were

3013
01:49:23,430 --> 01:49:20,239

they didn't have coverage right now

3014
01:49:25,830 --> 01:49:23,440
we've got socket skins to make it soft

3015
01:49:35,270 --> 01:49:25,840
um so it's this part

3016
01:49:42,470 --> 01:49:36,950
any questions

3017
01:49:44,310 --> 01:49:42,480
hi jeff wallace rockman520 rockman528 on

3018
01:49:45,990 --> 01:49:44,320
twitter uh so

3019
01:49:47,669 --> 01:49:46,000
what what's what give us some kind of

3020
01:49:50,070 --> 01:49:47,679
idea about what kind of force what kind

3021
01:49:50,950 --> 01:49:50,080
of assistance can you actually provide

3022
01:49:52,470 --> 01:49:50,960
in a

3023
01:49:54,830 --> 01:49:52,480
way that we can understand can crush a

3024
01:49:57,669 --> 01:49:54,840
bowling ball with that thing or what

3025
01:49:59,589 --> 01:49:57,679
well not quite um

3026
01:50:02,149 --> 01:49:59,599
you can get an extra five to ten pounds

3027
01:50:03,990 --> 01:50:02,159
of grip force out of this device which

3028
01:50:05,669 --> 01:50:04,000
is enough to make a difference and

3029
01:50:07,350 --> 01:50:05,679
that's really the key for it it's not

3030
01:50:08,790 --> 01:50:07,360
gonna make you superhuman

3031
01:50:11,109 --> 01:50:08,800
at least not yet

3032
01:50:12,470 --> 01:50:11,119
but uh it's it's designed just to make

3033
01:50:14,070 --> 01:50:12,480
things uh

3034
01:50:15,669 --> 01:50:14,080
easier for you right

3035
01:50:17,510 --> 01:50:15,679
so for the exoskeleton so we have to

3036
01:50:19,910 --> 01:50:17,520
actually be designed to measure

3037
01:50:22,950 --> 01:50:19,920
uh peak strength therefore we have to

3038
01:50:24,870 --> 01:50:22,960

assist uh you know peak strength so it's

3039
01:50:25,910 --> 01:50:24,880
actually we have a lot of capability in

3040
01:50:30,310 --> 01:50:25,920
this system

3041
01:50:35,589 --> 01:50:32,390
hi i'm dina rosenberg from boulder

3042
01:50:37,510 --> 01:50:35,599
colorado i'm feel the rules on twitter

3043
01:50:39,589 --> 01:50:37,520
my question was are all the astronauts

3044
01:50:40,950 --> 01:50:39,599
roughly the same size i'm only five feet

3045
01:50:42,870 --> 01:50:40,960
tall and i can't imagine that i would

3046
01:50:47,350 --> 01:50:42,880
also fit in that exoskeleton or that

3047
01:50:49,750 --> 01:50:47,360
glove it would come up to my bicep

3048
01:50:51,669 --> 01:50:49,760
uh no i don't believe they are and uh

3049
01:50:52,870 --> 01:50:51,679
the way we account for that is we have

3050
01:50:54,709 --> 01:50:52,880
what's called a

3051
01:50:56,310 --> 01:50:54,719
a distribution of

3052
01:50:57,589 --> 01:50:56,320
a sample population that we design the

3053
01:50:58,870 --> 01:50:57,599
device to

3054
01:51:00,470 --> 01:50:58,880
and it's actually one of the more

3055
01:51:02,149 --> 01:51:00,480
difficult challenges in device like this

3056
01:51:03,990 --> 01:51:02,159
not only to make it adjustable but to

3057
01:51:05,830 --> 01:51:04,000
make it easily adjustable

3058
01:51:07,589 --> 01:51:05,840
on orbit so we definitely have to

3059
01:51:08,310 --> 01:51:07,599
account for all those different folks

3060
01:51:10,629 --> 01:51:08,320
and

3061
01:51:12,709 --> 01:51:10,639
uh so it's a very difficult design

3062
01:51:15,669 --> 01:51:12,719
challenge but this device uh uh has a

3063
01:51:18,310 --> 01:51:15,679

wide range of of uh users yeah so you've

3064
01:51:21,189 --> 01:51:18,320
done people about my height i'm six too

3065
01:51:23,109 --> 01:51:21,199
and done people as short as she's about

3066
01:51:24,870 --> 01:51:23,119
five two or so yeah

3067
01:51:26,310 --> 01:51:24,880
in the into device so so rogers

3068
01:51:30,070 --> 01:51:26,320
certainly think of that as he designs

3069
01:51:33,030 --> 01:51:31,990
now for the glove uh this is our first

3070
01:51:35,109 --> 01:51:33,040
generation

3071
01:51:37,109 --> 01:51:35,119
and it was designed for an engineer with

3072
01:51:39,669 --> 01:51:37,119
a much larger hand than i have

3073
01:51:42,070 --> 01:51:39,679
uh so it's pretty tight around it's it's

3074
01:51:43,589 --> 01:51:42,080
cinched down pretty tight around me

3075
01:51:45,109 --> 01:51:43,599
in our newer generations we have a small

3076
01:51:47,510 --> 01:51:45,119
medium and large and there's actually

3077
01:51:50,310 --> 01:51:47,520
added variability inside the

3078
01:51:51,830 --> 01:51:50,320
the forearm portion to uh

3079
01:51:53,030 --> 01:51:51,840
to fit a wider range of people and

3080
01:51:54,470 --> 01:51:53,040
that's you know that's one of the things

3081
01:51:55,990 --> 01:51:54,480
that we learned

3082
01:51:58,149 --> 01:51:56,000
in developing this first generation is

3083
01:52:01,030 --> 01:51:58,159
where do we need the variability and how

3084
01:52:02,470 --> 01:52:01,040
much should we put in it

3085
01:52:04,950 --> 01:52:02,480
thanks we have time for two more

3086
01:52:06,709 --> 01:52:04,960
questions one here in the back

3087
01:52:08,390 --> 01:52:06,719
yeah hi there i'm valley and i am on

3088
01:52:11,750 --> 01:52:08,400

twitter but for political reasons i

3089
01:52:13,750 --> 01:52:11,760
shouldn't share my twitter name okay um

3090
01:52:15,830 --> 01:52:13,760
the campaign's done um

3091
01:52:18,149 --> 01:52:15,840
without due credit to alan steele a

3092
01:52:20,629 --> 01:52:18,159
science fiction writer really nice guy

3093
01:52:22,950 --> 01:52:20,639
and his space jockeys

3094
01:52:24,229 --> 01:52:22,960
what's the feasibility it you know this

3095
01:52:27,510 --> 01:52:24,239
is way out there but what's the

3096
01:52:29,270 --> 01:52:27,520
feasibility of embodying of embedding

3097
01:52:32,470 --> 01:52:29,280
both those kinds of

3098
01:52:34,950 --> 01:52:32,480
the exoskeletons but also your gripping

3099
01:52:37,750 --> 01:52:34,960
device and a number of others to build a

3100
01:52:39,750 --> 01:52:37,760
custom suit for a guy or gal to go out

3101
01:52:42,470 --> 01:52:39,760
there and mine asteroids i mean mining

3102
01:52:45,910 --> 01:52:42,480
asteroids is way out in the future but

3103
01:52:47,990 --> 01:52:45,920
could we transform our mobile capability

3104
01:52:50,070 --> 01:52:48,000
to be able to do this in the vacuum of

3105
01:52:52,390 --> 01:52:50,080
space or for that matter just do it in

3106
01:52:54,550 --> 01:52:52,400
the hard winter climates of alaska and

3107
01:52:56,790 --> 01:52:54,560
the yukon where they need that kind of

3108
01:52:59,589 --> 01:52:56,800
thing to be able to manipulate nature

3109
01:53:03,510 --> 01:52:59,599
and do drilling and so on so

3110
01:53:06,229 --> 01:53:03,520
could we adapt that technology to help

3111
01:53:08,790 --> 01:53:06,239
us be able to do this in environments

3112
01:53:10,870 --> 01:53:08,800
that are hostile to men thank you

3113
01:53:13,030 --> 01:53:10,880

yeah that's a great question um

3114
01:53:14,950 --> 01:53:13,040
so i mean that's kind of what what we do

3115
01:53:16,310 --> 01:53:14,960
and as we went in part of the fact that

3116
01:53:19,750 --> 01:53:16,320
we had partnerships here is we were

3117
01:53:22,070 --> 01:53:19,760
thinking not just you know our in space

3118
01:53:24,229 --> 01:53:22,080
you know mining asteroid uh applications

3119
01:53:25,910 --> 01:53:24,239
in the future um and i think that would

3120
01:53:27,270 --> 01:53:25,920
really involve taking these kind of

3121
01:53:29,510 --> 01:53:27,280
technologies and probably future

3122
01:53:31,910 --> 01:53:29,520
generations these technologies and

3123
01:53:34,229 --> 01:53:31,920
integrating with the suits so that

3124
01:53:37,830 --> 01:53:34,239
you know they were kind of part of a

3125
01:53:40,310 --> 01:53:37,840
human human machine interface so that's

3126
01:53:41,990 --> 01:53:40,320
i think down one front and presumably

3127
01:53:43,189 --> 01:53:42,000
that it would really just be somebody

3128
01:53:45,510 --> 01:53:43,199
that had a

3129
01:53:47,589 --> 01:53:45,520
a strong need to do just that

3130
01:53:49,189 --> 01:53:47,599
motivation to do it quickly and i think

3131
01:53:50,229 --> 01:53:49,199
you know with the right motivation we

3132
01:53:51,510 --> 01:53:50,239
could certainly

3133
01:53:53,189 --> 01:53:51,520
you know bring these sort of

3134
01:53:55,189 --> 01:53:53,199
capabilities to

3135
01:53:56,709 --> 01:53:55,199
a hostile environment whether it be the

3136
01:53:58,229 --> 01:53:56,719
hostile environment of space or the

3137
01:54:02,229 --> 01:53:58,239
hostile environments we see here on

3138
01:54:07,430 --> 01:54:04,629

hi i'm elizabeth wallace of tacoma park

3139
01:54:10,870 --> 01:54:07,440
maryland my hashtag is storytelling

3140
01:54:12,950 --> 01:54:10,880
and um i just this past weekend i spent

3141
01:54:15,430 --> 01:54:12,960
as i was a judge at a first lego

3142
01:54:16,950 --> 01:54:15,440
tournament and oh you guys are nodding

3143
01:54:18,390 --> 01:54:16,960
that's good

3144
01:54:20,310 --> 01:54:18,400
and um

3145
01:54:22,790 --> 01:54:20,320
a lot one of the kids one of the teams

3146
01:54:24,950 --> 01:54:22,800
created an exoskeleton for a disabled

3147
01:54:27,189 --> 01:54:24,960
former fireman who went in and saved

3148
01:54:29,510 --> 01:54:27,199
some people from a fire even though he

3149
01:54:31,990 --> 01:54:29,520
was you know an elder like 80 years old

3150
01:54:33,430 --> 01:54:32,000
he was empowered to save that and it was

3151
01:54:35,430 --> 01:54:33,440
really cool watching the kids come up

3152
01:54:37,830 --> 01:54:35,440
with amazing things that was mostly for

3153
01:54:41,350 --> 01:54:37,840
seniors these these products

3154
01:54:43,669 --> 01:54:41,360
what um is nasa doing to help more and

3155
01:54:48,149 --> 01:54:43,679
more to facilitate more and more nasa

3156
01:54:50,870 --> 01:54:48,159
engineers technicians etc to mentor kids

3157
01:54:52,629 --> 01:54:50,880
in this idea in this area of innovation

3158
01:54:54,790 --> 01:54:52,639
that is the softness of the softball for

3159
01:54:57,350 --> 01:54:54,800
us so so these two guys

3160
01:54:59,830 --> 01:54:57,360
are really come directly out of our

3161
01:55:03,189 --> 01:54:59,840
first robotics pipeline so jonathan was

3162
01:55:04,709 --> 01:55:03,199
on our local team at nasa johnson as as

3163
01:55:07,189 --> 01:55:04,719

a high school student

3164
01:55:09,910 --> 01:55:07,199
he uh came to work as a co-op at nasa

3165
01:55:11,669 --> 01:55:09,920
and then has been working at jsc on

3166
01:55:13,510 --> 01:55:11,679
robonaut amongst other things for about

3167
01:55:14,709 --> 01:55:13,520
six or seven years

3168
01:55:16,390 --> 01:55:14,719
rogers may be a little bit more

3169
01:55:18,149 --> 01:55:16,400
non-traditional uh

3170
01:55:20,229 --> 01:55:18,159
farm club kid where we met him as a

3171
01:55:23,030 --> 01:55:20,239
sophomore in college he came out and was

3172
01:55:24,310 --> 01:55:23,040
a college mentor on our first team

3173
01:55:25,830 --> 01:55:24,320
um

3174
01:55:28,070 --> 01:55:25,840
and you know he's kind of grown up with

3175
01:55:30,149 --> 01:55:28,080
us and for me me i got my job you know

3176
01:55:32,470 --> 01:55:30,159
working initially robonaut by i went out

3177
01:55:33,830 --> 01:55:32,480
and volunteered on a first team

3178
01:55:35,030 --> 01:55:33,840
and that's kind of how i made my

3179
01:55:36,310 --> 01:55:35,040
transition from i was working space

3180
01:55:38,629 --> 01:55:36,320
station at the time that's how i got

3181
01:55:40,709 --> 01:55:38,639
back into technology so we've

3182
01:55:42,709 --> 01:55:40,719
worked with hundreds and hundreds of

3183
01:55:44,390 --> 01:55:42,719
young men and women

3184
01:55:47,830 --> 01:55:44,400
and you know many of them are doing

3185
01:55:51,189 --> 01:55:49,990
okay we have one final question from

3186
01:55:53,990 --> 01:55:51,199
twitter

3187
01:55:58,870 --> 01:55:54,000
and that is can the exoskeleton also be

3188
01:56:03,030 --> 01:56:00,629

yeah so so at this point it can't be but

3189
01:56:05,270 --> 01:56:03,040
that's really one of our um our longer

3190
01:56:08,149 --> 01:56:05,280
term goals is really to have this be

3191
01:56:14,229 --> 01:56:08,159
part of a suit that might make a crew

3192
01:56:14,239 --> 01:56:24,149
okay well thank you everybody

3193
01:56:27,350 --> 01:56:25,189
thanks so much try to resolve the

3194
01:56:28,709 --> 01:56:27,360
microphone issue at part two this was

3195
01:56:30,390 --> 01:56:28,719
the afternoon session uh there's an

3196
01:56:31,589 --> 01:56:30,400
afternoon session after this uh thanks

3197
01:56:33,910 --> 01:56:31,599
very much for joining us for the morning

3198
01:56:35,669 --> 01:56:33,920
session uh we learned a lot today about

3199
01:56:37,189 --> 01:56:35,679
future technologies and how technology

3200
01:56:39,510 --> 01:56:37,199
is helping us here on earth and the