1
00:00:05,670 --> 00:00:02,550
good good good thanks so we'll share

2
00:00:07,110 --> 00:00:05,680
those mics if that's okay gents

3
00:00:09,270 --> 00:00:07,120
hi i'm trim parado public affairs

4
00:00:11,350 --> 00:00:09,280
officer at nasa headquarters welcome to

5
00:00:13,830 --> 00:00:11,360
today's nasa social media chat for the

6
00:00:15,190 --> 00:00:13,840
orion multi-purpose crew vehicle we've

7
00:00:16,950 --> 00:00:15,200
had a great event this morning here at

8
00:00:18,550 --> 00:00:16,960
nasa's kennedy space center in florida

9
00:00:21,029 --> 00:00:18,560
to recognize the arrival of the first

10
00:00:22,870 --> 00:00:21,039
space-bound orion spacecraft the one

11
00:00:24,230 --> 00:00:22,880
right behind me we're excited to have

12
00:00:26,070 --> 00:00:24,240
this opportunity to answer your

13
00:00:27,830 --> 00:00:26,080

questions at home about america's next

14
00:00:29,830 --> 00:00:27,840
generation spacecraft that will carry

15
00:00:30,870 --> 00:00:29,840
astronauts farther into space than ever

16
00:00:32,389 --> 00:00:30,880
before

17
00:00:33,990 --> 00:00:32,399
we've had a lot of great questions come

18
00:00:36,150 --> 00:00:34,000
in so far this morning on the comment

19
00:00:38,229 --> 00:00:36,160
threads of nasa's facebook and google

20
00:00:39,910 --> 00:00:38,239
plus pages for those of you following on

21
00:00:42,150 --> 00:00:39,920
twitter you can ask your questions of

22
00:00:44,470 --> 00:00:42,160
the panelist by using the hashtag ask

23
00:00:46,069 --> 00:00:44,480
nasa excuse me ask nasa and we'll get to

24
00:00:46,950 --> 00:00:46,079
as many as we can over the next 45

25
00:00:49,830 --> 00:00:46,960
minutes

26
00:00:52,310 --> 00:00:49,840
uh the spacebound orion behind me will

27
00:00:55,189 --> 00:00:52,320
launch on exploration flight test 1 an

28
00:00:57,510 --> 00:00:55,199
uncrewed mission plan for 2014.

29
00:00:59,430 --> 00:00:57,520
this will travel 3600 miles above the

30
00:01:01,189 --> 00:00:59,440
earth's surface 15 times farther than

31
00:01:03,189 --> 00:01:01,199
the international space station's

32
00:01:04,950 --> 00:01:03,199
current orbital position this is farther

33
00:01:06,710 --> 00:01:04,960
than any human spacecraft has gone in

34
00:01:08,310 --> 00:01:06,720
more than 40 years

35
00:01:10,630 --> 00:01:08,320
this flight will help prove that orion

36
00:01:12,469 --> 00:01:10,640
can survive the enormous speeds and heat

37
00:01:14,310 --> 00:01:12,479
generated during a return from deep

38
00:01:15,510 --> 00:01:14,320

space we have a distinguished panel of

39
00:01:17,830 --> 00:01:15,520
participants here to answer your

40
00:01:19,990 --> 00:01:17,840
questions about the spacecraft the 2014

41
00:01:21,749 --> 00:01:20,000
eft-1 flight and the future missions

42
00:01:23,510 --> 00:01:21,759
orion the space launch system and

43
00:01:26,070 --> 00:01:23,520
development will enable i'd like to

44
00:01:29,270 --> 00:01:26,080
introduce them now

45
00:01:31,749 --> 00:01:29,280
first we have mark guyer he is nasa's

46
00:01:33,910 --> 00:01:31,759
program manager for orion essentially

47
00:01:35,910 --> 00:01:33,920
he's the person managing the huge effort

48
00:01:37,510 --> 00:01:35,920
at nasa that's building and delivering

49
00:01:39,109 --> 00:01:37,520
the spacecraft that you see behind us in

50
00:01:41,510 --> 00:01:39,119
the team that'll turn it into a fully

51
00:01:43,510 --> 00:01:41,520
operational spacecraft uh next we have

52
00:01:45,030 --> 00:01:43,520
david beeman the nasa space launch

53
00:01:47,109 --> 00:01:45,040
system spacecraft and payload

54
00:01:48,950 --> 00:01:47,119
integration manager uh he's part of the

55
00:01:50,469 --> 00:01:48,960
team working on america's next heavy

56
00:01:52,310 --> 00:01:50,479
lift rocket it's going to provide an

57
00:01:54,789 --> 00:01:52,320
entirely new capability for human

58
00:01:56,789 --> 00:01:54,799
exploration beyond low earth orbit for

59
00:01:58,709 --> 00:01:56,799
more information about sls you can get

60
00:02:01,670 --> 00:01:58,719
all the facts at nasa.gov

61
00:02:03,429 --> 00:02:01,680
sls next we have pepper phillips the

62
00:02:05,429 --> 00:02:03,439
nasa ground systems development and

63
00:02:06,870 --> 00:02:05,439

operations program manager

64
00:02:08,309 --> 00:02:06,880
ground systems here at kennedy is

65
00:02:10,389 --> 00:02:08,319
leading the transformation of this

66
00:02:12,710 --> 00:02:10,399
launch complex to a next generation

67
00:02:15,190 --> 00:02:12,720
spaceport bustling with government and

68
00:02:17,750 --> 00:02:15,200
commercial activity and next we have

69
00:02:19,589 --> 00:02:17,760
astronaut rex walheim he's the astronaut

70
00:02:22,070 --> 00:02:19,599
office's main liaison with the orion

71
00:02:23,750 --> 00:02:22,080
program in that capacity he provides

72
00:02:26,070 --> 00:02:23,760
input from his unique perspective as an

73
00:02:28,150 --> 00:02:26,080
astronaut throughout orion's design and

74
00:02:29,830 --> 00:02:28,160
testing process he's a veteran of three

75
00:02:32,150 --> 00:02:29,840
space shuttle flights this includes

76
00:02:34,309 --> 00:02:32,160
being one of the four nasa astronauts to

77
00:02:35,830 --> 00:02:34,319
find fly on the final shuttle mission

78
00:02:37,270 --> 00:02:35,840
sts-135

79
00:02:39,190 --> 00:02:37,280
nearly a year ago

80
00:02:41,030 --> 00:02:39,200
so we're going to jump right into your

81
00:02:42,790 --> 00:02:41,040
questions and we've monitored quite a

82
00:02:44,550 --> 00:02:42,800
few that came in this morning i'm going

83
00:02:45,990 --> 00:02:44,560
to take the moderator's privilege and

84
00:02:48,390 --> 00:02:46,000
ask the first one if that's okay because

85
00:02:50,949 --> 00:02:48,400
i i'm guessing it's on your minds at

86
00:02:54,630 --> 00:02:50,959
home too and it's mark guyer why is your

87
00:02:59,350 --> 00:02:56,710
i had that same question a few years ago

88
00:03:01,030 --> 00:02:59,360

basically it's a coating it's a primer

89
00:03:02,790 --> 00:03:01,040
you can think of if you had a car or

90
00:03:03,990 --> 00:03:02,800
other metal pieces you like to put a

91
00:03:05,830 --> 00:03:04,000
primer on it protects it against

92
00:03:07,830 --> 00:03:05,840
corrosion and other things

93
00:03:08,869 --> 00:03:07,840
it'll be covered so when we fly you

94
00:03:10,149 --> 00:03:08,879
won't see

95
00:03:11,350 --> 00:03:10,159
the green we're actually going to have

96
00:03:13,030 --> 00:03:11,360
uh

97
00:03:14,470 --> 00:03:13,040
tiles on the back shell that would be

98
00:03:15,670 --> 00:03:14,480
black

99
00:03:17,190 --> 00:03:15,680
part of that is

100
00:03:19,670 --> 00:03:17,200
part of the thermal protection that we

101
00:03:20,949 --> 00:03:19,680
use as orion comes back in and the heat

102
00:03:23,430 --> 00:03:20,959
shield itself on the bottom will be

103
00:03:25,110 --> 00:03:23,440
white so all that has to do with

104
00:03:26,229 --> 00:03:25,120
understanding what

105
00:03:27,990 --> 00:03:26,239
how we want the

106
00:03:29,430 --> 00:03:28,000
thermal properties to behave and then

107
00:03:30,390 --> 00:03:29,440
what coatings we're certifying for

108
00:03:32,309 --> 00:03:30,400
flight

109
00:03:33,270 --> 00:03:32,319
okay all right so the first question

110
00:03:35,430 --> 00:03:33,280
we're going to take from the public

111
00:03:37,430 --> 00:03:35,440
comes to us from facebook and it's what

112
00:03:39,589 --> 00:03:37,440
makes the orion capsule suited for deep

113
00:03:41,750 --> 00:03:39,599

space exploration

114
00:03:43,910 --> 00:03:41,760
would ever like to take that

115
00:03:45,589 --> 00:03:43,920
start

116
00:03:47,350 --> 00:03:45,599
a couple things because of the long

117
00:03:49,110 --> 00:03:47,360
duration that it's going to have and we

118
00:03:50,630 --> 00:03:49,120
have four people four people are the

119
00:03:53,110 --> 00:03:50,640
mission that we have so the longer

120
00:03:55,350 --> 00:03:53,120
you're out in space the more stuff you

121
00:03:56,710 --> 00:03:55,360
need food water

122
00:03:58,710 --> 00:03:56,720
um

123
00:04:00,869 --> 00:03:58,720
also the crew requires suits and other

124
00:04:01,910 --> 00:04:00,879
things longer duration will actually

125
00:04:03,830 --> 00:04:01,920
require

126
00:04:05,589 --> 00:04:03,840
a toilet those kind of things so that

127
00:04:06,789 --> 00:04:05,599
that increases the volume so the volume

128
00:04:08,229 --> 00:04:06,799
is bigger

129
00:04:09,589 --> 00:04:08,239
the longer duration the crew is going to

130
00:04:10,390 --> 00:04:09,599
be out because again the stuff that they

131
00:04:11,670 --> 00:04:10,400
need

132
00:04:14,229 --> 00:04:11,680
to survive

133
00:04:15,110 --> 00:04:14,239
also long duration missions require are

134
00:04:21,030 --> 00:04:15,120
the

135
00:04:23,110 --> 00:04:21,040
more propulsion tanks so forth so

136
00:04:26,629 --> 00:04:23,120
the delta v we use to get us around

137
00:04:27,909 --> 00:04:26,639
drive the size of orion as well

138
00:04:30,390 --> 00:04:27,919

there's a lot of things that you don't

139
00:04:32,629 --> 00:04:30,400
see in the structure that uh would be in

140
00:04:33,909 --> 00:04:32,639
the avionics the computers and other

141
00:04:36,150 --> 00:04:33,919
things

142
00:04:38,310 --> 00:04:36,160
as you get further further from earth

143
00:04:40,790 --> 00:04:38,320
you want your reliability

144
00:04:42,310 --> 00:04:40,800
quality is much more important because

145
00:04:44,070 --> 00:04:42,320
failures and issues a long way from

146
00:04:46,629 --> 00:04:44,080
earth are a lot harder

147
00:04:49,590 --> 00:04:46,639
to recover from so those are the kind of

148
00:04:51,990 --> 00:04:49,600
things i think are big drivers for us

149
00:04:53,670 --> 00:04:52,000
radiation shielding is another one uh

150
00:04:55,270 --> 00:04:53,680
this structure of course is a big part

151
00:04:56,390 --> 00:04:55,280
of that and there are other things we do

152
00:04:58,310 --> 00:04:56,400
for the crew when they're a long way

153
00:04:59,430 --> 00:04:58,320
from earth to protect them for that got

154
00:05:01,590 --> 00:04:59,440
it

155
00:05:03,510 --> 00:05:01,600
directed you want to okay okay well let

156
00:05:05,270 --> 00:05:03,520
me go let me ask a related question

157
00:05:07,510 --> 00:05:05,280
actually for rex and it's something that

158
00:05:08,710 --> 00:05:07,520
i saw on facebook this morning too um

159
00:05:10,150 --> 00:05:08,720
and you

160
00:05:11,590 --> 00:05:10,160
described how the spacecraft will

161
00:05:13,110 --> 00:05:11,600
function and some of the considerations

162
00:05:14,950 --> 00:05:13,120
we need to make but a more pointed

163
00:05:16,629 --> 00:05:14,960

question how will astronauts be able to

164
00:05:19,670 --> 00:05:16,639
maintain muscle mass and bone density

165
00:05:21,350 --> 00:05:19,680
aboard orion how are we preparing for

166
00:05:22,710 --> 00:05:21,360
it'll be a lot to be fairly similar to

167
00:05:24,310 --> 00:05:22,720
what we do on the international space

168
00:05:25,909 --> 00:05:24,320
station will have resistive devices and

169
00:05:27,990 --> 00:05:25,919
then potentially some kind of ergonomic

170
00:05:29,189 --> 00:05:28,000
device and it's very important and

171
00:05:30,550 --> 00:05:29,199
that's one of the most important things

172
00:05:32,390 --> 00:05:30,560
we're learning from the space station is

173
00:05:34,950 --> 00:05:32,400
how to survive in space how the human

174
00:05:36,870 --> 00:05:34,960
body can withstand six months a year

175
00:05:38,230 --> 00:05:36,880
possibly and even even longer and so

176
00:05:39,510 --> 00:05:38,240
what we're learning on space station

177
00:05:41,189 --> 00:05:39,520
we've developed some effective counter

178
00:05:42,870 --> 00:05:41,199
measures how to stay in shape how to how

179
00:05:44,150 --> 00:05:42,880
to maintain your muscle mass and we'll

180
00:05:46,469 --> 00:05:44,160
incorporate those lessons into this

181
00:05:48,150 --> 00:05:46,479
vehicle

182
00:05:50,550 --> 00:05:48,160
that's great

183
00:05:52,310 --> 00:05:50,560
all right next question um any plans to

184
00:05:53,990 --> 00:05:52,320
make orion compatible with the

185
00:05:59,830 --> 00:05:54,000
international space station docks in

186
00:06:03,670 --> 00:06:01,990
part of our plan is to be potentially a

187
00:06:05,909 --> 00:06:03,680
backup

188
00:06:07,909 --> 00:06:05,919

in the unlikely case that maybe the

189
00:06:10,150 --> 00:06:07,919
commercial crew guys are not able to

190
00:06:11,590 --> 00:06:10,160
perform that function so

191
00:06:13,430 --> 00:06:11,600
it turns out a lot of the orion

192
00:06:15,670 --> 00:06:13,440
requirements are the same

193
00:06:17,590 --> 00:06:15,680
we have the capability to dock we can

194
00:06:20,469 --> 00:06:17,600
carry people we have the propulsion

195
00:06:22,150 --> 00:06:20,479
capability to do that

196
00:06:23,670 --> 00:06:22,160
so we would just they would need they

197
00:06:25,670 --> 00:06:23,680
would give us need to give us a you know

198
00:06:27,510 --> 00:06:25,680
a couple years to to

199
00:06:29,430 --> 00:06:27,520
change our plans to put some things like

200
00:06:30,790 --> 00:06:29,440
a rendezvous and docking sensor on orion

201
00:06:32,710 --> 00:06:30,800
which of course we have the capability

202
00:06:34,870 --> 00:06:32,720
to do so we can do it but i think the

203
00:06:35,990 --> 00:06:34,880
way you said it is right as a backup

204
00:06:38,390 --> 00:06:36,000
because

205
00:06:40,070 --> 00:06:38,400
uh really it's built for exploration

206
00:06:41,990 --> 00:06:40,080
it's as we talked about it's bigger

207
00:06:44,150 --> 00:06:42,000
because of exploration so it's not as an

208
00:06:46,710 --> 00:06:44,160
efficient uh an iss

209
00:06:48,629 --> 00:06:46,720
transport vehicle but we can be ready as

210
00:06:49,990 --> 00:06:48,639
needed as if we need to be called up

211
00:06:50,790 --> 00:06:50,000
okay

212
00:06:52,550 --> 00:06:50,800
um

213
00:06:55,029 --> 00:06:52,560

direct this question to uh to pepper

214
00:06:57,350 --> 00:06:55,039
into david um what

215
00:06:58,870 --> 00:06:57,360
what sorts of challenges technical

216
00:07:01,510 --> 00:06:58,880
communication

217
00:07:03,670 --> 00:07:01,520
you know et cetera essentially as we

218
00:07:06,390 --> 00:07:03,680
as we look to to send astronauts to and

219
00:07:07,589 --> 00:07:06,400
from deep space hear from kennedy how

220
00:07:09,110 --> 00:07:07,599
how do you have to approach that

221
00:07:10,870 --> 00:07:09,120
differently than you've ever done before

222
00:07:13,350 --> 00:07:10,880
as you prepare sls to launch from here

223
00:07:15,270 --> 00:07:13,360
as you prepare ground systems to to be

224
00:07:16,629 --> 00:07:15,280
able to support sls what's what's

225
00:07:18,070 --> 00:07:16,639
different this time around when you're

226
00:07:20,710 --> 00:07:18,080
when you're looking at a farther target

227
00:07:22,950 --> 00:07:20,720
like somewhere in deep space okay well i

228
00:07:24,469 --> 00:07:22,960
i think we have some experience in in

229
00:07:26,230 --> 00:07:24,479
going to the moon and we and we're going

230
00:07:27,350 --> 00:07:26,240
to take advantage of that you know one

231
00:07:29,510 --> 00:07:27,360
of the biggest

232
00:07:32,070 --> 00:07:29,520
challenges that you have is is having

233
00:07:33,510 --> 00:07:32,080
good safe and reliable access to deep

234
00:07:35,510 --> 00:07:33,520
space

235
00:07:37,909 --> 00:07:35,520
you talked about the physical aspects

236
00:07:39,670 --> 00:07:37,919
making sure that the health of the

237
00:07:41,350 --> 00:07:39,680
astronauts

238
00:07:42,950 --> 00:07:41,360

you have to have redundancy you have to

239
00:07:44,309 --> 00:07:42,960
make sure that if you put a crew out

240
00:07:46,309 --> 00:07:44,319
there you have the ability to get it

241
00:07:47,830 --> 00:07:46,319
back part of that is the launch vehicle

242
00:07:50,790 --> 00:07:47,840
and part of that is the spacecraft

243
00:07:53,749 --> 00:07:50,800
itself so you know

244
00:07:55,270 --> 00:07:53,759
it drives our design time it drives our

245
00:07:58,150 --> 00:07:55,280
test time and we want to make sure that

246
00:07:59,990 --> 00:07:58,160
we have the safest most reliable system

247
00:08:02,710 --> 00:08:00,000
out there

248
00:08:04,469 --> 00:08:02,720
and for us for the ground it's much like

249
00:08:06,230 --> 00:08:04,479
we're our processing is just like we do

250
00:08:08,309 --> 00:08:06,240
for shuttle or any of the other

251
00:08:10,230 --> 00:08:08,319
spacecraft we've launched from here

252
00:08:12,550 --> 00:08:10,240
our job is if there's going to be a

253
00:08:14,790 --> 00:08:12,560
failure let it be on the ground

254
00:08:16,390 --> 00:08:14,800
reliability is a big deal for these guys

255
00:08:18,309 --> 00:08:16,400
we want to make sure the testing the

256
00:08:20,230 --> 00:08:18,319
checkout the things that are we look at

257
00:08:22,309 --> 00:08:20,240
on the ground are complete

258
00:08:24,070 --> 00:08:22,319
satisfy the criteria that the designers

259
00:08:27,110 --> 00:08:24,080
design the vehicles to and then we're

260
00:08:29,110 --> 00:08:27,120
ready to go okay

261
00:08:31,110 --> 00:08:29,120
um next question came in from twitter

262
00:08:32,709 --> 00:08:31,120
what is the predicted date of an orion

263
00:08:34,230 --> 00:08:32,719

manned space flight

264
00:08:35,829 --> 00:08:34,240
and actually you know can you give us a

265
00:08:37,430 --> 00:08:35,839
little more detail on it what it is that

266
00:08:39,029 --> 00:08:37,440
we're looking forward to

267
00:08:41,589 --> 00:08:39,039
yeah good um

268
00:08:43,829 --> 00:08:41,599
so we have this flight test first in

269
00:08:45,509 --> 00:08:43,839
2014 we have an abort flight test

270
00:08:48,310 --> 00:08:45,519
that'll be that we're working on the

271
00:08:50,630 --> 00:08:48,320
date probably around the 2017 time frame

272
00:08:53,430 --> 00:08:50,640
that'll be done out of florida uh our

273
00:08:54,949 --> 00:08:53,440
first big test with sls will be in 2017

274
00:08:56,630 --> 00:08:54,959
it'll be unmanned because we want to

275
00:08:58,710 --> 00:08:56,640
flush out the systems the integration

276
00:09:00,230 --> 00:08:58,720
with the rocket

277
00:09:01,269 --> 00:09:00,240
unmanned before we actually put people

278
00:09:04,310 --> 00:09:01,279
on board

279
00:09:05,590 --> 00:09:04,320
so those have to happen first

280
00:09:07,190 --> 00:09:05,600
and then we have a lot of tests on the

281
00:09:09,190 --> 00:09:07,200
ground to qualify

282
00:09:11,509 --> 00:09:09,200
eclipse displays and controls other

283
00:09:14,550 --> 00:09:11,519
things seats that are part of launching

284
00:09:17,030 --> 00:09:14,560
people so beyond 17 that date is really

285
00:09:18,470 --> 00:09:17,040
driven by by the budget

286
00:09:19,670 --> 00:09:18,480
uh we're working with headquarters and

287
00:09:21,350 --> 00:09:19,680
exactly what the budget's going to be

288
00:09:22,710 --> 00:09:21,360

it's a little it's a few years out today

289
00:09:25,110 --> 00:09:22,720
we're projecting

290
00:09:26,470 --> 00:09:25,120
uh probably in the 2021 time frame i

291
00:09:27,990 --> 00:09:26,480
believe we can do better than that and

292
00:09:31,269 --> 00:09:28,000
that's what we're trying to work on

293
00:09:33,590 --> 00:09:31,279
accelerating those dates okay all right

294
00:09:36,389 --> 00:09:33,600
let's see for uh we'll do it for david

295
00:09:38,710 --> 00:09:36,399
uh question from twitter um

296
00:09:40,870 --> 00:09:38,720
your sls is going to take us to deep

297
00:09:42,550 --> 00:09:40,880
space carry the orion spacecraft there

298
00:09:44,230 --> 00:09:42,560
how much farther outside earth's orbit

299
00:09:46,550 --> 00:09:44,240
is that what's your what's your line

300
00:09:48,470 --> 00:09:46,560
where's your where are you aiming what's

301
00:09:50,310 --> 00:09:48,480
that what's the boundary for you well

302
00:09:51,829 --> 00:09:50,320
obviously i think you know the first

303
00:09:53,829 --> 00:09:51,839
goal is to go around the moon with the

304
00:09:57,269 --> 00:09:53,839
first two early missions and and we'd

305
00:09:59,350 --> 00:09:57,279
like to have a a manned mars mission um

306
00:10:01,670 --> 00:09:59,360
a lot of discussion about going to an

307
00:10:04,470 --> 00:10:01,680
asteroid that's one potential but you

308
00:10:06,150 --> 00:10:04,480
know i think near term we want to repeat

309
00:10:07,910 --> 00:10:06,160
the success we had previously going to

310
00:10:10,710 --> 00:10:07,920
the moon we want to make sure we provide

311
00:10:12,550 --> 00:10:10,720
orion with the the test flights that

312
00:10:15,590 --> 00:10:12,560
they need to prove the deep space

313
00:10:18,870 --> 00:10:15,600

capability and then really you know the

314
00:10:20,470 --> 00:10:18,880
planets the stars are the limit

315
00:10:22,790 --> 00:10:20,480
so we know space starts about 100

316
00:10:23,910 --> 00:10:22,800
kilometers there is there a a measure

317
00:10:25,430 --> 00:10:23,920
when you're when you're talking deep

318
00:10:27,910 --> 00:10:25,440
space is there a certain kilometer

319
00:10:29,670 --> 00:10:27,920
measure that you're using say sls needs

320
00:10:31,030 --> 00:10:29,680
to get us this far

321
00:10:33,350 --> 00:10:31,040
i really don't think that because i

322
00:10:34,870 --> 00:10:33,360
think relatively speaking that's a whole

323
00:10:36,389 --> 00:10:34,880
lot closer than we want to go you know

324
00:10:38,150 --> 00:10:36,399
when we talk deep space we're talking

325
00:10:40,630 --> 00:10:38,160
mars we're talking an asteroid and i

326
00:10:41,509 --> 00:10:40,640
think that the dividing line between you

327
00:10:43,910 --> 00:10:41,519
know

328
00:10:45,430 --> 00:10:43,920
a low earth orbit and deep space i think

329
00:10:47,110 --> 00:10:45,440
is a whole lot closer than we want to

330
00:10:48,389 --> 00:10:47,120
get as an agency

331
00:10:50,310 --> 00:10:48,399
all right

332
00:10:52,150 --> 00:10:50,320
uh here's a fairly

333
00:10:54,389 --> 00:10:52,160
technical question from from facebook

334
00:10:56,790 --> 00:10:54,399
will the service module be adapted to

335
00:10:58,790 --> 00:10:56,800
carry mission-specific payloads such as

336
00:11:01,670 --> 00:10:58,800
planetary science earth observation or

337
00:11:04,069 --> 00:11:01,680
astronomy instruments

338
00:11:06,069 --> 00:11:04,079

so from the beginning we designed the

339
00:11:10,069 --> 00:11:06,079
service module to have cargo caping

340
00:11:14,949 --> 00:11:12,150
with a two tank configuration so

341
00:11:16,550 --> 00:11:14,959
depending on what uh propulsion delta v

342
00:11:17,750 --> 00:11:16,560
you think you need we can actually carry

343
00:11:19,990 --> 00:11:17,760
quite large

344
00:11:22,150 --> 00:11:20,000
payloads uh in the four full tank

345
00:11:24,550 --> 00:11:22,160
configuration like the one we're sending

346
00:11:25,590 --> 00:11:24,560
on our flight test around the moon we

347
00:11:28,069 --> 00:11:25,600
have a

348
00:11:29,670 --> 00:11:28,079
we still have volume that can either be

349
00:11:31,350 --> 00:11:29,680
attached to the side of the service

350
00:11:33,430 --> 00:11:31,360
module or actually could be areas that

351
00:11:35,110 --> 00:11:33,440
we could extract from the bottom so we

352
00:11:37,269 --> 00:11:35,120
are looking at that very closely because

353
00:11:39,110 --> 00:11:37,279
i think it's extremely important

354
00:11:41,509 --> 00:11:39,120
to be able to have

355
00:11:44,310 --> 00:11:41,519
payload capability experiment capability

356
00:11:45,670 --> 00:11:44,320
since we're going to these far places

357
00:11:48,470 --> 00:11:45,680
those payloads will actually give us a

358
00:11:51,190 --> 00:11:48,480
lot of capability to understand

359
00:11:53,509 --> 00:11:52,230
just a reminder for those of you

360
00:11:55,110 --> 00:11:53,519
watching at home if you're on twitter

361
00:11:57,910 --> 00:11:55,120
you can ask your questions of the

362
00:11:59,350 --> 00:11:57,920
panelists by using the hashtag ask nasa

363
00:12:00,069 --> 00:11:59,360

if you're on google plus and facebook

364
00:12:01,829 --> 00:12:00,079
just

365
00:12:03,430 --> 00:12:01,839
look for the comment thread that we have

366
00:12:05,509 --> 00:12:03,440
going and put your question there we

367
00:12:07,030 --> 00:12:05,519
have a team uh getting us the questions

368
00:12:09,590 --> 00:12:07,040
just as quick as you're putting them in

369
00:12:12,150 --> 00:12:09,600
so the next one comes from twitter and

370
00:12:14,230 --> 00:12:12,160
that's uh it could be mark could be rex

371
00:12:16,790 --> 00:12:14,240
it's an interesting one why why did the

372
00:12:18,710 --> 00:12:16,800
shuttle fly a manned first test flight

373
00:12:20,949 --> 00:12:18,720
and why are we planning an uncrewed test

374
00:12:22,150 --> 00:12:20,959
of the orion capsule first

375
00:12:23,670 --> 00:12:22,160
depends on the capabilities of the

376
00:12:25,829 --> 00:12:23,680
system you're developing what you'd like

377
00:12:27,350 --> 00:12:25,839
to do is if you have the ability to test

378
00:12:29,509 --> 00:12:27,360
something unmanned it's the safest way

379
00:12:31,110 --> 00:12:29,519
to do it and so with the shuttle they

380
00:12:32,389 --> 00:12:31,120
just they deemed as it got closer to

381
00:12:33,829 --> 00:12:32,399
launch that having the presence of

382
00:12:35,509 --> 00:12:33,839
people on board was the best way to do

383
00:12:37,509 --> 00:12:35,519
it they couldn't automate the uh the

384
00:12:39,430 --> 00:12:37,519
landing sequence uh in time to be able

385
00:12:41,509 --> 00:12:39,440
to put people on to to be able to do it

386
00:12:43,509 --> 00:12:41,519
automated for the first flight uh so it

387
00:12:45,350 --> 00:12:43,519
took a lot of guts and uh courage to

388
00:12:46,629 --> 00:12:45,360

send those two guys john young and bob

389
00:12:48,629 --> 00:12:46,639
crippen on that first flight in the man

390
00:12:50,389 --> 00:12:48,639
configuration but if you can test these

391
00:12:53,829 --> 00:12:50,399
out unmanned an automated capability

392
00:12:55,030 --> 00:12:53,839
first that's the way you want to go

393
00:12:58,150 --> 00:12:55,040
anything there

394
00:13:00,230 --> 00:12:58,160
mark okay got it gotta go okay

395
00:13:01,750 --> 00:13:00,240
uh what scientific fields will be

396
00:13:03,829 --> 00:13:01,760
necessary for deep space human

397
00:13:04,870 --> 00:13:03,839
exploration

398
00:13:07,910 --> 00:13:04,880
what do you have to learn now

399
00:13:10,310 --> 00:13:07,920
scientifically that's going to enable

400
00:13:11,590 --> 00:13:10,320
human travel

401
00:13:13,110 --> 00:13:11,600
rex has actually been up there so why

402
00:13:14,949 --> 00:13:13,120
don't you start with that okay for what

403
00:13:16,710 --> 00:13:14,959
kind of field you need to be you might

404
00:13:17,509 --> 00:13:16,720
want to have on a deep space mission

405
00:13:18,629 --> 00:13:17,519
well it's going to be a little bit

406
00:13:20,470 --> 00:13:18,639
different uh

407
00:13:21,750 --> 00:13:20,480
from a uh from the low earth orbit we

408
00:13:23,430 --> 00:13:21,760
were building the space station we

409
00:13:25,350 --> 00:13:23,440
needed and we're operating the space

410
00:13:28,310 --> 00:13:25,360
station you have a wide variety of

411
00:13:30,629 --> 00:13:28,320
backgrounds uh from uh engineers to

412
00:13:32,150 --> 00:13:30,639
scientists to pilots you can have the

413
00:13:33,350 --> 00:13:32,160

same kind of core background for deep

414
00:13:37,670 --> 00:13:33,360
space missions but you're also going to

415
00:13:40,310 --> 00:13:37,680
need a more heavily geology-based

416
00:13:41,430 --> 00:13:40,320
field of knowledge or or training and so

417
00:13:43,590 --> 00:13:41,440
we're actually looking at that national

418
00:13:46,150 --> 00:13:43,600
office we're training uh our astronauts

419
00:13:47,990 --> 00:13:46,160
to be better geologists we're looking at

420
00:13:49,350 --> 00:13:48,000
prototype programs and we did that in

421
00:13:51,030 --> 00:13:49,360
the apollo program we have to get back

422
00:13:52,230 --> 00:13:51,040
to that because uh the really important

423
00:13:53,829 --> 00:13:52,240
thing about uh

424
00:13:55,990 --> 00:13:53,839
about manned space flight is you have

425
00:13:57,110 --> 00:13:56,000
curiosity you have a knowledge base they

426
00:13:58,949 --> 00:13:57,120
have when they get there and they have a

427
00:14:00,710 --> 00:13:58,959
curiosity when they get there they can

428
00:14:02,550 --> 00:14:00,720
be trained all about geology and told

429
00:14:03,670 --> 00:14:02,560
okay this is where we want to look at

430
00:14:05,030 --> 00:14:03,680
but when they look to the side a little

431
00:14:06,790 --> 00:14:05,040
bit and see something different they say

432
00:14:08,710 --> 00:14:06,800
huh that's odd those are where some of

433
00:14:11,030 --> 00:14:08,720
your best discoveries come from so we'll

434
00:14:12,629 --> 00:14:11,040
we'll try to have a little uh broader uh

435
00:14:14,470 --> 00:14:12,639
training in geology and some of the

436
00:14:18,470 --> 00:14:14,480
planetary sciences and i think that'll

437
00:14:21,910 --> 00:14:19,910
the um

438
00:14:23,590 --> 00:14:21,920

technology that we need to send people

439
00:14:25,750 --> 00:14:23,600
further in space we're learning a lot on

440
00:14:27,750 --> 00:14:25,760
space station so the long duration you

441
00:14:29,350 --> 00:14:27,760
we great question on the

442
00:14:31,509 --> 00:14:29,360
bone mass and other things which was a

443
00:14:32,629 --> 00:14:31,519
huge uncertainty until space station

444
00:14:34,470 --> 00:14:32,639
where we've learned a lot about what

445
00:14:36,389 --> 00:14:34,480
exercise equipment can do and help

446
00:14:37,990 --> 00:14:36,399
radiation is another one we we

447
00:14:40,069 --> 00:14:38,000
understand what the environment is like

448
00:14:41,590 --> 00:14:40,079
how can we protect the crew better what

449
00:14:42,710 --> 00:14:41,600
are the real effects that's another one

450
00:14:45,269 --> 00:14:42,720
that we're i think we're pushing the

451
00:14:47,110 --> 00:14:45,279
envelope on two good examples

452
00:14:48,949 --> 00:14:47,120
so so david how about on the on the sls

453
00:14:50,870 --> 00:14:48,959
side this is a sort of related question

454
00:14:53,269 --> 00:14:50,880
from twitter what what innovations do

455
00:14:54,310 --> 00:14:53,279
you have to do on your end to sustain

456
00:14:55,430 --> 00:14:54,320
human

457
00:14:57,990 --> 00:14:55,440
uh

458
00:15:00,230 --> 00:14:58,000
life as as we go out into deep space how

459
00:15:01,670 --> 00:15:00,240
are you designing the launch vehicle

460
00:15:02,870 --> 00:15:01,680
with that in mind what innovations do

461
00:15:04,870 --> 00:15:02,880
you need to make

462
00:15:06,389 --> 00:15:04,880
okay and i think there's a couple of

463
00:15:08,150 --> 00:15:06,399

areas that we have to cover you have to

464
00:15:10,389 --> 00:15:08,160
have a large enough launch vehicle to

465
00:15:11,910 --> 00:15:10,399
send the supplies just in the spacecraft

466
00:15:14,069 --> 00:15:11,920
and other things that you'll need to be

467
00:15:15,430 --> 00:15:14,079
able to sustain that so so we have to

468
00:15:17,350 --> 00:15:15,440
build this

469
00:15:20,150 --> 00:15:17,360
we have to build it smart we have to

470
00:15:22,710 --> 00:15:20,160
build a vehicle that will allow us to

471
00:15:25,430 --> 00:15:22,720
put the payloads the cargo and and the

472
00:15:27,110 --> 00:15:25,440
spacecraft in space uh to the location

473
00:15:29,590 --> 00:15:27,120
that's desired and have the ability to

474
00:15:32,069 --> 00:15:29,600
provide the supplies for that long-term

475
00:15:34,629 --> 00:15:32,079
uh duration

476
00:15:37,110 --> 00:15:34,639
as i spoke earlier most important thing

477
00:15:38,949 --> 00:15:37,120
is safety safety is paramount and a lot

478
00:15:40,870 --> 00:15:38,959
of times safety not only drives our

479
00:15:42,710 --> 00:15:40,880
costs but drives our mass

480
00:15:44,790 --> 00:15:42,720
we need to do things smart we need to

481
00:15:46,150 --> 00:15:44,800
decide when enough is enough we need to

482
00:15:48,150 --> 00:15:46,160
design something

483
00:15:49,829 --> 00:15:48,160
that will meet our needs but we don't

484
00:15:52,829 --> 00:15:49,839
need to try to design the perfect

485
00:15:54,949 --> 00:15:52,839
vehicle because we'll never get there

486
00:15:56,150 --> 00:15:54,959
so okay

487
00:15:58,310 --> 00:15:56,160
let's see

488
00:16:01,749 --> 00:15:58,320

this question uh i'm gonna actually ask

489
00:16:03,189 --> 00:16:01,759
this of all of all four of you um

490
00:16:04,790 --> 00:16:03,199
what is the core purpose this comes from

491
00:16:06,829 --> 00:16:04,800
facebook what is the core purpose of

492
00:16:09,189 --> 00:16:06,839
this exploration for

493
00:16:11,829 --> 00:16:09,199
humanity why are we doing it why are we

494
00:16:13,910 --> 00:16:11,839
why are we why are each of you you know

495
00:16:16,150 --> 00:16:13,920
making the sacrifices you are building

496
00:16:18,550 --> 00:16:16,160
your career around this this goal of

497
00:16:21,350 --> 00:16:18,560
deep space exploration why do we do it

498
00:16:23,189 --> 00:16:21,360
well for me i think exploration is a

499
00:16:25,110 --> 00:16:23,199
desire that's it's in the human heart

500
00:16:27,189 --> 00:16:25,120
people want to explore

501
00:16:29,269 --> 00:16:27,199
and i think uh true exploration takes

502
00:16:30,710 --> 00:16:29,279
the government it it takes the resources

503
00:16:32,230 --> 00:16:30,720
of a government to do true exploration

504
00:16:34,150 --> 00:16:32,240
from the time of lewis and clark when

505
00:16:36,069 --> 00:16:34,160
president jefferson said we want to send

506
00:16:38,069 --> 00:16:36,079
you guys out to do exploration to find a

507
00:16:39,509 --> 00:16:38,079
way to the pacific ocean he didn't say

508
00:16:40,629 --> 00:16:39,519
go there and you know set up some shops

509
00:16:42,150 --> 00:16:40,639
and make some money it was true

510
00:16:43,829 --> 00:16:42,160
exploration we didn't know what we

511
00:16:45,189 --> 00:16:43,839
didn't know we found and then when he

512
00:16:47,110 --> 00:16:45,199
sent them out we found new kinds of

513
00:16:48,949 --> 00:16:47,120

plants new kinds of animals and we were

514
00:16:50,150 --> 00:16:48,959
better as a country for that i think the

515
00:16:51,829 --> 00:16:50,160
same thing holds true with space

516
00:16:53,430 --> 00:16:51,839
exploration we don't know what we don't

517
00:16:54,710 --> 00:16:53,440
know and when we find those things we

518
00:16:56,310 --> 00:16:54,720
make those discoveries we're going to be

519
00:16:57,509 --> 00:16:56,320
better off just as a people but also

520
00:17:04,230 --> 00:16:57,519
it's going to have applications that

521
00:17:07,110 --> 00:17:05,990
exactly right i think also when you look

522
00:17:08,470 --> 00:17:07,120
at the

523
00:17:09,669 --> 00:17:08,480
uh

524
00:17:12,789 --> 00:17:09,679
some of the more

525
00:17:15,110 --> 00:17:12,799
near term or i'd say uh not too far from

526
00:17:16,710 --> 00:17:15,120
earth discoveries like going to mars and

527
00:17:18,789 --> 00:17:16,720
looking at whether there's life on mars

528
00:17:21,270 --> 00:17:18,799
i can't imagine anything more

529
00:17:23,110 --> 00:17:21,280
fundamental to our understanding

530
00:17:24,710 --> 00:17:23,120
of our life and what happens here on

531
00:17:27,110 --> 00:17:24,720
earth if we were to find and discover

532
00:17:28,470 --> 00:17:27,120
life on mars so and having people as a

533
00:17:30,230 --> 00:17:28,480
part of that exploration i think is

534
00:17:32,150 --> 00:17:30,240
going to be is going to be critical so i

535
00:17:34,390 --> 00:17:32,160
think that's just one example also i

536
00:17:35,990 --> 00:17:34,400
think it's important as far as uh

537
00:17:38,310 --> 00:17:36,000
to be a great nation

538
00:17:40,070 --> 00:17:38,320

uh great nations lead they lead on

539
00:17:41,430 --> 00:17:40,080
things that are hard to do

540
00:17:43,350 --> 00:17:41,440
like exploration i think the best

541
00:17:45,510 --> 00:17:43,360
example is that is for those countries

542
00:17:46,710 --> 00:17:45,520
that don't have that exploration

543
00:17:47,590 --> 00:17:46,720
capability

544
00:17:48,950 --> 00:17:47,600
uh

545
00:17:50,470 --> 00:17:48,960
the time and effort they're spending to

546
00:17:52,390 --> 00:17:50,480
get it i think china is a great example

547
00:17:54,390 --> 00:17:52,400
so i think it's something that

548
00:17:55,909 --> 00:17:54,400
as a great nation as a leader

549
00:18:00,150 --> 00:17:55,919
we need to keep leading

550
00:18:03,990 --> 00:18:02,230
and from an overall country perspective

551
00:18:06,070 --> 00:18:04,000
an agency perspective

552
00:18:07,830 --> 00:18:06,080
if you look when you try to do something

553
00:18:09,830 --> 00:18:07,840
that no one else has done try to go

554
00:18:11,029 --> 00:18:09,840
somewhere and know what no one else has

555
00:18:13,270 --> 00:18:11,039
been to

556
00:18:15,830 --> 00:18:13,280
um you create an environment where

557
00:18:17,350 --> 00:18:15,840
people become innovative

558
00:18:20,150 --> 00:18:17,360
they come up with new ideas new

559
00:18:22,470 --> 00:18:20,160
approaches it becomes a pull technology

560
00:18:24,390 --> 00:18:22,480
where you develop the technology in

561
00:18:27,669 --> 00:18:24,400
order to reach your goal and that

562
00:18:28,470 --> 00:18:27,679
technology ends up benefiting mankind so

563
00:18:30,470 --> 00:18:28,480

you know

564
00:18:32,390 --> 00:18:30,480
the things that came out of our early

565
00:18:33,510 --> 00:18:32,400
the early space race the things that

566
00:18:35,029 --> 00:18:33,520
have come out of the space shuttle

567
00:18:36,549 --> 00:18:35,039
program as well as the international

568
00:18:40,470 --> 00:18:36,559
space station i think benefit all

569
00:18:44,549 --> 00:18:42,470
i think it's mostly been said but uh i

570
00:18:48,150 --> 00:18:44,559
think it's human nature to want to

571
00:18:51,830 --> 00:18:48,160
discover uh discovery is what humans uh

572
00:18:54,470 --> 00:18:51,840
benefit from what humans pursue

573
00:18:57,270 --> 00:18:54,480
and learning is part of that discovery

574
00:19:00,230 --> 00:18:57,280
process so for us it's developing a

575
00:19:01,190 --> 00:19:00,240
capability learning discovering and

576
00:19:03,510 --> 00:19:01,200
pushing

577
00:19:05,990 --> 00:19:03,520
the bounds of what the human race has

578
00:19:07,270 --> 00:19:06,000
done to this point

579
00:19:09,110 --> 00:19:07,280
i think i have another question for all

580
00:19:11,270 --> 00:19:09,120
four of you actually i i think you'd all

581
00:19:13,270 --> 00:19:11,280
have different and interesting examples

582
00:19:14,950 --> 00:19:13,280
and this is from twitter and it's

583
00:19:17,830 --> 00:19:14,960
can you give examples of which

584
00:19:19,830 --> 00:19:17,840
technologies from the apollo and shuttle

585
00:19:21,590 --> 00:19:19,840
are used in orion but i actually want to

586
00:19:23,830 --> 00:19:21,600
expand that just a little bit so so the

587
00:19:25,430 --> 00:19:23,840
legacy what what are you building on

588
00:19:26,950 --> 00:19:25,440

that's that's that's hardware that's

589
00:19:29,110 --> 00:19:26,960
that's that's practically speaking

590
00:19:30,390 --> 00:19:29,120
related to apollo and shuttle that's

591
00:19:33,669 --> 00:19:30,400
actually helping you do your jobs and

592
00:19:35,510 --> 00:19:33,679
that you're using to move forward

593
00:19:37,270 --> 00:19:35,520
um

594
00:19:39,990 --> 00:19:37,280
so there's a couple things

595
00:19:41,830 --> 00:19:40,000
i would start with is the shape

596
00:19:43,350 --> 00:19:41,840
okay you look at the shape of rhines

597
00:19:45,750 --> 00:19:43,360
very similar

598
00:19:47,270 --> 00:19:45,760
to apollo we've done a lot of studies on

599
00:19:48,950 --> 00:19:47,280
different shapes

600
00:19:51,430 --> 00:19:48,960
and it turns out this shape

601
00:19:54,070 --> 00:19:51,440
is actually very close to the optimum

602
00:19:55,590 --> 00:19:54,080
for this kind of deep space

603
00:19:57,669 --> 00:19:55,600
and the entries that we're going to do

604
00:19:59,510 --> 00:19:57,679
so i'd say we learned a lot from that

605
00:20:02,710 --> 00:19:59,520
and checked it again and found out that

606
00:20:05,590 --> 00:20:02,720
those guys got that part right

607
00:20:07,669 --> 00:20:05,600
there's a lot of things we learned about

608
00:20:09,270 --> 00:20:07,679
radiation about the lunar dust those

609
00:20:11,110 --> 00:20:09,280
kind of things that we do take into

610
00:20:13,190 --> 00:20:11,120
account when we do our internal systems

611
00:20:14,710 --> 00:20:13,200
design because in the long run we hope

612
00:20:16,230 --> 00:20:14,720
we're going to be going to other bodies

613
00:20:18,230 --> 00:20:16,240

and need to be able to accommodate those

614
00:20:21,430 --> 00:20:18,240
kind of things

615
00:20:24,950 --> 00:20:21,440
beyond that though the internal stuff

616
00:20:26,630 --> 00:20:24,960
uh computers guidance navigation and so

617
00:20:29,029 --> 00:20:26,640
forth those are really

618
00:20:31,190 --> 00:20:29,039
state of the art we've taken

619
00:20:33,510 --> 00:20:31,200
the latest updates for

620
00:20:35,350 --> 00:20:33,520
a highly reliable computer systems

621
00:20:37,270 --> 00:20:35,360
networks and those came and accommodated

622
00:20:38,789 --> 00:20:37,280
them into iran so i look at it as from

623
00:20:41,830 --> 00:20:38,799
the outside

624
00:20:43,270 --> 00:20:41,840
cars from the 50s and today look pretty

625
00:20:45,110 --> 00:20:43,280
similar they have four wheels they have

626
00:20:46,950 --> 00:20:45,120
a steering wheel but the insides are

627
00:20:49,510 --> 00:20:46,960
fundamentally different that's much more

628
00:20:50,950 --> 00:20:49,520
like where orion is today so the shape

629
00:20:53,669 --> 00:20:50,960
is the same because that still makes

630
00:20:55,350 --> 00:20:53,679
sense from a physics standpoint but the

631
00:20:57,190 --> 00:20:55,360
internal parts the part that actually

632
00:20:58,549 --> 00:20:57,200
keeps the crew safe and gets them to

633
00:21:01,430 --> 00:20:58,559
where they need to go is state of the

634
00:21:05,590 --> 00:21:03,350
and i guess when you a lot of times we

635
00:21:07,110 --> 00:21:05,600
think more toward hardware technologies

636
00:21:08,470 --> 00:21:07,120
when we talk about technology

637
00:21:10,710 --> 00:21:08,480
advancements and things that we use

638
00:21:12,310 --> 00:21:10,720

today you know i think one of the things

639
00:21:15,270 --> 00:21:12,320
that we've learned most from our from

640
00:21:18,230 --> 00:21:15,280
our early missions in the past is

641
00:21:20,310 --> 00:21:18,240
the technologies and analytical tools

642
00:21:22,230 --> 00:21:20,320
the the tools that we use today are so

643
00:21:24,070 --> 00:21:22,240
far advanced from where we were and a

644
00:21:25,669 --> 00:21:24,080
lot of that came from the early work

645
00:21:29,110 --> 00:21:25,679
that came from the apollo program and

646
00:21:31,029 --> 00:21:29,120
others that allowed us to not only test

647
00:21:33,510 --> 00:21:31,039
but predict what the results of the test

648
00:21:36,630 --> 00:21:33,520
would be verify those tests and use

649
00:21:39,270 --> 00:21:36,640
those advanced analytical tools to

650
00:21:41,669 --> 00:21:39,280
to predict off nominal events so we

651
00:21:44,230 --> 00:21:41,679
could deal with them in in the future so

652
00:21:47,270 --> 00:21:44,240
so to me the the tools is a real

653
00:21:49,430 --> 00:21:47,280
technology advancement

654
00:21:52,230 --> 00:21:49,440
so i really like this question because

655
00:21:55,350 --> 00:21:52,240
we've done a lot of study on the

656
00:21:57,909 --> 00:21:55,360
apollo program and the mercury program

657
00:21:59,190 --> 00:21:57,919
and gemiini programs and as things have

658
00:22:01,590 --> 00:21:59,200
evolved

659
00:22:03,430 --> 00:22:01,600
how they ended up choosing the assets

660
00:22:04,710 --> 00:22:03,440
that they used and the processing

661
00:22:06,310 --> 00:22:04,720
techniques

662
00:22:08,789 --> 00:22:06,320
uh much of which have been developed

663
00:22:10,470 --> 00:22:08,799

over the years but fundamentally

664
00:22:11,990 --> 00:22:10,480
like mark said with the shape of his

665
00:22:15,669 --> 00:22:12,000
spacecraft

666
00:22:19,510 --> 00:22:15,679
ground processing requires the basic

667
00:22:20,549 --> 00:22:19,520
capabilities to service to test and to

668
00:22:22,390 --> 00:22:20,559
launch

669
00:22:23,909 --> 00:22:22,400
those things we looked at things like

670
00:22:26,149 --> 00:22:23,919
transport mode

671
00:22:28,470 --> 00:22:26,159
things like where you integrate a

672
00:22:31,270 --> 00:22:28,480
vehicle integrating a vehicle vertically

673
00:22:33,110 --> 00:22:31,280
versus horizontally we studied all those

674
00:22:35,350 --> 00:22:33,120
items and looked at the best

675
00:22:36,549 --> 00:22:35,360
capabilities and ways to do it now sure

676
00:22:40,390 --> 00:22:36,559
you have

677
00:22:43,430 --> 00:22:40,400
modern capabilities to you know launch

678
00:22:46,230 --> 00:22:43,440
processing systems command and control

679
00:22:48,630 --> 00:22:46,240
systems all of those things make

680
00:22:49,909 --> 00:22:48,640
what has been done in the past far

681
00:22:52,310 --> 00:22:49,919
more

682
00:22:54,549 --> 00:22:52,320
integrated and better in today's

683
00:22:56,870 --> 00:22:54,559
environment but fundamentally we're

684
00:22:58,070 --> 00:22:56,880
still the same we're using a crawler to

685
00:23:00,470 --> 00:22:58,080
get out of the

686
00:23:02,230 --> 00:23:00,480
vab and transport it to the pad once it

687
00:23:03,830 --> 00:23:02,240
gets to the pad it goes through a basic

688
00:23:05,590 --> 00:23:03,840

systems test to make sure it's

689
00:23:08,390 --> 00:23:05,600
integrated well with the

690
00:23:10,149 --> 00:23:08,400
servicing systems at the pad so a little

691
00:23:11,510 --> 00:23:10,159
blend of the old blend of the new but

692
00:23:14,789 --> 00:23:11,520
they were pretty smart guys in the

693
00:23:15,990 --> 00:23:14,799
apollo ear that came up with this

694
00:23:17,430 --> 00:23:16,000
yeah i think i would just echo that i

695
00:23:18,789 --> 00:23:17,440
think the theme you're hearing here is

696
00:23:20,149 --> 00:23:18,799
we take the best of what we had in the

697
00:23:21,669 --> 00:23:20,159
past and we add to it today's

698
00:23:22,390 --> 00:23:21,679
technologies and we've done that over

699
00:23:23,990 --> 00:23:22,400
and over

700
00:23:25,590 --> 00:23:24,000
uh from the basic design from having to

701
00:23:26,870 --> 00:23:25,600
launch abort system and having the

702
00:23:28,390 --> 00:23:26,880
capsule on top of the rocket that

703
00:23:29,990 --> 00:23:28,400
increases safety we learned that the

704
00:23:31,990 --> 00:23:30,000
hard way and and we're going to

705
00:23:33,750 --> 00:23:32,000
implement that how we do operations how

706
00:23:35,350 --> 00:23:33,760
we uh do space walks we've learned how

707
00:23:36,630 --> 00:23:35,360
to do spacewalks over the years and we

708
00:23:38,149 --> 00:23:36,640
we know how to do that better and better

709
00:23:39,590 --> 00:23:38,159
how to build spacesuits and then how to

710
00:23:40,630 --> 00:23:39,600
operate in space for long periods of

711
00:23:41,590 --> 00:23:40,640
time like we're learning on the space

712
00:23:45,750 --> 00:23:41,600
station we're going to put all that to

713
00:23:50,310 --> 00:23:48,230

a question that came in from twitter

714
00:23:52,789 --> 00:23:50,320
will orion has currently envisioned be

715
00:23:54,470 --> 00:23:52,799
able to endure in orbit around mars for

716
00:23:59,029 --> 00:23:54,480
the three years required for human

717
00:24:03,110 --> 00:23:59,990
today

718
00:24:05,029 --> 00:24:03,120
the orion systems we've designed them to

719
00:24:07,510 --> 00:24:05,039
to be extensible for six months in a

720
00:24:08,710 --> 00:24:07,520
quiescent mode you know so

721
00:24:10,310 --> 00:24:08,720
it could be orbiting around the moon

722
00:24:11,909 --> 00:24:10,320
there was nobody on

723
00:24:14,070 --> 00:24:11,919
if it was unmanned system the systems

724
00:24:14,870 --> 00:24:14,080
could survive for six months

725
00:24:16,149 --> 00:24:14,880
um

726
00:24:17,909 --> 00:24:16,159
what we would have to do once we

727
00:24:19,350 --> 00:24:17,919
understand the mars mission more and the

728
00:24:20,310 --> 00:24:19,360
specifics about

729
00:24:22,070 --> 00:24:20,320
uh

730
00:24:23,269 --> 00:24:22,080
how long where would we be going how

731
00:24:24,950 --> 00:24:23,279
long we would be there we'd have to look

732
00:24:26,710 --> 00:24:24,960
at each system and decide what it would

733
00:24:28,870 --> 00:24:26,720
take to certify those for longer

734
00:24:31,110 --> 00:24:28,880
duration to find actually a lot of the

735
00:24:33,990 --> 00:24:31,120
systems can do that it helps if we had

736
00:24:35,590 --> 00:24:34,000
crew on board um in a mars mission i

737
00:24:37,750 --> 00:24:35,600
expect that we would right in orbit so

738
00:24:39,269 --> 00:24:37,760

they could do maintenance uh check those

739
00:24:41,029 --> 00:24:39,279
systems out so that'd be something that

740
00:24:42,230 --> 00:24:41,039
we would go look to extend where we

741
00:24:43,510 --> 00:24:42,240
started from the six months we have

742
00:24:45,110 --> 00:24:43,520
today

743
00:24:47,029 --> 00:24:45,120
okay another another question from

744
00:24:48,390 --> 00:24:47,039
twitter uh do you think the orion

745
00:24:54,630 --> 00:24:48,400
program will last longer than the

746
00:25:00,549 --> 00:24:57,430
so i i believe it will because

747
00:25:03,029 --> 00:25:00,559
i think now we're moving back past earth

748
00:25:05,909 --> 00:25:03,039
orbit there are so many things for us to

749
00:25:07,669 --> 00:25:05,919
do beyond earth orbit uh asteroids the

750
00:25:09,750 --> 00:25:07,679
moon and onto mars

751
00:25:11,029 --> 00:25:09,760
also this orion design from the

752
00:25:13,430 --> 00:25:11,039
beginning

753
00:25:15,190 --> 00:25:13,440
is designed to be flexible to handle all

754
00:25:17,669 --> 00:25:15,200
these different missions

755
00:25:18,549 --> 00:25:17,679
so i believe it can it can adapt just

756
00:25:19,990 --> 00:25:18,559
like

757
00:25:21,990 --> 00:25:20,000
there was a lot of adaptation between

758
00:25:23,269 --> 00:25:22,000
the early apollo missions up to apollo

759
00:25:25,430 --> 00:25:23,279
soyuz

760
00:25:28,470 --> 00:25:25,440
the shuttle design was adapted quite a

761
00:25:30,070 --> 00:25:28,480
bit to then become capable of flying iss

762
00:25:32,789 --> 00:25:30,080
so i think we're already starting with a

763
00:25:34,149 --> 00:25:32,799

very flexible system so i think it can

764
00:25:35,909 --> 00:25:34,159
do so many sys

765
00:25:38,149 --> 00:25:35,919
so many different missions

766
00:25:40,310 --> 00:25:38,159
uh as america decides where it wants to

767
00:25:42,630 --> 00:25:40,320
head that i believe can last a very very

768
00:25:45,110 --> 00:25:42,640
long time and the avionics is easily

769
00:25:46,470 --> 00:25:45,120
upgradeable as well so we can add new

770
00:25:49,029 --> 00:25:46,480
technology

771
00:25:50,390 --> 00:25:49,039
uh state-of-the-art computers as needed

772
00:25:53,669 --> 00:25:50,400
to keep us

773
00:25:55,909 --> 00:25:53,679
in step with the technologies

774
00:25:58,470 --> 00:25:55,919
question for for rex i believe from from

775
00:26:00,789 --> 00:25:58,480
facebook uh some deep flight uh deep

776
00:26:02,470 --> 00:26:00,799
space flight missions could require six

777
00:26:04,710 --> 00:26:02,480
months to a year just to arrive at the

778
00:26:07,029 --> 00:26:04,720
destination uh how would an astronaut

779
00:26:08,390 --> 00:26:07,039
spend his or her days during that year's

780
00:26:10,310 --> 00:26:08,400
journey

781
00:26:11,990 --> 00:26:10,320
that would be a challenge uh it really

782
00:26:14,070 --> 00:26:12,000
would you know the thing about being in

783
00:26:15,590 --> 00:26:14,080
space and over on the space station uh

784
00:26:17,110 --> 00:26:15,600
for six months is that you have the the

785
00:26:18,470 --> 00:26:17,120
view of the earth to look back on and

786
00:26:19,350 --> 00:26:18,480
you can see your home and it's right

787
00:26:21,029 --> 00:26:19,360
there

788
00:26:23,190 --> 00:26:21,039

it's going to be a tremendous challenge

789
00:26:25,510 --> 00:26:23,200
to take a vehicle like this and go off

790
00:26:27,510 --> 00:26:25,520
for potentially a three-year mission and

791
00:26:29,190 --> 00:26:27,520
it's not going to be long just a few

792
00:26:30,630 --> 00:26:29,200
weeks before the earth starts receding

793
00:26:32,390 --> 00:26:30,640
in the distance and the earth is just

794
00:26:33,430 --> 00:26:32,400
one of the stars among the many and i've

795
00:26:34,870 --> 00:26:33,440
heard some people say it's going to

796
00:26:37,029 --> 00:26:34,880
redefine the meaning of the word

797
00:26:38,630 --> 00:26:37,039
loneliness and it will but there's

798
00:26:40,149 --> 00:26:38,640
explorers out there the same way we've

799
00:26:41,590 --> 00:26:40,159
had explorers in the past that crossed

800
00:26:43,029 --> 00:26:41,600
oceans taking new lives that have

801
00:26:44,789 --> 00:26:43,039
decided that they want to devote their

802
00:26:46,310 --> 00:26:44,799
lives to exploration and they'll do that

803
00:26:48,390 --> 00:26:46,320
it'll be tough and there'll be times

804
00:26:49,750 --> 00:26:48,400
where it'll be a real challenge to

805
00:26:50,710 --> 00:26:49,760
figure out mentally how you deal with

806
00:26:51,990 --> 00:26:50,720
that but

807
00:26:53,990 --> 00:26:52,000
we'll prepare our people they'll be

808
00:26:56,310 --> 00:26:54,000
excited to to be the first people going

809
00:26:57,269 --> 00:26:56,320
to someplace like mars and i think i

810
00:26:59,909 --> 00:26:57,279
think we'll prepare them well and

811
00:27:02,070 --> 00:26:59,919
they'll be able to handle that voyage

812
00:27:04,470 --> 00:27:02,080
a question from from twitter is is nasa

813
00:27:06,149 --> 00:27:04,480

working on a crew habitat to attach the

814
00:27:10,549 --> 00:27:06,159
orion crew capsule for long duration

815
00:27:14,230 --> 00:27:12,390
uh sorry nasa's looking at a lot of

816
00:27:15,669 --> 00:27:14,240
different options of how to extend the

817
00:27:16,870 --> 00:27:15,679
stay

818
00:27:19,430 --> 00:27:16,880
of the crew

819
00:27:21,510 --> 00:27:19,440
whether it be to a asteroid or onto to

820
00:27:24,149 --> 00:27:21,520
mars so very we're in the very early

821
00:27:26,070 --> 00:27:24,159
stages of thinking about ways to do that

822
00:27:28,389 --> 00:27:26,080
um orion of course is designed from the

823
00:27:31,110 --> 00:27:28,399
beginning to do rendezvous and docking

824
00:27:32,710 --> 00:27:31,120
uh with station or with a lander and so

825
00:27:33,430 --> 00:27:32,720
clearly we could do that with a habitat

826
00:27:35,830 --> 00:27:33,440
so

827
00:27:36,870 --> 00:27:35,840
it's we're early in those uh discussions

828
00:27:38,470 --> 00:27:36,880
okay

829
00:27:41,350 --> 00:27:38,480
i think this may be for for you and

830
00:27:44,230 --> 00:27:41,360
david uh what will be the primary fuel

831
00:27:46,789 --> 00:27:44,240
for both orion and sls is there any way

832
00:27:50,470 --> 00:27:46,799
to go faster by using some type of solar

833
00:27:54,549 --> 00:27:51,830
okay well if you look at our early

834
00:27:56,789 --> 00:27:54,559
capability we're basically staying with

835
00:27:58,549 --> 00:27:56,799
current technologies that we have you

836
00:28:01,750 --> 00:27:58,559
know you have the lox hydrogen engines

837
00:28:03,830 --> 00:28:01,760
you have solid solid fuels you have

838
00:28:05,510 --> 00:28:03,840

in space upper stages

839
00:28:07,750 --> 00:28:05,520
and so from that standpoint we are

840
00:28:09,830 --> 00:28:07,760
staying with existing technology but

841
00:28:13,350 --> 00:28:09,840
we're looking to stretch that technology

842
00:28:15,750 --> 00:28:13,360
and get more out of it i think long term

843
00:28:18,470 --> 00:28:15,760
we will have to have some

844
00:28:21,110 --> 00:28:18,480
sustained additional capability

845
00:28:23,029 --> 00:28:21,120
i think our partnering with the science

846
00:28:25,909 --> 00:28:23,039
communities and technology development

847
00:28:28,789 --> 00:28:25,919
focuses is allowing us to move forward

848
00:28:30,710 --> 00:28:28,799
anticipating that so i think some some

849
00:28:31,750 --> 00:28:30,720
type of

850
00:28:33,909 --> 00:28:31,760
you know

851
00:28:34,870 --> 00:28:33,919
solar cell some type of

852
00:28:36,549 --> 00:28:34,880
um

853
00:28:37,990 --> 00:28:36,559
you know in space stage is different

854
00:28:40,950 --> 00:28:38,000
than what we have today we'll have to

855
00:28:42,630 --> 00:28:40,960
have something like that in the future

856
00:28:44,389 --> 00:28:42,640
yeah so for orion we use you know

857
00:28:46,230 --> 00:28:44,399
hypergolic propellants

858
00:28:47,830 --> 00:28:46,240
they're efficient they work great we

859
00:28:48,950 --> 00:28:47,840
have systems that are built to operate

860
00:28:49,909 --> 00:28:48,960
with them

861
00:28:51,909 --> 00:28:49,919
uh

862
00:28:53,269 --> 00:28:51,919
they're less expensive so it's it's

863
00:28:54,389 --> 00:28:53,279

that's why it's part of the orion design

864
00:28:57,190 --> 00:28:54,399
and it does the mission that it's

865
00:29:00,470 --> 00:28:58,630
but david mentioned

866
00:29:02,789 --> 00:29:00,480
nasa's also looking not only at the hab

867
00:29:04,470 --> 00:29:02,799
but let's say solar electric other means

868
00:29:06,710 --> 00:29:04,480
to accelerate

869
00:29:09,510 --> 00:29:06,720
uh these larger pieces out to these far

870
00:29:11,350 --> 00:29:09,520
durations those take a long time

871
00:29:14,070 --> 00:29:11,360
to do that right they're not very fast

872
00:29:16,230 --> 00:29:14,080
but they're uh

873
00:29:18,149 --> 00:29:16,240
get us to further destinations so

874
00:29:19,750 --> 00:29:18,159
we are looking at ways of accelerating

875
00:29:21,190 --> 00:29:19,760
the cargo kind of things and then you

876
00:29:22,389 --> 00:29:21,200
get the crew there faster because you

877
00:29:25,190 --> 00:29:22,399
don't want the crew sitting on those for

878
00:29:26,549 --> 00:29:25,200
a very long time but

879
00:29:28,389 --> 00:29:26,559
uh what are the this is from twitter

880
00:29:31,350 --> 00:29:28,399
what are the specifications of the delta

881
00:29:36,070 --> 00:29:31,360
iv heavy that lead it to uh having been

882
00:29:39,669 --> 00:29:37,909
things we all again we all started from

883
00:29:41,669 --> 00:29:39,679
the objectives the objectives of this

884
00:29:44,549 --> 00:29:41,679
test were really to stress the heat

885
00:29:46,870 --> 00:29:44,559
shield stress the exploration functions

886
00:29:48,789 --> 00:29:46,880
of the orion

887
00:29:51,110 --> 00:29:48,799
so there were really two launch vehicles

888
00:29:52,549 --> 00:29:51,120

that exist today

889
00:29:54,630 --> 00:29:52,559
that could get us close to the

890
00:29:56,789 --> 00:29:54,640
velocities we need to stress the heat

891
00:29:59,269 --> 00:29:56,799
shield one was atlas v and the other is

892
00:30:04,710 --> 00:29:59,279
delta iv

893
00:30:07,430 --> 00:30:04,720
orion today could basically sit on top

894
00:30:09,110 --> 00:30:07,440
not require a significant fairing

895
00:30:11,190 --> 00:30:09,120
upgrade to go do that so that's part of

896
00:30:13,029 --> 00:30:11,200
what we gave the objectives to lockheed

897
00:30:15,110 --> 00:30:13,039
they did a search of the potential

898
00:30:17,830 --> 00:30:15,120
capabilities of the launch vehicle so it

899
00:30:19,430 --> 00:30:17,840
came came down to delta v and minimizing

900
00:30:23,269 --> 00:30:19,440
modifications to both orion and the

901
00:30:29,110 --> 00:30:26,310
see when will we be able to send humans

902
00:30:31,990 --> 00:30:29,120
to mars and when will we be able to send

903
00:30:35,350 --> 00:30:32,000
a human to jupiter or presumably around

904
00:30:39,190 --> 00:30:36,870
you want you want to start

905
00:30:41,750 --> 00:30:39,200
well so first things first you know we

906
00:30:43,029 --> 00:30:41,760
gotta we gotta get uh humans back beyond

907
00:30:44,470 --> 00:30:43,039
low earth orbit and that's what we're

908
00:30:45,430 --> 00:30:44,480
trying to do with orion as soon as we

909
00:30:46,310 --> 00:30:45,440
can

910
00:30:48,070 --> 00:30:46,320
uh

911
00:30:51,029 --> 00:30:48,080
and then i think the key will be what is

912
00:30:52,870 --> 00:30:51,039
the next destination and how do we

913
00:30:55,269 --> 00:30:52,880

get the systems both technology and

914
00:30:57,590 --> 00:30:55,279
funding wise to make that happen so

915
00:30:59,750 --> 00:30:57,600
right now there is no specific date

916
00:31:01,830 --> 00:30:59,760
for mars i think the key thing is to be

917
00:31:03,269 --> 00:31:01,840
pushing the envelope learning more about

918
00:31:04,870 --> 00:31:03,279
extended duration the kind of things

919
00:31:06,789 --> 00:31:04,880
that rex talked about

920
00:31:09,509 --> 00:31:06,799
uh so that we uh

921
00:31:11,190 --> 00:31:09,519
get those behind us and so we can move

922
00:31:14,389 --> 00:31:11,200
forward on under the mars trip yeah and

923
00:31:15,830 --> 00:31:14,399
i think this is a a methodical program

924
00:31:17,029 --> 00:31:15,840
that we're going through this is just

925
00:31:18,149 --> 00:31:17,039
the very first

926
00:31:21,269 --> 00:31:18,159
first launch but the important thing

927
00:31:22,710 --> 00:31:21,279
this is orion01 you know if we have the

928
00:31:24,389 --> 00:31:22,720
opportunity to look back from in the

929
00:31:26,389 --> 00:31:24,399
future about where this program went

930
00:31:27,350 --> 00:31:26,399
there's no there's no fixed assets that

931
00:31:28,870 --> 00:31:27,360
we're going to lose like the space

932
00:31:30,549 --> 00:31:28,880
shuttle the space shuttle eventually we

933
00:31:32,070 --> 00:31:30,559
reused them until we

934
00:31:33,190 --> 00:31:32,080
you know we could continue using them

935
00:31:34,630 --> 00:31:33,200
but they would eventually reach the end

936
00:31:36,310 --> 00:31:34,640
of their lifetime and the other thing

937
00:31:37,990 --> 00:31:36,320
about the space shuttle program is that

938
00:31:39,190 --> 00:31:38,000

it eventually you can you can fly it we

939
00:31:40,070 --> 00:31:39,200
could have flown it for 10 more years

940
00:31:41,750 --> 00:31:40,080
potentially but we're never going to

941
00:31:43,029 --> 00:31:41,760
leave low earth orbit with it so with

942
00:31:44,310 --> 00:31:43,039
this vehicle we can go any of these

943
00:31:45,750 --> 00:31:44,320
places if we just doing a build-up

944
00:31:47,509 --> 00:31:45,760
approach and we can make it tomorrow

945
00:31:49,269 --> 00:31:47,519
someday it may take we're not sure but

946
00:31:51,990 --> 00:31:49,279
hopefully in it we can be in the mars

947
00:31:53,669 --> 00:31:52,000
vicinity in the in the 2030s so i think

948
00:31:55,430 --> 00:31:53,679
that is a reasonably attainable goal but

949
00:31:56,950 --> 00:31:55,440
it's going to be a stair-step slow

950
00:31:58,230 --> 00:31:56,960
fashion it's not going to be easy it's

951
00:31:59,830 --> 00:31:58,240
going to be something we just have to

952
00:32:01,750 --> 00:31:59,840
remain committed to and if we remain

953
00:32:03,350 --> 00:32:01,760
committed to as a nation as a space

954
00:32:06,070 --> 00:32:03,360
agency as a contractor family i think we

955
00:32:11,430 --> 00:32:08,789
i think the long-term evolvable approach

956
00:32:13,110 --> 00:32:11,440
to sls in general

957
00:32:15,830 --> 00:32:13,120
allows us that we start with an early

958
00:32:17,990 --> 00:32:15,840
capability a 70 metric ton capability

959
00:32:20,389 --> 00:32:18,000
with the goal driving toward 130 metric

960
00:32:24,549 --> 00:32:22,149
taking that evolvable approach will

961
00:32:26,950 --> 00:32:24,559
allow us to to prove the technologies

962
00:32:28,950 --> 00:32:26,960
that we we develop new for this

963
00:32:31,669 --> 00:32:28,960

it'll allow us to to take incremental

964
00:32:34,389 --> 00:32:31,679
steps going to the moon first uh then

965
00:32:38,310 --> 00:32:34,399
maybe to an asteroid or toward mars so i

966
00:32:41,590 --> 00:32:38,320
think the evolvability is the real key

967
00:32:43,990 --> 00:32:41,600
okay uh an engineering question i think

968
00:32:45,990 --> 00:32:44,000
you'd categorize this from from twitter

969
00:32:47,669 --> 00:32:46,000
uh and it's a doozy is there any

970
00:32:49,830 --> 00:32:47,679
practical way to generate artificial

971
00:32:53,990 --> 00:32:49,840
gravity on a spaceship

972
00:32:58,310 --> 00:32:56,070
well the only way to do it is to is to

973
00:33:00,070 --> 00:32:58,320
have a a spacecraft that is tethered

974
00:33:01,590 --> 00:33:00,080
that rotates basically so if you had two

975
00:33:02,950 --> 00:33:01,600
spacecraft with a long enough tether you

976
00:33:04,870 --> 00:33:02,960
could rotate them on the way to mars and

977
00:33:06,630 --> 00:33:04,880
you'd have artificial gravity the only

978
00:33:08,149 --> 00:33:06,640
problem is if it's got to be very very

979
00:33:10,230 --> 00:33:08,159
large because it can be very disoriented

980
00:33:12,230 --> 00:33:10,240
if you have a large spin rate so it is

981
00:33:14,710 --> 00:33:12,240
possible that'd be one way to counteract

982
00:33:16,070 --> 00:33:14,720
uh counteract the zero g in in transit

983
00:33:17,590 --> 00:33:16,080
but i think we're getting pretty good in

984
00:33:20,470 --> 00:33:17,600
the space station to find out ways to

985
00:33:22,710 --> 00:33:20,480
con to combat the the atrophy you get

986
00:33:24,389 --> 00:33:22,720
from zero gravity by using exercise and

987
00:33:26,230 --> 00:33:24,399
counter measures so i think that won't

988
00:33:30,710 --> 00:33:26,240

be necessary but it is possible to be

989
00:33:34,070 --> 00:33:32,950
um this is an interesting question from

990
00:33:35,669 --> 00:33:34,080
from twitter

991
00:33:37,509 --> 00:33:35,679
and maybe rex can take the first crack

992
00:33:40,310 --> 00:33:37,519
at it what qualities would you look for

993
00:33:42,710 --> 00:33:40,320
in the astronauts who will fly on orion

994
00:33:44,230 --> 00:33:42,720
uh and would an olympian astrophysicist

995
00:33:46,389 --> 00:33:44,240
even make the cut

996
00:33:47,990 --> 00:33:46,399
an olympian astrophysicist well yeah

997
00:33:49,990 --> 00:33:48,000
they might you know there there's a

998
00:33:51,110 --> 00:33:50,000
certain baseline technical expertise

999
00:33:52,389 --> 00:33:51,120
people need

1000
00:33:53,909 --> 00:33:52,399
and there's a lot of people that have

1001
00:33:55,430 --> 00:33:53,919
that but then the most important thing

1002
00:33:58,149 --> 00:33:55,440
is the ability to get along with others

1003
00:33:59,669 --> 00:33:58,159
and the ability to handle adversity

1004
00:34:01,029 --> 00:33:59,679
even today with our six months missions

1005
00:34:02,789 --> 00:34:01,039
to the space station we train our

1006
00:34:04,230 --> 00:34:02,799
astronauts to how to cope with adversity

1007
00:34:05,750 --> 00:34:04,240
we train them to

1008
00:34:07,990 --> 00:34:05,760
to develop their coping skills how do

1009
00:34:09,270 --> 00:34:08,000
you cope with things when they go wrong

1010
00:34:11,909 --> 00:34:09,280
we do things like send the people out

1011
00:34:13,270 --> 00:34:11,919
into the wilderness for ten day uh

1012
00:34:14,790 --> 00:34:13,280
national outdoor leadership school

1013
00:34:15,990 --> 00:34:14,800

training sessions where we

1014
00:34:17,270 --> 00:34:16,000
what we learn about what's what are

1015
00:34:19,349 --> 00:34:17,280
these people how do they react when

1016
00:34:20,629 --> 00:34:19,359
they're cold and wet and hungry and

1017
00:34:21,909 --> 00:34:20,639
you'd be surprised that when you when

1018
00:34:23,829 --> 00:34:21,919
you get in those situations you can

1019
00:34:25,190 --> 00:34:23,839
learn to develop those coping skills so

1020
00:34:26,550 --> 00:34:25,200
we need somebody who has coping skills

1021
00:34:27,990 --> 00:34:26,560
because like i said it's going to it's

1022
00:34:29,829 --> 00:34:28,000
going to be a tremendous journey to go

1023
00:34:31,030 --> 00:34:29,839
someplace like mars so you know the

1024
00:34:32,310 --> 00:34:31,040
coping skills you know the interpersonal

1025
00:34:34,389 --> 00:34:32,320
relationship skills somebody who gets

1026
00:34:35,909 --> 00:34:34,399
along well with just about everybody and

1027
00:34:37,430 --> 00:34:35,919
then somebody who has an incredible

1028
00:34:38,790 --> 00:34:37,440
psychological fortitude to handle

1029
00:34:40,950 --> 00:34:38,800
something like that to leave his whole

1030
00:34:43,109 --> 00:34:40,960
world behind and go someplace new with

1031
00:34:44,389 --> 00:34:43,119
the hope of making new explorations and

1032
00:34:49,750 --> 00:34:44,399
and

1033
00:34:53,750 --> 00:34:51,589
uh how long is from twitter how long

1034
00:34:58,230 --> 00:34:53,760
will final assembly take on the eft-1

1035
00:35:01,030 --> 00:34:59,910
what you see here is the primary

1036
00:35:03,270 --> 00:35:01,040
structure

1037
00:35:05,270 --> 00:35:03,280
that will hold the pressure for example

1038
00:35:07,910 --> 00:35:05,280

when we eventually uh send people out

1039
00:35:10,310 --> 00:35:07,920
into space that primary structure

1040
00:35:11,990 --> 00:35:10,320
took us a few months to put together

1041
00:35:13,430 --> 00:35:12,000
but there are a lot of other pieces that

1042
00:35:15,270 --> 00:35:13,440
are already in production that will

1043
00:35:16,470 --> 00:35:15,280
start showing up here at the cape so i

1044
00:35:18,870 --> 00:35:16,480
think the next

1045
00:35:21,510 --> 00:35:18,880
couple of key things to think about is

1046
00:35:23,270 --> 00:35:21,520
uh all the avian the computers the

1047
00:35:25,750 --> 00:35:23,280
cables all that kind of stuff will start

1048
00:35:28,710 --> 00:35:25,760
showing up we'll actually power it on

1049
00:35:30,790 --> 00:35:28,720
uh in the february march time frame here

1050
00:35:33,030 --> 00:35:30,800
right right here in this building do the

1051
00:35:34,630 --> 00:35:33,040
integrated testing then

1052
00:35:38,150 --> 00:35:34,640
the heat shield shows up a little bit

1053
00:35:40,470 --> 00:35:38,160
later than that so by the end of

1054
00:35:42,829 --> 00:35:40,480
2013 it'll be totally assembled and

1055
00:35:45,910 --> 00:35:42,839
ready to be shipped for the

1056
00:35:48,150 --> 00:35:45,920
launch okay we just we have just less

1057
00:35:49,510 --> 00:35:48,160
than 10 minutes uh so keep the great

1058
00:35:52,470 --> 00:35:49,520
questions coming again if you're on

1059
00:35:54,310 --> 00:35:52,480
twitter hashtag ask nasa and if you're

1060
00:35:55,990 --> 00:35:54,320
on google plus or facebook just find the

1061
00:35:58,069 --> 00:35:56,000
comment thread and put your question

1062
00:35:59,589 --> 00:35:58,079
there and we'll get to as many as we can

1063
00:36:01,829 --> 00:35:59,599

before we have to end

1064
00:36:03,510 --> 00:36:01,839
next question looks like it's from

1065
00:36:08,150 --> 00:36:03,520
facebook how many test articles have

1066
00:36:11,030 --> 00:36:09,270
start with the

1067
00:36:13,349 --> 00:36:11,040
orion side and then

1068
00:36:16,310 --> 00:36:13,359
i know david's got stuff and uh pepper

1069
00:36:17,910 --> 00:36:16,320
does too so for orion we had a pad abort

1070
00:36:19,430 --> 00:36:17,920
one which was

1071
00:36:21,589 --> 00:36:19,440
where we tested out the launch abort

1072
00:36:22,390 --> 00:36:21,599
system that was probably the the first

1073
00:36:23,829 --> 00:36:22,400
big

1074
00:36:26,790 --> 00:36:23,839
test article

1075
00:36:28,230 --> 00:36:26,800
that had to match the mass properties

1076
00:36:31,349 --> 00:36:28,240
pretty close of what orion would look

1077
00:36:32,950 --> 00:36:31,359
like because we did a full abort test

1078
00:36:34,550 --> 00:36:32,960
using the full bolt motor and attitude

1079
00:36:36,390 --> 00:36:34,560
control motor so that was that was the

1080
00:36:38,390 --> 00:36:36,400
big one

1081
00:36:39,829 --> 00:36:38,400
we did a ground test article which is

1082
00:36:42,310 --> 00:36:39,839
actually also in this building just a

1083
00:36:43,510 --> 00:36:42,320
little bit down the way

1084
00:36:45,430 --> 00:36:43,520
did that one first of all to get our

1085
00:36:46,870 --> 00:36:45,440
manufacturing processes figured out and

1086
00:36:49,030 --> 00:36:46,880
then we also did a lot of acoustic

1087
00:36:51,349 --> 00:36:49,040
testing because during liftoff

1088
00:36:52,710 --> 00:36:51,359

the rocket creates a lot of

1089
00:36:55,270 --> 00:36:52,720
sound

1090
00:36:56,470 --> 00:36:55,280
energy as well as if we did an abort uh

1091
00:36:57,910 --> 00:36:56,480
there's a lot of energy from that as

1092
00:37:00,230 --> 00:36:57,920
well so you need to test the structure

1093
00:37:02,069 --> 00:37:00,240
under acoustic load and actually do

1094
00:37:03,589 --> 00:37:02,079
vibration testing to see how it behaves

1095
00:37:04,470 --> 00:37:03,599
so we built a ground test article for

1096
00:37:05,589 --> 00:37:04,480
that

1097
00:37:07,670 --> 00:37:05,599
um

1098
00:37:09,270 --> 00:37:07,680
we've done some a few boiler plates

1099
00:37:11,430 --> 00:37:09,280
which are basically simple structures

1100
00:37:13,910 --> 00:37:11,440
that model orion that we've dropped at

1101
00:37:17,349 --> 00:37:13,920
langley in the pool there to get to to

1102
00:37:23,910 --> 00:37:19,510
as far as we've had a lot of them

1103
00:37:27,670 --> 00:37:25,670
panels of the structure that we've put

1104
00:37:29,589 --> 00:37:27,680
under load all sorts of smaller pieces

1105
00:37:31,750 --> 00:37:29,599
that we've done that too down to

1106
00:37:32,790 --> 00:37:31,760
tripoli parts that we've tested so i

1107
00:37:33,670 --> 00:37:32,800
think if you're talking about the big

1108
00:37:37,270 --> 00:37:33,680
ones

1109
00:37:38,150 --> 00:37:37,280
the next one of course you see it behind

1110
00:37:44,310 --> 00:37:38,160
us

1111
00:37:45,750 --> 00:37:44,320
to do an ascent abort

1112
00:37:47,190 --> 00:37:45,760
again like i said here out of the cape

1113
00:37:48,630 --> 00:37:47,200

we'll put a peacekeeper first stage

1114
00:37:50,630 --> 00:37:48,640
underneath it and go do that test here

1115
00:37:51,990 --> 00:37:50,640
out of florida so that's and then we're

1116
00:37:56,710 --> 00:37:52,000
on to uh

1117
00:37:58,950 --> 00:37:56,720
um em1 which is in 2017.

1118
00:38:00,710 --> 00:37:58,960
um from an sls perspective

1119
00:38:03,990 --> 00:38:00,720
there's a lot of test articles we've had

1120
00:38:06,550 --> 00:38:04,000
so far you look at just in the j2x

1121
00:38:07,910 --> 00:38:06,560
development all of the the the motors

1122
00:38:09,990 --> 00:38:07,920
that have been tested the engines that

1123
00:38:11,990 --> 00:38:10,000
have been tested down at stennis

1124
00:38:14,950 --> 00:38:12,000
there's been from a solid standpoint

1125
00:38:16,390 --> 00:38:14,960
there's been three development motors

1126
00:38:19,270 --> 00:38:16,400
then if you start looking toward our

1127
00:38:22,550 --> 00:38:19,280
support for eft one we're in the process

1128
00:38:24,790 --> 00:38:22,560
now of assembling our first test

1129
00:38:27,109 --> 00:38:24,800
article which is our pathfinder article

1130
00:38:29,109 --> 00:38:27,119
at marshall space flight center and then

1131
00:38:32,069 --> 00:38:29,119
in the near term we'll be building a

1132
00:38:34,150 --> 00:38:32,079
structural test article also

1133
00:38:36,069 --> 00:38:34,160
as we get into further development from

1134
00:38:38,230 --> 00:38:36,079
a core vehicle standpoint we'll have

1135
00:38:40,870 --> 00:38:38,240
significant test articles with that too

1136
00:38:42,710 --> 00:38:40,880
so from an overall sls standpoint it's a

1137
00:38:46,870 --> 00:38:42,720
been a significant amount of test

1138
00:38:48,470 --> 00:38:46,880

articles in support of where we are

1139
00:38:50,230 --> 00:38:48,480
from the ground perspective we largely

1140
00:38:52,150 --> 00:38:50,240
benefit from the flight guys test

1141
00:38:53,750 --> 00:38:52,160
articles themselves so we'll take a

1142
00:38:56,230 --> 00:38:53,760
boiler plate that mark developed and

1143
00:38:58,790 --> 00:38:56,240
then we'll run our recovery operations

1144
00:39:00,630 --> 00:38:58,800
tests for his recovery operations that

1145
00:39:03,109 --> 00:39:00,640
will perform so

1146
00:39:05,589 --> 00:39:03,119
we get benefit when the sls guys are

1147
00:39:06,950 --> 00:39:05,599
building their assets we take our teams

1148
00:39:08,550 --> 00:39:06,960
and go out to the

1149
00:39:10,790 --> 00:39:08,560
respective test sites where they have

1150
00:39:12,150 --> 00:39:10,800
their test articles in at play so we

1151
00:39:13,750 --> 00:39:12,160
understand the functionality of the

1152
00:39:18,230 --> 00:39:13,760
systems and can bring that to bear when

1153
00:39:21,510 --> 00:39:19,270
we've got the

1154
00:39:23,750 --> 00:39:21,520
the test article we have at jsc where we

1155
00:39:24,550 --> 00:39:23,760
actually outfit it with the seats and

1156
00:39:37,190 --> 00:39:24,560
the

1157
00:39:40,230 --> 00:39:37,200
article that has more to do with

1158
00:39:41,510 --> 00:39:40,240
um human factors assessments

1159
00:39:43,750 --> 00:39:41,520
and i've been i've been waiting for this

1160
00:39:45,109 --> 00:39:43,760
question uh i've seen it asked a few

1161
00:39:47,270 --> 00:39:45,119
different ways but you know it's the

1162
00:39:48,870 --> 00:39:47,280
beatles or stones right it's why have we

1163
00:39:51,349 --> 00:39:48,880

returned to a capsule design and not a

1164
00:39:53,109 --> 00:39:51,359
not a wing design what what is it about

1165
00:39:56,710 --> 00:39:53,119
capsule that makes it the right

1166
00:39:58,710 --> 00:39:56,720
design for for deep space moving forward

1167
00:40:02,870 --> 00:39:58,720
yeah it's really it really comes down to

1168
00:40:05,109 --> 00:40:02,880
again that uh entry velocity um for us a

1169
00:40:06,790 --> 00:40:05,119
wing vehicle can make a lot more sense

1170
00:40:08,069 --> 00:40:06,800
in low earth orbit you're using it to

1171
00:40:09,829 --> 00:40:08,079
give you more

1172
00:40:11,030 --> 00:40:09,839
flexibility on where you can land on the

1173
00:40:12,309 --> 00:40:11,040
earth's surface

1174
00:40:14,230 --> 00:40:12,319
um

1175
00:40:15,829 --> 00:40:14,240
we can get that coming back from the

1176
00:40:18,309 --> 00:40:15,839
moon the guidance and navigation

1177
00:40:20,390 --> 00:40:18,319
algorithms and techniques nowadays are

1178
00:40:22,069 --> 00:40:20,400
much better we actually do a skip entry

1179
00:40:24,790 --> 00:40:22,079
technique that slows us down and allows

1180
00:40:26,150 --> 00:40:24,800
us to target very closely where we want

1181
00:40:28,470 --> 00:40:26,160
to go and a

1182
00:40:29,910 --> 00:40:28,480
wing system would be much more difficult

1183
00:40:31,589 --> 00:40:29,920
to

1184
00:40:33,349 --> 00:40:31,599
implement in the high velocities and it

1185
00:40:38,150 --> 00:40:33,359
really it really would not add any

1186
00:40:41,349 --> 00:40:38,160
functionality to our system that we need

1187
00:40:42,470 --> 00:40:41,359
what's uh and i think i'd ask you if um

1188
00:40:44,550 --> 00:40:42,480

maybe even the whole you know all the

1189
00:40:49,430 --> 00:40:44,560
panelists what criteria would you find

1190
00:40:52,069 --> 00:40:49,440
the eft one mission deemed as successful

1191
00:40:55,190 --> 00:40:52,079
successful what are the success criteria

1192
00:40:56,870 --> 00:40:55,200
for all of you we have a long list of uh

1193
00:40:59,430 --> 00:40:56,880
specific

1194
00:41:01,829 --> 00:40:59,440
data we're looking for on this test

1195
00:41:03,270 --> 00:41:01,839
um fundamentally we're testing the heat

1196
00:41:04,550 --> 00:41:03,280
shield so that's the obvious one and

1197
00:41:07,109 --> 00:41:04,560
we're actually instrumenting it with

1198
00:41:08,790 --> 00:41:07,119
hundreds of sensors which allow us to

1199
00:41:10,630 --> 00:41:08,800
validate our models

1200
00:41:12,550 --> 00:41:10,640
that we've done to design the system so

1201
00:41:13,910 --> 00:41:12,560
we'll actually get real data that says

1202
00:41:15,589 --> 00:41:13,920
look the heat shield performed as

1203
00:41:17,430 --> 00:41:15,599
expected and the environment was what we

1204
00:41:19,430 --> 00:41:17,440
expected so that's a big one

1205
00:41:20,790 --> 00:41:19,440
we do a lot of the other key things

1206
00:41:22,630 --> 00:41:20,800
we're going to test is the guidance and

1207
00:41:23,990 --> 00:41:22,640
navigation system i mentioned we're

1208
00:41:25,030 --> 00:41:24,000
actually going to take control of the

1209
00:41:27,589 --> 00:41:25,040
capsule

1210
00:41:29,109 --> 00:41:27,599
uh it has to control its attitude during

1211
00:41:31,030 --> 00:41:29,119
entry to make sure we hit the target

1212
00:41:33,349 --> 00:41:31,040
point so that's a key one did the gnc

1213
00:41:36,230 --> 00:41:33,359

system work as planned

1214
00:41:38,630 --> 00:41:36,240
we have a lot of separation events

1215
00:41:40,150 --> 00:41:38,640
for example the service module fairings

1216
00:41:43,109 --> 00:41:40,160
will be jettisoned the launch abort

1217
00:41:44,470 --> 00:41:43,119
system will be jettisoned uh the crew

1218
00:41:46,230 --> 00:41:44,480
module is separated from the service

1219
00:41:47,990 --> 00:41:46,240
module these are all critical separation

1220
00:41:49,270 --> 00:41:48,000
events that again we model very well we

1221
00:41:50,790 --> 00:41:49,280
have tools for we're going to do some

1222
00:41:52,309 --> 00:41:50,800
tests on the ground but you really want

1223
00:41:53,589 --> 00:41:52,319
to fly it in the flight environment to

1224
00:41:55,270 --> 00:41:53,599
see that it works because they're very

1225
00:41:57,270 --> 00:41:55,280
important to the system and then we'll

1226
00:41:59,430 --> 00:41:57,280
do the parachute deployment again we we

1227
00:42:01,190 --> 00:41:59,440
do a lot of drop tests out in california

1228
00:42:02,710 --> 00:42:01,200
but we want to do that we want to do the

1229
00:42:04,069 --> 00:42:02,720
parachute deploy in the exact

1230
00:42:06,230 --> 00:42:04,079
environments and the ranges we're going

1231
00:42:07,589 --> 00:42:06,240
to see on flight so those i would say

1232
00:42:08,950 --> 00:42:07,599
those are the key objectives so a lot of

1233
00:42:10,550 --> 00:42:08,960
stuff there's a lot of stuff impacted

1234
00:42:12,069 --> 00:42:10,560
into this one flight

1235
00:42:13,190 --> 00:42:12,079
i see only two minutes left so i'm going

1236
00:42:14,150 --> 00:42:13,200
to have to make

1237
00:42:16,870 --> 00:42:14,160
please

1238
00:42:18,630 --> 00:42:16,880

we're also uh as david said we're

1239
00:42:19,750 --> 00:42:18,640
working out our interfaces with sls

1240
00:42:21,349 --> 00:42:19,760
we're going to understand the loads to

1241
00:42:22,470 --> 00:42:21,359
the upper stage that's important and

1242
00:42:23,670 --> 00:42:22,480
peppers guys are actually going to

1243
00:42:25,589 --> 00:42:23,680
recover

1244
00:42:26,950 --> 00:42:25,599
the the capsule on the west coast with

1245
00:42:28,630 --> 00:42:26,960
their nominal plans so they're going to

1246
00:42:31,030 --> 00:42:28,640
be exercising those things as well those

1247
00:42:32,230 --> 00:42:31,040
are all key objectives to the flight

1248
00:42:33,349 --> 00:42:32,240
okay we're going to speed around here

1249
00:42:34,710 --> 00:42:33,359
there's some really great great

1250
00:42:35,510 --> 00:42:34,720
questions i want to get to as many as we

1251
00:42:37,510 --> 00:42:35,520
can

1252
00:42:38,950 --> 00:42:37,520
probably have time for like two more uh

1253
00:42:40,870 --> 00:42:38,960
the orion capsule was built to explore

1254
00:42:42,870 --> 00:42:40,880
however i'm a bit confused as to what

1255
00:42:47,829 --> 00:42:42,880
capabilities will be without a landing

1256
00:42:53,349 --> 00:42:50,550
yeah the orion is not by itself designed

1257
00:42:54,790 --> 00:42:53,359
to land on another uh terrestrial body

1258
00:42:55,829 --> 00:42:54,800
it's the it's the part that gets the

1259
00:42:58,550 --> 00:42:55,839
crew there

1260
00:43:00,150 --> 00:42:58,560
safely and gets them home if you

1261
00:43:02,150 --> 00:43:00,160
actually want to land on another body

1262
00:43:03,510 --> 00:43:02,160
you would need a lander

1263
00:43:04,630 --> 00:43:03,520

so that's part of an architecture that

1264
00:43:06,710 --> 00:43:04,640
would have to be

1265
00:43:09,829 --> 00:43:06,720
developed so that's not the part of the

1266
00:43:11,990 --> 00:43:09,839
mission that orion performs

1267
00:43:13,750 --> 00:43:12,000
why is it called orion any special

1268
00:43:15,670 --> 00:43:13,760
meaning behind the mission name

1269
00:43:17,190 --> 00:43:15,680
um

1270
00:43:20,150 --> 00:43:17,200
gosh i'm trying to remember it was been

1271
00:43:21,670 --> 00:43:20,160
so long ago we came up with that name uh

1272
00:43:23,270 --> 00:43:21,680
i think fundamentally because it's a

1273
00:43:25,270 --> 00:43:23,280
part of

1274
00:43:27,990 --> 00:43:25,280
human history to look to the stars the

1275
00:43:30,309 --> 00:43:28,000
orion constellation is a big part of

1276
00:43:31,829 --> 00:43:30,319
uh what people have seen for a long time

1277
00:43:33,270 --> 00:43:31,839
and and i think

1278
00:43:36,390 --> 00:43:33,280
correlate with

1279
00:43:38,230 --> 00:43:36,400
space and uh and our curiosity about

1280
00:43:39,589 --> 00:43:38,240
what's out there so

1281
00:43:42,309 --> 00:43:39,599
okay unfortunately i think that's gonna

1282
00:43:44,069 --> 00:43:42,319
have to have to do it for today uh thank

1283
00:43:45,510 --> 00:43:44,079
you all for for your time and for

1284
00:43:47,270 --> 00:43:45,520
participating in this and thank you all

1285
00:43:49,910 --> 00:43:47,280
for joining us if we didn't get to your

1286
00:43:51,670 --> 00:43:49,920
question fear not uh we'll get to as

1287
00:43:53,030 --> 00:43:51,680
many as we can on on twitter facebook

1288
00:43:54,950 --> 00:43:53,040

and google plus we'll try to answer them

1289
00:43:56,870 --> 00:43:54,960
over the next couple of days before the

1290
00:43:58,950 --> 00:43:56,880
holiday if we still don't get to it just

1291
00:44:01,109 --> 00:43:58,960
just keep hammering us on twitter we we

1292
00:44:02,870 --> 00:44:01,119
try to do as the best job we can to

1293
00:44:05,510 --> 00:44:02,880
answer all questions that come in to us

1294
00:44:06,790 --> 00:44:05,520
a reminder you can find all of nasa's

1295
00:44:08,870 --> 00:44:06,800
social media accounts including our

1296
00:44:10,790 --> 00:44:08,880
various centers missions spacecraft

1297
00:44:13,230 --> 00:44:10,800
hardware the tweeting robots the folks

1298
00:44:15,670 --> 00:44:13,240
tweeting from space all of it at

1299
00:44:17,109 --> 00:44:15,680
www.nasa.gov connect for more

1300
00:44:18,710 --> 00:44:17,119
information about progress being made on

1301
00:44:21,670 --> 00:44:18,720
the future of american human space

1302
00:44:23,750 --> 00:44:21,680
flight including orion the eft-1 launch

1303
00:44:25,109 --> 00:44:23,760
in 2014 the space launch system and

1304
00:44:27,030 --> 00:44:25,119
development the ground systems

1305
00:44:28,550 --> 00:44:27,040
development operations and the thriving

1306
00:44:30,309 --> 00:44:28,560
commercial space industry that's

1307
00:44:32,550 --> 00:44:30,319
enabling nasa to set our sites in deep

1308
00:44:35,510 --> 00:44:32,560
space destinations you can visit us on

1309
00:44:36,870 --> 00:44:35,520
the web at www.nasa.gov

1310
00:44:38,790 --> 00:44:36,880
exploration

1311
00:44:40,230 --> 00:44:38,800
that's that'll do it so goodbye from the